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Report for:
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Building Stone Assessment:

Playfair Paving Schemes in Edinburgh: An investigation of materials and paving patterns

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Report: *GR_200560/1*

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1. INTRODUCTION

1.1 Aims of the study

William H. Playfair (1789-1857) was a renowned architect who contributed greatly to the Scottish Enlightenment and was responsible for many of Edinburgh's prominent buildings during the early 19th century. The purpose of this report is to provide information on the historic paving schemes associated with Playfair buildings in order to help inform the design of a proposed new paving scheme for the Old College. The centre of the Old College courtyard is currently a gravel surface. A proposal is under consideration to pave some of this area using natural stone. Documenting areas of existing paving associated with Playfair buildings may allow the design and specification of the new paving scheme to reflect the historic paving styles used in the city at the time these buildings were first constructed and used. Not all of the sites described in this study are designed by Playfair; other contemporary buildings were also visited.

This study consists of three elements;

- Historical research to provide information on the original paving in Old College and contemporary historic schemes.

- Site visits to selected historic buildings which provide physical evidence of the nature of historic paving in both Playfair and contemporary 19th century buildings.

- Identification of (i) stone types used historically, and (ii) recording of principle features such as slab sizes, laying patterns, surface finishes and other details such as gutter design.

1.2 Layout of the report

In this report the historic sites visited are described in the following order:

- University of Edinburgh Old College
- Donaldson's Hospital (School for the Deaf)
- George Heriot's School
- New College and Assembly Hall
- General Register House and New Register House
- Milne's Court
- National Gallery of Scotland

For each site a brief outline of the relevant architectural history is provided, followed by a description of the main paving elements, including observations of patterns and stone types present. Where relevant, measurements of representative slab sizes are given. Other features such as surface tooling and gutter details are also described. The key features at each locality are illustrated by photographs.

A discussion of the main stone types present at the sites is given at the end of the report, as well as with descriptions of more recent replacement stone and examples of new natural stone paving. The original stone types are identified and their quarry origins discussed. Finally, options for obtaining new supplies of appropriate stone types are considered.

1.3 Other considerations not covered in this report

It should be noted that this study is an informative description of relevant historic paved areas selected to inform the proposed Old College paving project. It does not take into account modern requirements of paving such as strength characteristics (e.g. ability to support vehicles), measurements of slip resistance, etc. The work is intended purely to provide a background documentary record of original stone paving in order to inform the design and material selection process to produce new paving that retains the character of the historic paving, as evidenced by surviving historic areas. Specific requirements and engineering properties of particular stone types should be discussed with the stone suppliers.

2. UNIVERSITY OF EDINBURGH OLD COLLEGE

2.1 History of the courtyard and associated paving

The A-listed building was constructed in several phases: Robert Adam (1789); William Playfair (1819-27); and Rowand Anderson (1887). Robert Adam submitted the first design scheme for the Old College in 1789 and was responsible for the eastern entrance and external elevations. Playfair completed Adam's design with some alterations, notably creating the Greek-revival inner courtyard. Playfair maintained Adams' corner quadrant arcades as planned (only the northwest corner was completed during Adam's lifetime). Rowand Anderson completed the dome as designed by Adam, although larger in size than originally planned.

The Old College courtyard is rectilinear in plan. Initially, the floor of the courtyard was infilled and made level to the entrances and doorways of the college buildings; the steps and terracing are a later addition. Due to the increased height of the courtyard, a staircase had to be constructed to compensate for the differential height of the street level at South Bridge and the courtyard entrance. Between 1829 and 1833 the courtyard was lowered and the staircase removed and replaced with the current carriageway through the arched gateway. It was at this time that Playfair's balustraded terrace and steps were completed.

Playfair originally intended a continual flight of stairs surrounding the entire courtyard. However, this was thought to limit the amount of usable space and proved too costly for the College Commissioners. Instead, it was agreed to have nine flights of stairs around the court leading to the various entrances of the academic blocks and at each corner. In November 1832 a tender was accepted and construction of the terrace and steps began.

According to Andrew Fraser ("The building of Old College: Adam, Playfair & the University of Edinburgh" 1989) a contract survives for this 1832 tender, which specifies that the terrace and the steps were to be of Craigleith stone, whilst the terrace wall and balustrades were to be of Humbie stone (from West Lothian) in order to save costs. It is recorded that problems arose with the funds for the terracing and steps around the inner court. It is documented in the College Commissioners Minutes (1816-34) that the solution proposed (in 1829) was to obtain suitable stones from Craigleith quarry, have them roughly-dressed and cheaply laid so that they could be re-used for the final work. Fraser also highlights subsequent repairs to the balustrades completed during the 20th century due to the lesser quality of the Humbie stone.

Little documentation has been found describing the intended paving pattern of the courtyard. However, a letter written in 1833 by Playfair to Lewis A. Wallace (builder) makes it clear in that the courtyard was indeed to be paved. Although no plans survive, Playfair did specify "the Paving stone is to be from Craig Leith Quarry—of the sizes pointed out to you & chamfered on the edges." This confirms that a paving scheme was planned, but never fully carried out. It is understood that this correspondence raised doubts over the option of "causewaying in whinstone", questioning whether this was an appropriate material for the building. Further information from Playfair's Letter Book may exist (ECA CC Trunk No.3 Box 3) but it has not been possible to examine this source during the present study.

By November 1833 the courtyard was finished in a 'temporary' manner that has remained with little change to the present day. A formal courtyard paving scheme was never adopted at the Old College, and it is understood that the area has been covered with gravel ever since. Playfair's original four corner staircases were removed by the College of Commissioners during a programme of works in the 1950s.

2.2 Observations of paving: patterns and materials

The stone paving in the Old College courtyard is mostly restricted to the terrace that flanks the buildings, forming a continuous raised walkway with an outer balustrade and a series of steps providing access to the (lower and gravel) central courtyard. The pavement terrace is symmetrical and has a uniform paving pattern throughout. The paving material appears to be largely the same stone type, although there has been some significant replacement of the paving and steps at the west end of the Quad (Fig. 1). Rare replacement Caithness flagstone paving is present in a few localised areas, and a number of small indents using a 'York-type' sandstone are present (Fig. 2). The original paving appears to be a typical Hailes-type sandstone which has weathered to a distinctive variable orange-brown surface colour (Figs. 3 to 4), typical of that observed at other Playfair paving schemes (see other site descriptions below).

The original paved terrace area in the Old College is highly uniform in terms of materials and symmetrical in terms of paving patterns. The paving pattern can be divided into three main components, repeated throughout the scheme; (1) areas of wide pavement, (2) areas of narrow pavement, and (3) curved corner pavement. Each of these is documented below and illustrated in Figs. 5 to 8. Measurements of slab sizes and images of the paving patterns were taken from the southeast side of the quad.

