Spaul, J.E.H. 2000: *Cohors*^{2}. *The Evidence for and a Short History of the Auxiliary Infantry Units of the Imperial Roman Army*, BAR International Series 841, Oxford
Speidel, M.P. 1986: 'The soldiers' homes', in Eck and Wolff 1986, 467–81
Webster, G. 1975: *The Cornovii*, London

Roman Field-System Earthworks in the Birklands and Belhaugh Hays, Nottinghamshire

By STEVE MALONE

ABSTRACT

Processing and analysis of LiDAR data in Nottinghamshire has identified the survival of earthwork field-systems beneath woodland in some of the oldest established parts of Sherwood Forest. The morphology and alignment of these field-systems strongly suggest that they represent a survival of the late Iron Age and Roman brickwork-plan field-systems of North Nottinghamshire and South Yorkshire with considerable potential to elucidate the history of abandonment of these fields and the establishment of Sherwood Forest.

Keywords: Sherwood Forest; LiDAR; brickwork-plan fields; Roman field-system; earthworks; Nottinghamshire

The brickwork field-systems of North Nottinghamshire and South Yorkshire were first recognised from the air by Riley[89] and have since been subject to ongoing research through survey and excavation which has contributed to our current understanding of their character and date.[90] They comprise a coherent landscape of co-axial fields arranged in parallel blocks divided by trackways and interspersed with small enclosure groups. They were certainly in use throughout the first few centuries A.D. but their precise history remains obscure; origins in the later Iron Age have been suggested but conclusive evidence of their inception (and demise) remains elusive. They form one of a number of such large-scale field-systems of the late Iron Age and Roman periods recognised across Britain.[91]

The most coherent blocks of this landscape appear to be confined to the Sherwood Sandstone of North Nottinghamshire and South Yorkshire (FIG. 9), although the distribution may be more apparent than real; adjacent coal measures and mudstones are not so conducive to cropmark formation. In the medieval period this part of North Nottinghamshire became Sherwood Forest and (if never in fact entirely wooded) is still well wooded today. The frequent observation of cropmarks in gaps between woodland strongly suggests that the field-systems formerly extended beneath areas now wooded and leads to the suspicion (or hope) that earthwork remains might be preserved, particularly within areas of longer-established Ancient Woodland. However, the factors which lead to potential survival also militate against discovery, with potentially quite subtle surface traces difficult to see within woodland with varying ground cover, lack of extensive views and absence of aerial survey.

[89] Riley 1980.
[90] e.g. aerial photographic mapping: Deegan 1996; 1999; fieldwalking: Garton 2007; 2008; excavation: Garton 1987; Davies 2000; Jones 2007.
[91] Taylor 2007, 55–72; Rippon *et al.* 2015.

https://doi.org/10.1017/S0068113X17000046 Published online by Cambridge University Press