(1) Wide pavement areas (Fig. 6)
The pavement consists of a central area of flagstone courses aligned perpendicular to the pavement direction (1A; 1B), with single courses of flagstone at each edge running parallel to the pavement direction (1C; 1D). The outer edge course (1D; adjacent to balustrade) is cut to give a dished drainage channel. There are four slab sizes present:

Slab measurements:

1A (central coursed flagstones; large size):
Length (mm): 1640-1680 (av. = 1660)
Width (mm): 590-680 (av. = 640)
No. of flagstones measured = 6

1B (central coursed flagstones; small size):
Length (mm): 870-910 (av. = 890)
Width (mm): 590-680 (av. = 635)
No. of flagstones measured = 6

1C (inner edge course adjacent to buildings):
Length (mm): 1220 -1440 (av. = 1330)
Width (mm): 680
No. of flagstones measured = 5

1D (outer edge course adjacent to balustrade; with dished gutter):
Length (mm): 1250-1380 (av. = 1290)
Width (mm): 740-760 (av. = 750)
No. of flagstones measured = 6.

(2) Narrow pavement areas (Fig.7)
The pavement consists of a single course of central flagstones (2A) with two edge courses comprising single flagstones aligned parallel to the pavement direction (2B, 2C). The outer edge flagstones (2C, adjacent to balustrade) are cut to give a dished drainage channel. There are three slab sizes present:

Slab measurements:

2A (central flagstones):
Length (mm): 1170
Width (mm): 680-850 (av. = 750)
No. of flagstones measured = 11

2B (inner edge course adjacent to building):
Length (mm): 1170-1460 (av. = 1350)
Width (mm): 760-770
No. of flagstones measured = 4

2C (outer edge course adjacent to balustrade; with dished gutter):
Length (mm): 1400-1460 (av. 1430)
Width (mm): 680-690
No. of flagstones measured = 4

(3) Corner pavement areas (Fig. 8)
The four corners of the paved terrace area are curved with the paving slabs shaped to continue around the corner, giving a radial pattern. In plan each slab is shaped to an isosceles trapezoid shape (i.e. a tapering rectangle). The corner pavement consists of (i) central coursed flagstones (3A; 3B) aligned perpendicular to the pavement direction (and curving around the corner circumference); (ii) an inner row of large slabs (3C) adjacent to the internal steps (accessing the corner arcades), each slab aligned perpendicular to the pavement direction; and (iii) an outer edge of uniform slabs adjacent to the balustrade (3D), each aligned parallel to the pavement direction (and with dished gutter).

Slab measurements:

3A (central coursed flagstones; large size):
Length (mm): 1350 to 1510 (av. = 1420)
Width (mm): 520-730 (av. = 630)
No. of flagstones measured = 7

3B (central coursed flagstones; small size):
Length (mm): 1020-1160 (av. = 1090)
Width (mm): 430-800 (av. = 610)
No. of flagstones measured = 7

3C (inner edge course adjacent to steps to corner arcade):
Length (mm): 1320-1340 (av. 1330)
Width (mm): 650 to 820 (av. = 710)
No. of flagstones measured = 6

3D (outer edge course adjacent to balustrade; with dished gutter):
Length (mm): 640-730 (av. = 680)
Width (mm): 490-840 (av. = 680)
No. of flagstones measured = 5

2.3 Other features of the paving

The original terrace paving scheme appears to deal with drainage of surface water principally using dished gutters cut into the sandstone flags. These gutters are carefully executed and, like the entire scheme, are symmetrical throughout the quad. Flow direction is controlled by gradients determined by the depth of the dishing. These features are typical of the other Playfair paving schemes examined in this study (see below). Dished gutters are present on the terrace pavement on the inside of the balustrade and at the base of the terrace wall adjacent to the gravel infill to the central courtyard (Fig. 9 and previous figs).

Original surface tooling on the paving slabs is visible in only a few places of low footfall where it has been fortuitously preserved (Fig. 10). Where present it consists of multiple parallel rows of fine droving running across the slab. This surface finish is typical of that seen at the other Playfair paving schemes examined in this study (see below). It is not known whether this tooling was executed to provide a flat surface, a decorative finish or a non-slip surface. It is important to note that although the paving slabs have been worn smooth over most of the pavement, the surface retains a natural non-slip character due to the fact that the Hailes-type sandstone has a grainsize which gives an inherent 'coarseness' to the surface.

In some parts of the terrace pavement there has been additional measures designed to improve drainage. This is apparent on the pavement immediately above the lower steps leading to the gravel courtyard where grooved channels have been cut in the terrace pavement to encourage water run-off down the steps (Fig. 11). This is visually disruptive to the regular paving scheme and is assumed to be a later feature i.e. not original part of the original design.

2.4 Description of the vehicle entrance

The entrance to Old College from the public road on South Bridge consists of a central covered vehicle entrance flanked by pedestrian passages. The pedestrian areas are paved using the same Hailes-type sandstone and appear contemporaneous with the original paving to the terrace area inside the collage quad. The vehicle lane is paved using dark whinstone setts (Figs 12 and 13), with light grey granite setts at the junction with South Bridge (Fig. 14). At this junction the kerbstones are wide blocks of distinctive pink Corrennie granite, and the public pavement on South Bridge is recent dark Caithness flagstone which contrasts with the paler Hailes-type sandstone.

The use of whinstone setts is not characteristic of other Playfair paving schemes examined in this study (Heriot's and New Register House) where sandstone setts are used for the vehicle entranceways. It is likely that in the early 19th century sandstone was more readily available than igneous rock, and it was the preferred choice of material for setts (see also historical evidence above). It is likely that only subsequent to the opening of the Union canal in the 1820's that the whinstone sett industry became established on the western outskirts of Edinburgh (e.g. Ratho quarry) allowing whinstone to become more widely used.

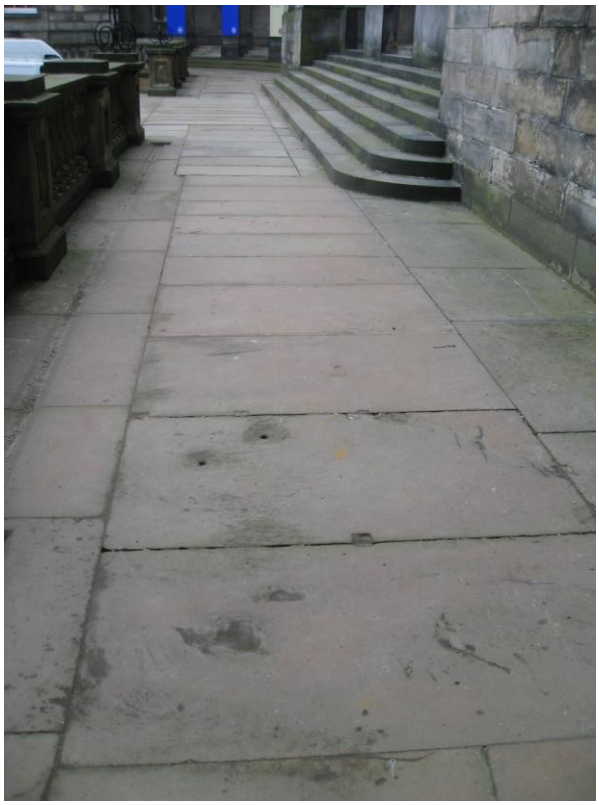

Fig. 1. Terrace pavement at west end of Old College, showing area of replacement paving with new slabs immediately adjacent to the steps. The terrace pavement and the steps below to the courtyard are replacement 'York-type' sandstone. Note the visual disruption to the original paving pattern where the new slabs have been inserted (3062).

Fig. 2. Detail of original paving slab of Hailes-type sandstone showing indent repair using northern England ('York-type') sandstone, highlighting the contrasting coarse grained 'gritty' texture and bland buff colour compared to the original Hailes stone (3450).

Fig. 3. Typical ‘contour’ surface pattern of paving slab in Old College, caused by the presence of ripple-bedding in the sandstone. This distinctive texture, and the associated variable colour, is typical of Hailes sandstone (see section 9 for full explanation). (3070)

Fig. 4. Detail of step showing the presence of ripple bedding (small irregular discontinuous bedding planes) in the sandstone. This is typical of Hailes sandstone (and also some Craigleith sandstones), resulting in the distinctive ‘contour’ pattern to the slab surface. The same ‘Hailes-type’ sandstone appears to have been used for both the steps and paving at Old College. (3056).

Fig. 5. Southeast corner of the terrace pavement, illustrating the three main paving components described in the text (Narrow area in the foreground; Wide area in centre of image; Curved corner at back). (3080)

Fig. 6. Typical ‘wide’ section of paving on terrace area (southeast side), showing regular sized slabs, with two single rows at edges with slabs aligned parallel to direction of footpath (note edge adjacent to balustrade has dished gutter). The central area consists of regular sized slabs (one large, one small) laid in courses perpendicular to the pavement direction. (3069).

Fig. 7. Transition between wide pavement area and narrow area. Note continuation of the paving pattern with edge courses at each side (dished gutter to balustrade on right-hand side), and single central slab laid perpendicular to pavement direction. Not the regularity of slab sizes (3075).

Fig. 8. Detail of southeast corner showing radial paving pattern with narrow inner course of small slabs adjacent to balustrade (with dished gutter) and outer row of large single slabs adjacent to steps (from where photograph was taken). The centre of the pavement consists of courses each of two slabs (one larger, one smaller) aligned across the pavement direction. Note the uniformity of slab sizes and regularity of joint patterns (particularly the regular off-sets). (3083)

Fig. 9. Detail of 'original' dished sandstone gutters at base of terrace wall adjacent to gravel of central courtyard (east end), showing traces of the original broached tooling. (3472)

Fig. 10. Remnants of surface tooling on paving, generally preserved only in areas of low footfall or adjacent to buildings. The tooling consists of a series of narrow rows of fine droving running across the slab. In most places the tooling has worn away, although the grainsize of the sandstone gives the stone a natural slip resistance. (3051)

Fig. 11. Terrace pavement adjacent to steps leading down to gravel courtyard (south side of quad), showing narrow channels cut into pavement to provide drainage allowing rainwater to flow down the steps. This tooling (present in a number of places on the terrace), is presumably not part of the original paving design and was undertaken retrospectively to improve drainage. It is disruptive to the uniform paving pattern. (0898)

Fig. 12. Inner vehicle entrance to Old College, comprising dark whinstone setts leading to the gravel courtyard. (3430)

Fig. 13. Inner part of vehicle entrance to Old College, showing dark whinstone setts against original Hailes-type sandstone pavement (note distinctive orange-brown patina). A drainage channel has been cut diagonally across the pavement below the right-hand side of step. Note also the large 'recent' replacement copestones on the terrace wall using a grey-buff Northern England sandstone, giving a 'blocky' appearance uncharacteristic of the Playfair detailing. (3431).

Fig. 14. Entrance to Old College at South Bridge, showing 'modern' dark blue-grey Caithness flagstone on the public pavement adjacent to the paler original Hailes-type sandstone paving of Old College. The vehicle entranceway comprises grey granite setts with wide kerbstones of pink Correnie (Aberdeenshire) granite. (3444).

3. DONALDSON'S HOSPITAL (SCHOOL FOR THE DEAF), WEST COATES

This A-Listed building was designed by William Playfair and constructed c.1842-52. The large central courtyard appears to retain its original paving stone slabs and details. It is understood that the courtyard was rarely used when the building was in use as a hospital/school, and today the material appears to be relatively unworn and in good condition. The lack of use (particularly recently as the building is currently unoccupied) has resulted in a biogenic soiling which darkens the stone surface to a greyish-brown colour and masks the true surface colour of the stone

The courtyard is paved in a simple rectangular pattern centred on a central sandstone fountain (Fig. 15). The paving slabs are a light grey to pale orange sandstone, with a variable orange-brown surface patina. The lack of wear has preserved the original finely droved tooling on the slab surfaces (Fig. 16). There is a gradual fall in height from the centre to the edges, where a broad shallow dished gutter in the same sandstone removes surface water to a series of underground drains. The gutter stones are well executed with curved details at corners and around the large ventilation grills (Figs. 17 and 18).

The stone used for the paving slabs, gutter stones and entrance steps shows features of colour and texture characteristic of a Hailes-type sandstone.

Random Measurements (in millimetres) of 6 paving slabs selected at random are given below:

- Length (mm): 1370 to 870 (av. 906)
- Width (mm): 480 to 560 (av. 528)

Fig. 15. General view of flagstone paving in central courtyard, showing centred rectangular paving pattern with central fountain. The flagstone is sandstone with a variable orange-brown surface patina (rather dull due to biogenic soiling). The pavement shows a gradual fall in height from centre to margins to allow drainage of water. Donaldson's Hospital (987)

Fig. 16. Detail of paving slab showing tooled surface, detailed as a series of droved bands. The damaged edge reveals the stone to be a pale grey/cream coloured sandstone weathering to a strong orange surface patina, typical of local Edinburgh sandstone such as Hailes. Donaldson's Hospital (3204)

Fig. 17. Drainage channel and step edge detail at perimeter of main courtyard, showing dished gutters cut into single sandstone blocks. Donaldson's Hospital (3214).

Fig. 18. Drainage channel at edge of main courtyard, showing dished gutters cut into single sandstone blocks. The depth of the cut channel varies along the length of the gutter to control water flow (here deepening from left to right). Note curved detail around ventilation grill. Donaldson's Hospital (3205).

4. GEORGE HERIOT'S SCHOOL, LAURISTON PLACE

This A-Listed building was designed by William Playfair and constructed c.1828. The central courtyard is paved in a centred rectangular pattern, but with distinctive diagonal linear joints radiating from the centre to the four corners (Figs. 19 and 20). The courtyard paving shows a gradual though distinct fall in height from the centre to the margins, draining to gutters at the margins.

The paving stone has a variable strong orange-red surface patina and a 'contour'-textured natural surface, characteristic of Hailes type sandstone (Fig. 21). This strongly coloured patina and 'worn' surface texture is likely be a result of a high degree of foot traffic causing exposure of the ripple-bedding and oxidation of iron minerals (see description in section 9). The wear has also produced a rounding to the appearance of the stone (Fig. 2), which, combined with the hand cut slabs and variable joint sizes, gives a natural 'soft' appearance to the scheme. There is no evidence of surface tooling details in the courtyard, probably as a result of the wear to the stone.

At the edge of the courtyard (though not immediately adjacent to the walls of the building) is a continuous broad dished gutter, consisting of a single gutter stone and an outer 'kerb' stone, which curves around the corners of the courtyard (Figs. 22 to 24). Drainage from the building is dealt with by smaller subsidiary dished gutters which run from the base of downpipes inwards to the main dished gutter (Fig. 5). The gutter is particularly broad and shallow, and it is clearly designed to be walked over without presenting a hazard (Fig. 26). Both the gutter and kerb are the same sandstone as the paving slabs; the kerb stone being laid on edge.

Edge-bedded sandstone blocks are used outside the north entrance to the courtyard (Fig. 27), and at the vehicle entrance to Lauriston Place (Fig. 28). The blocks have worn smooth, but have a single or twin broad central tooling cut along the length of the block (probably to prevent skidding). At both localities the elongate blocks are laid with block length perpendicular to the direction of traffic. This stone also appears to be a Hailes-type sandstone, the same as that used in the courtyard.

Measurements of 6 paving slabs randomly selected in the courtyard (in millimetres) are:

- Length (mm): 480 to 1060 (av. 850)
- Widths (mm): 460 to 540

Fig. 19. General view of central courtyard showing rectangular centred paving pattern with strong variable orange-brown patina to flagstone slabs, typical of Hailes-type sandstone. The pavement shows a gradual fall in height from centre to margins to allow drainage of water. George Heriot's School (3234)

Fig. 20. General view of central courtyard showing rectangular centred paving pattern with diagonal linear joins at corners. The flagstone is Hailes-type sandstone showing a characteristic orange-brown patina with 'contour-bedded' surface. George Heriot's School (3247)

Fig. 21. Detail of paving slab showing orange-brown patina and ‘contour-bedded’ surface characteristic of Hailes type sandstone. George Heriot’s School (3245)

Fig. 22. Details of corner in central courtyard showing radial linear junction and curved dished gutter at corner. George Heriot’s School (3251)

Fig. 23. Detail of corner in central courtyard showing curved dished gutter at corner. George Heriot's School (3235)

Fig. 24. Details at edge of central courtyard showing dished gutter with outer kerb, all made from Hailes-type sandstone. The kerb blocks are bedded on edge. George Heriot's School (3250)

Fig. 25. Edge of central courtyard at north entrance showing main curved dished gutter with adjoining smaller gutter from downpipe outlet, made from Hailes-type sandstone. George Heriot's School (3242)

Fig. 26. Details at edge of central courtyard showing dished gutter with outer kerb, all made from Hailes-type sandstone. The kerb blocks are bedded on edge. George Heriot's School (1023)

Fig. 27. North entrance to central courtyard showing stone paving on roadway, consisting of elongate sandstone blocks on edge, each with a single centre groove cut along the length of the block. The stone appears to be a Hailes-type sandstone, the same as that used in the courtyard. George Heriot's School (3230)

Fig. 28. Entrance to George Heriot's School on Lauriston Place consisting of elongate sandstone blocks on edge, each with a simple coarse groove cut along the length of the block, probably to prevent skid. The stone appears to be a Hailes-type sandstone, the same as that used in the courtyard. George Heriot's School (3087)

5. NEW COLLEGE AND ASSEMBLY HALL, MOUND PLACE

This A-Listed building was designed by William Playfair and constructed c.1845-50. The courtyard appears to have been 'recently' repaved using a new replacement sandstone. Although no details of the repaving are known, the condition of the flagstone suggests this is likely to have occurred in the last few decades. From a preliminary visual examination the replacement stone appears to be a York-type sandstone. The new paving has a relatively uniform appearance both in colour and texture (Fig. 29). The paving has been laid in a rectangular pattern centred around the middle of the courtyard, with a gradual fall in height to the outer drains (Fig. 30).

The original stone paving is preserved in the surrounding dished gutter stones around the outer edge of the courtyard, and in the entrance steps to buildings. This original stone appears to be a Hailes-type sandstone with a characteristic variable colour; typically pale grey in areas of low footfall (Fig. 31; gutter stones), and a stronger reddish-brown surface patina on entrance steps (Fig. 32). The gutter stones have a dished profile that has variable depth to provide a gradient and promote water flow to the underground drains.

The contrast between the replacement paving and the original stone is marked, particularly at the base of the curved entrance steps to the School of Divinity Offices (Fig. 33). The replacement paving has been precisely sawn, producing a very regular slab size and tight joints -giving a rather angular or 'harsh' appearance to the central courtyard, compared to the 'softer' appearance of the remaining original stone.

The replacement stone appears to have a flat sawn surface, and has not been tooled. The original dished gutters show finely droved surface tooling (Fig. 31). No evidence remains of the original paving slabs from the courtyard, other than the dished gutters and steps.

The entrance to the courtyard shows a mixture of three types of stone; original Hailes-type sandstone, replacement York sandstone, and dark Caithness flagstone which has been used for the public pavement. The detailing (particularly the laying of the Caithness stone) is poor, and the contrast between the three the different stone types is marked (Fig. 33).

Fig. 29. Edge of curved entrance steps showing junction with replacement courtyard paving. New College (3104)

Fig. 30. General view of courtyard showing rectangular centred paving pattern. New College (0912)

Fig. 31. Remaining section of original dished sandstone gutter at edge of replacement paving to courtyard. Note the finely tooled (droved) surface finish. New College (3099)

Fig. 32. Curved entrance steps of Hailes-type sandstone showing variable colours with orange-red patina, adjacent to replacement paving in courtyard which is a more uniform 'York-type' sandstone. New College (3102)

Fig. 33. Detail of junction between original curved steps (Hailes-type sandstone) and replacement ‘York-type’ sandstone flags. The York stone has a more uniform greyish colour compared to the orange-red patina on the Hailes sandstone. New College (3111)

Fig. 34. Entrance to New College, showing a mixture of three types of paving stone. The long entrance sill is the original Hailes (or Craigleith) type stone; the courtyard (bottom-right) has been repaved using a greenish-buff York-type sandstone; and the external pavement has been paved using ‘modern’ dark grey Caithness flagstone.

6. GENERAL REGISTER HOUSE & NEW REGISTER HOUSE, PRINCES STREET

The A-Listed General Register House was designed by Robert Adam and constructed 1774-88; recorded as using sandstone from the Craigleith and Hailes quarries. Much of the original paving surrounding the building and the main entrance steps appears to be Hailes sandstone, showing a typical orange-brown patina and 'contour' texture on weathered/worn surfaces (Figs. 34 and 35). It is documented that additional construction to the north of the main building during the 1820s used paving stone from Craigleith, Hailes and Carmyllie. Carmyllie flagstone is used as internal paving in the entrance hall, showing characteristic dull grey colour and fine grained uniform texture (Fig. 36).

The adjacent New Register House was constructed in 1858-63. The vehicle entrance to the front of the building has an area of paving consisting of grooved sandstone setts on edge laid perpendicular to the direction of traffic, as well as sandstone kerbstones, all of Hailes-type sandstone (Fig. 37). It is not known whether these features date to the earlier General Register House. The flagstone paving to the north (rear) and west sides of New Register House are 'old' Caithness flagstone, probably dating from the late 19th century, indicating that following the construction of this building in 1863, Caithness flagstone paving was available and being used in Edinburgh.

Fig. 34. Detail of entrance steps to General Register House showing characteristic variable orange-red patina and 'contoured' natural surface texture, all typical of Hailes sandstone.

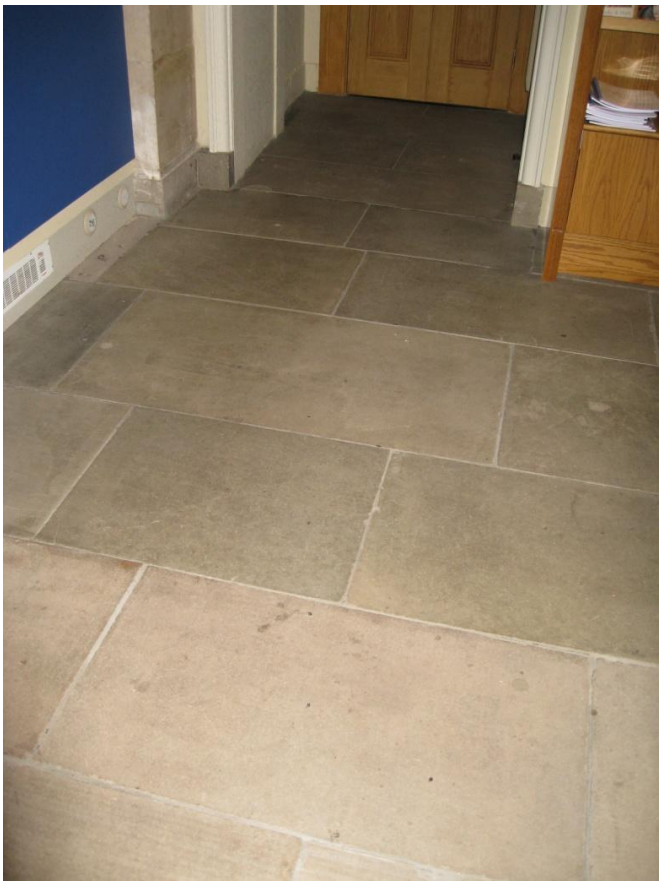

Fig. 36. Internal paving in entrance hall to General Register House, showing typical characteristics of 'Carmyllie' (Angus) paving with uniform dark grey colour and fine grained surface texture. (3176)

Fig. 35. External paving slabs from rear of General Register House, lifted for re-laying of the surrounding footpaths during 2007. Note the dark bedding planes characteristic of Hailes sandstone. The undersides have been marked with unique numbers to identify the blocks for reinstatement (photo taken 2007).

Fig. 37. Part of vehicle entrance to New Register House with sandstone blocks laid on edge, each with a simple tooled groove cut along the block length. This pattern is almost identical to George Heriot's School (Figs. 27 and 28) (3184)

7. MILNE'S COURT, HIGH STREET

The A-listed Milne's Court is one of Edinburgh's earliest open courtyards, constructed by the master mason Robert Mylne following demolition of existing closes in 1690. The courtyard was bound by existing structures to the east and west. The western buildings were later demolished in 1883. Partial restoration work was completed c.1914 by J.A. Williamson and again between 1966 and 1970 by Ian G. Lindsay and Partners. The latter refurbishment (commissioned by the University of Edinburgh) restored the north and south blocks, rebuilt the east range, and involved repaving of the courtyard and close.

The paved area consists of a private open courtyard and a public footpath 'close'. Both of these are paved using original sandstone flagstone which was reclaimed (probably from Edinburgh New Town). The stone has a variable colour ranging from pale orange to reddish-brown. The blocks have a variable surface texture, many showing irregular bedding surfaces giving a 'contour' pattern on the surfaces (Fig. 38), all typical of Hailes-type sandstone.

The edges of the blocks are irregular and not sawn, leading to relatively wide and variable width joints between blocks. The combination of variable colour, irregular surface texture and wide non-uniform joints produces a natural 'soft' appearance to the paved areas. Unlike the enclosed courtyards in the Playfair buildings, the paved areas at Milne's Court have less formality to the stonework.

In the close, the paving flags are arranged in regular courses running perpendicular to the footpath direction (Fig. 39). A single dished sandstone gutter is present at the base of the adjacent property to the east. This has been executed in new stone understood to be from the Hopeman quarries (Clashach and Greenbrae, operated in the 1960s by Alexander Hall, Builders). The dished gutter detail is relatively narrow and deeply profiled with straight sawn edges. The upper surface of the stone is sawn smooth, although the gutter itself has a finely 'pecked' or bush-hammered surface finish.

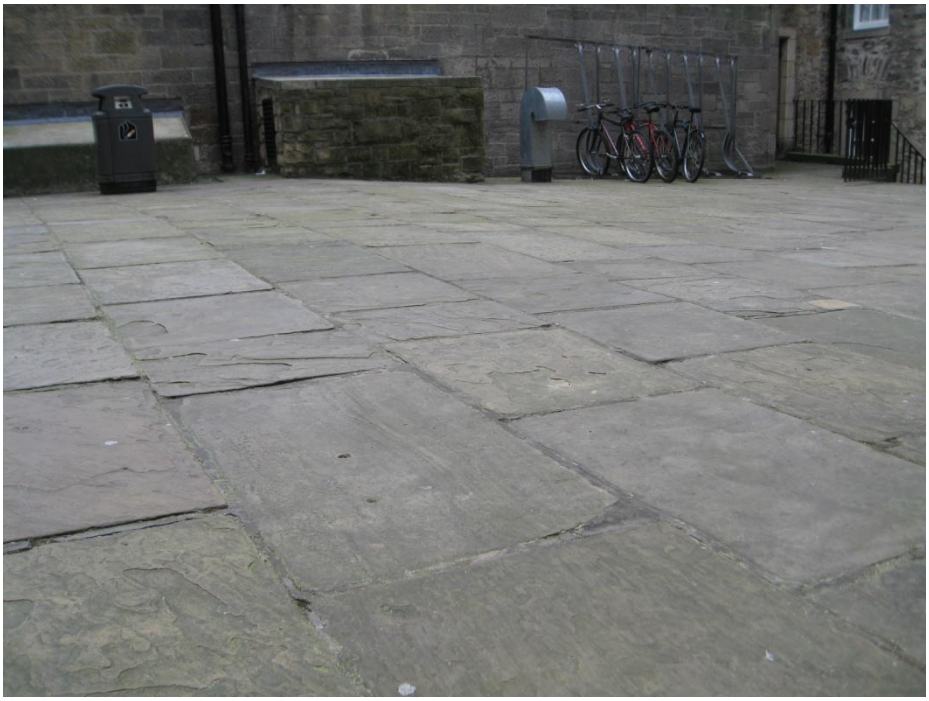

Fig. 38. Sandstone paving, probably re-laid in the 1960s, showing the typical variable appearance and natural 'contoured' surface texture typical of local sandstone such as Hailes. Milne's Close (909)

Fig. 39. Sandstone pavement (probably re-laid in the 1960s) with new sandstone dished gutter. The paving flags have the variable appearance typical of local Hailes sandstone. Milne's Close (907)

8. NATIONAL GALLERY OF SCOTLAND, THE MOUND

William Playfair completed the Royal Scottish Academy (c.1822-26 and 1831-36) using sandstone from Craigleith and Culallo quarries, and designed the National Gallery of Scotland (built c.1850-59 using Binny sandstone). Both buildings are A-listed. As part of a major refurbishment in 2001-4 (the 'Playfair Project': John Miller & Partners and Simpson & Brown) the area to the front of the National Gallery was repaved and detailed using Clashach sandstone.

The new pavement slabs are carefully detailed to reflect the historic sandstone paving. It is laid in courses perpendicular to the footpath direction. The Clashach sandstone has some variation in colour, from uniform grey in some blocks to variable orange-browns in others (Fig. 40), and this replicates the colour of some of the historic Hailes-type sandstone seen at other Playfair sites.

The paved footpath has a dished sandstone gutter along the edge with the railings (Fig. 40). The surfaces of the slabs has a droved tooled finish, replicating hand-tooling observed in original paving at other Playfair localities (Fig. 41). As well as visually reflecting the original finish, this will also add to the anti-slip qualities of the stone.

In addition, the new Clashach paving has some well-executed masonry detailing, including angled edges at the margins of a sloping pavement (Fig. 43), and superb dished gutter and drain detailing (Fig. 44).

A vehicle entrance on the west side of the National Gallery has a ramp comprising elongate sandstone blocks (presumably also Clashach) with a central groove cut along the block length. This replicates the historic detailing seen at George Heriot's School and General Register House (Figs. 27, 28 and 37), albeit with a diagonal 'herringbone' orientation rather than perpendicular to the entrance (Fig. 45).

Fig. 40. General view of recently paved area showing new flagstone footpath, edging to gravel area and dished gutter, all using Clashach sandstone. Note the variable colours in the flagstone paving which resembles historic Hailes sandstone paving. National Galleries (935)

Fig. 41. Detail of surface of replacement Clashach sandstone paving slab, showing hand-tooled droved surface finish, similar to those observed on well preserved examples of original sandstone paving at other Playfair sites. National Galleries (949)

Fig. 42. Replacement sandstone paving showing dished gutter at edge, with hand-tooled droved surface finish. National Galleries (930)

Fig. 43. Part of recently paved area (Clashach Sandstone) showing well-executed edge detailing for sloping footpath. National Galleries (3139)

Fig. 44. Well executed masonry detailing around drain in dished gutter in recent paving using Clashach sandstone. Note traditional fine droved tooling finish, replicating that seen on original historic sandstone paving in Playfair schemes. National Galleries (3140)

Fig. 45. Vehicle access area executed using elongate sandstone blocks, showing coarse tooling to mimic the historic sandstone setts at entranceways to historic Playfair paving schemes. National Galleries (3144)

9. HISTORIC PAVING IN EDINBURGH: SOURCES OF STONE AND FUTURE SUPPLIES

9.1 The geology of Hailes sandstone

The original paving slabs examined at Playfair buildings and related historic schemes during this study all have characteristics typical of a Hailes-type sandstone. Hailes sandstone is typified by having a distinctive bedded appearance, and weathers (or wears) to give a particular variable orange brown colour on the bedding surfaces. Hailes quarry in Edinburgh, and nearby quarries (e.g. Redhall, Craigiemill) worked the Hailes sandstone which outcrops on the southwest outskirts of Edinburgh.

Hailes sandstone is typically a fine to medium grained quartz-rich sandstone with a pale cream to very pale orange colour when fresh. The most distinguishing feature is the presence of 'ripple bedding', seen as thin irregular and discontinuous laminae, defined by planar concentrations of black carbonaceous fragments with flakes of white mica and iron oxide grains, which weather to a red-brown colour. It is typically hard and compact.

The weathered surface of Hailes sandstone when used as paving is very distinctive with a variable colour ranging from grey to orange-brown, combined with a 'contour-effect' surface pattern created by wearing through different ripple bedding layers. The mechanism for the formation of ripple bedding and its resultant visual effect on the surface of paving slabs is illustrated in Fig. 46. Characteristic examples of Hailes sandstone, showing the ripple bedded textures are shown in Figs 47 and 48.

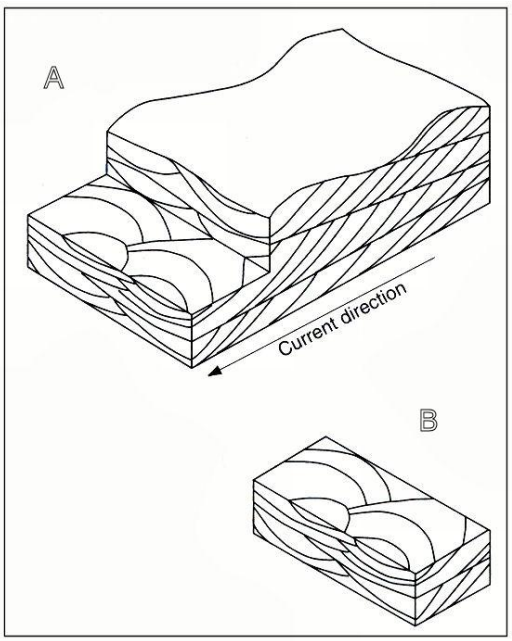

Fig. 46. Block diagram showing the internal bedding structure of ripple bedded sandstone (A), and its origin from the deposition of sand layers in a flowing water current. The thin beds contain a series of multiple, thin oblique ripple bedding laminae. On the upper surface of the stone block this gives a 'contour effect' (B), enhanced as the surface becomes worn with use. This is the familiar surface texture seen on many original 'Hailes-type' sandstone paving slabs in Edinburgh.

The presence of thin bedding planes in this type of sandstone would have allowed it to be relatively easily split or riven into thin ‘flags’, a process historically done by hand. This also means that the stone is particularly strong in compression when laid with the bedding planes horizontal. These factors, plus the relatively quartz-rich, fine grained and compact nature of the sandstone, made it particularly suitable for use as paving stone. In addition, the outcrop of the Hailes sandstone was close to the centre of Edinburgh, allowing relatively easy transportation in historic times.

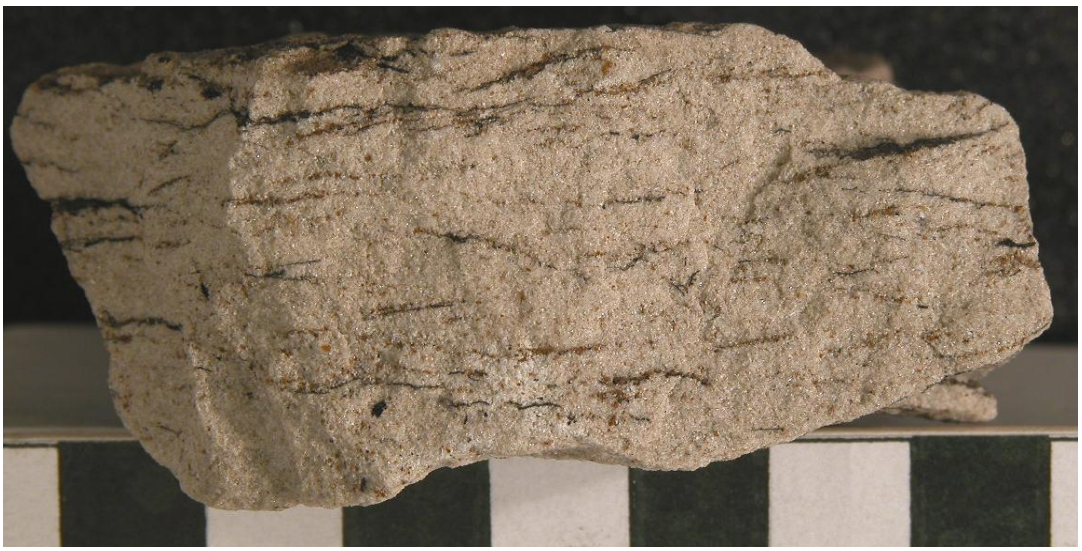

Fig. 47 (top image): Sample of typical Hailes-type sandstone from paving at Charlotte Square, showing the characteristic irregular dark ripple bedding laminae. Fig. 48 (bottom image): Sample of sandstone pavement from Calton Hill, showing the typical characteristics of Hailes-type sandstone, in particular the presence of irregular dark coloured bedding planes. Scale divisions are centimetres.

Craigleith sandstone (from the Gullane Formation rocks of western Edinburgh) is different to Hailes sandstone in that it commonly has a uniform texture. It is similar in terms of its quartz-rich composition and fine to medium grainsize. It is however known that certain beds within Craigleith quarry contained ripple bedded sandstone (known as 'feak' rock) similar to Hailes, and this bedded Craigleith stone is seen in many buildings throughout Edinburgh (e.g. National Monument, Calton Hill). This Craigleith feak rock is recorded as having been used for rubble work, foundations, steps, plats and paving and is essentially indistinguishable from Hailes sandstone. In effect both Hailes sandstone and bedded Craigleith feak rock can be considered as essentially the same material, such that in this report the term 'Hailes-type' sandstone is used to refer to either bedded Craigleith or Hailes sandstone.

9.2 History of the use of Hailes sandstone in Edinburgh

Hailes quarry was first referred to in the early 1600s. It was of considerable size by 1787, when a steam engine was employed to pump water, and at the peak of production in 1825, 600 cartloads of stone were transported to the city. By 1845 the quarry was 90 feet deep, and the output had reduced to 60 to 70 cartloads per day. Even as late as 1899 the quarry still employed 225 men. The quarry was worked intermittently after the First World War, and had ceased by 1944. Today the quarry is infilled and a public park.

George Smith, writing in 1835, described the stone as "strong hard flags which are extensively used for the foot-paths of Edinburgh streets". The finest stone was used for steps, plats, internal paving and chimney finishings. The poorer stone was used for rubble walling, producing the "best ruble stone of any quarry near Edinburgh". The presence of a bedded texture probably precluded its use for 'polite' ashlar work. It seems that Hailes sandstone was the principal paving stone used for the Edinburgh New Town, and given its availability in the early 19th century, it is highly likely to have been the stone used in the Playfair paving schemes.

9.3 Future supplies and selection of appropriate replacement stone

The results of this study show that the external paving in the historic Playfair and contemporary schemes was dominated by sandstone from Hailes quarry (or nearby quarries exploiting the same or similar sandstone formations, e.g. bedded varieties of Craigleith sandstone). The geological make-up of Hailes sandstone is such that it has a distinctive appearance, and it is quite different from most of the currently-available sandstone paving quarried in the UK today. All the original sandstone quarries in the Edinburgh area are closed and infilled and new stone is unavailable. In order to obtain similar stone for repairs to historic pavement, and for new natural stone paving which resembles the historic pavement, either a substitute 'matching' stone type is required, or a new quarry needs to open (or reopen) in Hailes or similar sandstone.

The Hailes sandstone was produced mostly from Hailes and Redhall quarries on the southwest side of Edinburgh. Both these quarries are now infilled and close to or part of residential areas of the city. It is highly unlikely that any significant extraction of stone would be possible from either of these sites. Geologically, the Hailes sandstone is one of a number of sandstone units present within the West Lothian Oil Shale Formation. It occurs in two main outcrops (British Geological Survey 2003); a restricted area in southwest Edinburgh where it was worked at quarries at Hailes, Redhall and Baberton, and in a broad north-south belt stretching from Gyle to Cramond (formerly worked at Craigiemill near Cramond Brig). Hailes sandstone was known to vary in character from quarry to quarry (McMillan et al. 1999).

Because of the proximity to Edinburgh it may not be possible to re-open or open a quarry in Hailes sandstone, although some of the outcrop occurs in rural areas along the western edge of the city. No modern resource assessment has been undertaken of the potential for obtaining future supplies of Hailes sandstone from these deposits. Alternatively, stone of similar characteristics may be present in several geologically similar sandstone units within Scottish Central Belt, likely to be present in a number of locations remote from built-up areas. With further investigation it may be possible to identify a number of former quarry sites which have similar stone and the potential to be reopened. However, this may be unlikely to happen for a single paving project and may require a coordinated strategic approach. One such quarry, Drumhead quarry near Denny, is currently undergoing an investigation coordinated by the Scottish Stone Liaison Group, and may in the future provide a ‘local’ source of appropriate sandstone for conservation work in the Central Belt.

A number of alternative currently available sandstone types have been used in recent years as a replacement stone for historic paving in Edinburgh. The most commonly used stone type is Caithness flagstone, now ubiquitously seen in modern public realm paving schemes throughout the UK. Caithness flagstone is a fundamentally different material from the Carboniferous sandstone of the central belt –it is a uniform fine grained siltstone with a high organic content giving a much darker grey colour (see contrast in Figs. 14 and 33); and was geologically formed in a lake-bed (lacustrine) environment giving it a very different texture to the (mostly river-bed or fluviatile) Central Belt sandstone. Although Caithness flagstones have been extensively used for paving in Edinburgh they differ strongly in character from the historic Hailes-type sandstone paving.

Most sandstone paving produced today in the UK is from the West Yorkshire sandstones (collectively termed ‘York Stone’). Although this is an excellent paving stone in terms of quality, it tends to have a uniform texture and colour, making it rather bland in appearance commonly with a pale buff colour; lacking the variable colour and surface texture typical of local Hailes-type sandstone paving (Figs. 49 and 50). It should be noted that some varieties of York Stone (and sandstones from other parts of England) can show variable colours and textures which may resemble the Hailes-type sandstone. Scoutmoor sandstone (quarried in Lancashire) has a similar

ripple bedded texture resulting in a ‘contoured’ surface to paving slabs, and has been used successfully in several parts of Edinburgh (e.g. Waverley Bridge, Fig. 51). However, Scoutmoor sandstone generally has a finer grainsize and a more grey colour, although bands of orange iron staining can give it a variable appearance.

One of the most similar currently-available stone types to the local Edinburgh sandstone –and a stone type that is also suitable for use as paving– is Clashach sandstone from Moray. It has a very similar grainsize and composition to Hailes and Craigleith sandstone, and although lacking the ripple bedded texture, it commonly shows varying colours which can give it a similar appearance to weathered and worn Hailes-type sandstone. The recent (2007) use of Clashach paving at the National Galleries illustrates the success of this stone type at replicating the historic Hailes-type pavement (e.g. Fig. 40).

Fig. 49. Small area of modern replacement paving in Charlotte Square, with two slabs of York-type sandstone (centre of image) showing typical uniform, strong yellow-buff appearance, contrasting with the original ‘Hailes type’ sandstone (to either side) showing a more variable appearance ranging from grey to orange-brown colour.

Fig. 50. Use of replacement Yorkshire sandstone as replacement steps adjacent to original 'Hailes type' sandstone paving (Charlotte Square). The typical uniform yellow-buff colour of the York stone contrasts with the more variable and stronger coloured original paving slabs. Note also the poor detailing of the replacement steps, particularly the use of a thin slab.

Fig. 51. Modern natural stone pavement on Waverly Bridge, typical of sandstone from Scout Moor quarry. This stone type has some similar characteristics to historic Hailes-type sandstone paving used in Edinburgh, in particular a variable colour from pale grey to orange-brown and the presence of bedding planes on the surface providing a 'contour surface' effect.

10. SUMMARY AND DISCUSSION

The purpose of this study has been to document the historic paving patterns and materials found at Old College and other Playfair paving schemes across Edinburgh. The other sites that have been visited are New College and Assembly Hall, Mound Place; Donaldson's Hospital (School for the Deaf), West Coates; George Heriot's School, Lauriston Place; Milne's Court; the National Galleries on the Mound; and General and New Register House (Princes Street). At each site the paving patterns and materials were recorded, including details such as slab sizes, surface tooling and details such as drainage channels.

The best preserved historic courtyard paving schemes are at Donaldson's Hospital and George Heriot's School. Along with the paved terrace at Old College, these sites provide the best evidence of the original paving patterns and materials. The courtyard at the Assembly Hall has been repaved using a York-type sandstone, although the original paving pattern may have been retained.

The formal courtyards all show a centred rectangular pattern, with a gradual fall in height from the centre to the edges for drainage. At George Heriot's School the corners of the courtyard have diagonal linear joints radiating from the centre to the four corners. At Donaldson's Hospital the central point of the courtyard is marked by a fountain. At each site, water run-off at the edges is handled by shallow dished gutters with the flow direction controlled by gradients determined by the depth of the dishing. The dished gutters are all cut to curve around the corners.

The surface of the paving slabs have been tooled with parallel rows of fine droving, although many areas are now worn smooth. Slab sizes vary between sites, but each site shows uniformity of sizes and regular patterns. At Old College in particular, the terrace pavement is marked by very regular slab sizes and patterns, giving a strong formality and symmetry to the scheme.

The principal material used for the paving is bedded 'flaggy' sandstones, probably from Hailes quarry in Edinburgh. Identical bedded sandstone varieties from other Edinburgh quarries such as Craigleith may also have been used. Angus (Carmyllie) flagstones appear to have been used almost exclusively for internal use (entrance porches, internal stairs, landings, etc.) and have not been observed as external pavement in any of the schemes. The local Hailes-type sandstone weathers and wears in such a way as to give a highly distinctive variable orange-brown patina on the flagstone surface, which is enhanced by a 'contour' surface effect produced by the thin bedding planes. These features are very characteristic of the early 19th century pavement in Edinburgh.

The same local Hailes-type sandstone has been used for kerbstones and setts at vehicle entrances, where blocks are placed edge-bedded and tooled with a broad groove to prevent slip. There is no evidence for the use of igneous rock such as whinstone or granite in the original schemes.

All of the sandstone quarries in the Edinburgh area are closed, and new supplies of Hailes-type sandstone are currently unavailable. A number of former quarries in the Central Belt may have the potential for reopening and supply of similar stone in the future, although a coordinated resource assessment is required. In the absence of such 'local' stone, a small number of alternative stone types may give a similar appearance to the Hailes-type sandstone. Clashach sandstone, has similar geological properties, meaning that it has a similar appearance and takes tooling in a similar way to the historic local stone.

Information about this Report

Introduction:
This report provides a petrographic examination of a sample or samples of building stone. It is designed for use by professionals involved in building repair and/or conservation but it might also be useful for private individuals to help them judge whether or not further professional advice should be sought. We recommend that members of the public consult a qualified professional about the results in this report before making any major decisions based on it.

Limitations of the report:

- This report is based on analysis of the sample or samples provided and cannot be assumed to be representative of all materials in a building or structure unless an on-site assessment has been carried out by a qualified professional.
- Please note that a recommendation of a replacement stone does not constitute a repair specification. All aspects of the building (location, detailing, other materials) must be considered in competent repair work.
- The report provides a petrographic examination of stone type. This does not guarantee that a replacement stone is suitable for a particular purpose (e.g. carved detail), nor does it guarantee specific properties of a stone such as strength.
- Please note that the characteristics of stone from a quarry source can vary over time, and that the recommendations in this report are based on comparison with samples held in our collections. It is recommended that prior to specification, current samples should be obtained from a particular quarry, and we would be happy to comment on these if required. Whilst the analysis undertaken in this report complies with BS EN 12407:2000, the mention of specific stone types should not be taken as an endorsement, or otherwise, of the quality of a particular product.
- Recommendations for replacement stone are based on and limited to an interpretation of the records in the possession of The British Geological Survey (BGS) at the time the examination is carried out.

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