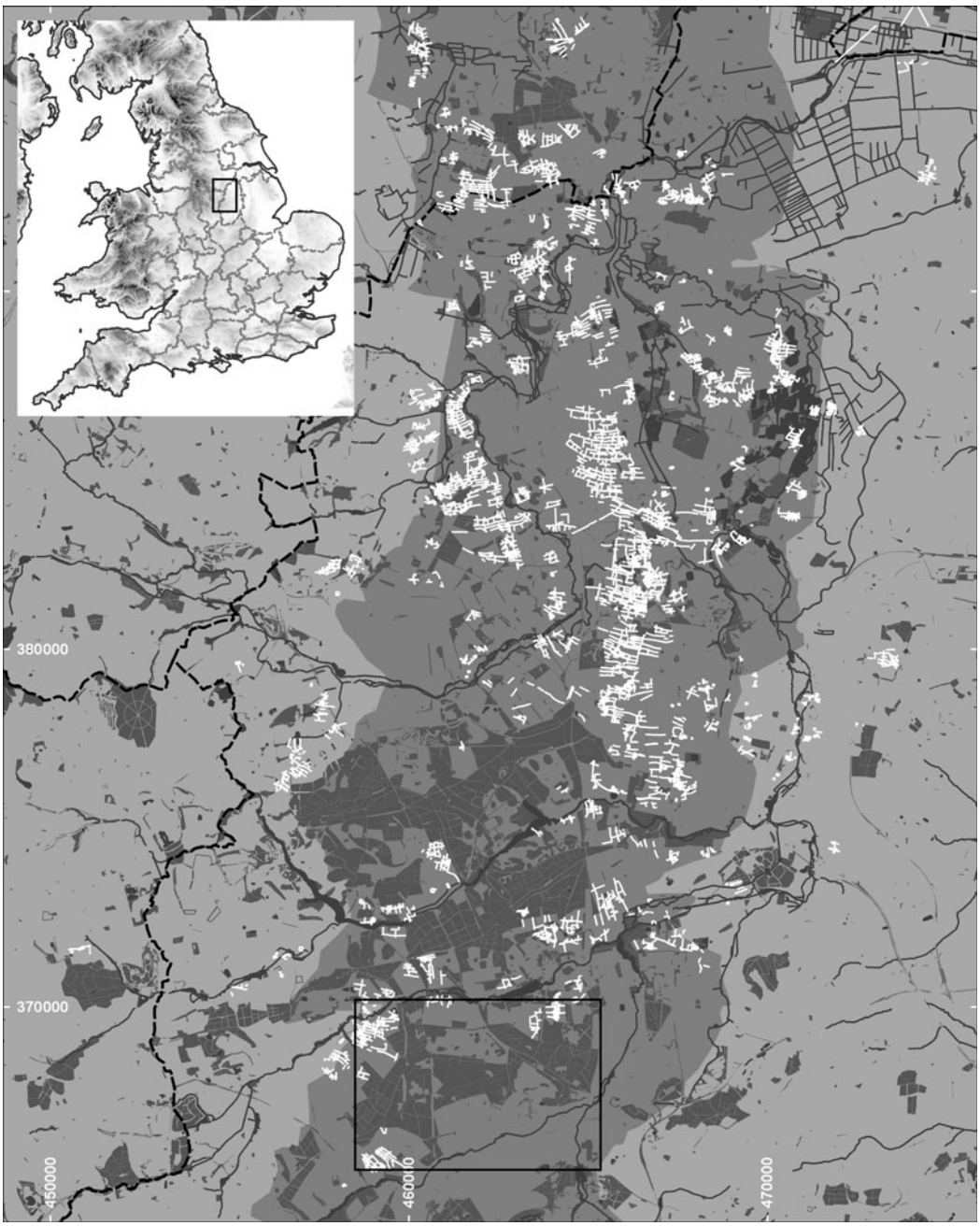

FIG. 9. Location of study area. Brickwork-plan field-system cropmarks (white) on the Sherwood Sandstone (central grey band) west of the river Idle in north Nottinghamshire showing extent of woodland (dark grey). (*Contains Ordnance Survey data. Crown Copyright and database right 2016*)

https://doi.org/10.1017/S0068113X17000046 Published online by Cambridge University Press

The advent of new survey techniques, in the form of LiDAR, together with advances in processing and visualisation means that it is now possible to see beneath the tree cover, enabling new insights into the extent and preservation of elements of this early field-system. In the course of Historic England funded research into the potential of LiDAR for mapping palaeochannels in the Trent catchment, available LiDAR for the whole of Nottinghamshire was processed and notwithstanding the focus on river valleys, the presence of earthwork features within some woodland areas became readily apparent. The degree of survival is varied, with nothing at all in many areas, but in some of the oldest parts of Sherwood Forest, the Birklands and Belhaugh Hays in Ollerton, Edwinstowe and Perlethorpe parishes, the results have been remarkable (FIG. 10).

LiDAR

The archaeological potential of LiDAR surveys is now well established.[92] The extensive areas of slight earthwork which characterise relict field-systems can be expressed well by the technique; the presence of woodland is often a driver for preservation and the ability of LiDAR to filter out tree cover opens up previously unexplored vistas.[93]

LiDAR data gathered by the Environment Agency is available under Open Government Licence with coverage at 1 m resolution for the whole of the Birklands and Bilhaugh and coverage at 0.5 m for the Birklands. All processing was undertaken on the bare-earth digital terrain model (DTM) datasets. EA LiDAR data tiles for OS grid squares SK56 and SK66 were mosaicked together to produce a continuous raster grid surface model. Further processing was undertaken using the Relief Visualization Toolbox produced by the Research Centre of the Slovenian Academy of the Sciences and Arts to produce multi-directional hill-shaded plots supplemented with other non-directional techniques, e.g. sky-view-factor and positive openness. The use of a combination of visualisation techniques is generally recommended,[94] although earlier proposals have to some degree been superseded by continuing developments in the field.[95] Hill-shaded models remain intuitively easier to read but layering with other techniques can produce clearer plots of earthwork features. The best results here have been found using positive openness merged with multi-directional hill-shaded DTMs with the processed LiDAR revealing very subtle changes in topography across the study area attributable to both natural and anthropogenic causes.

RESULTS

Birklands and Belhaugh Hays represent some of the oldest surviving woodland of Sherwood Forest, with some 450 ha designated as Ancient Woodland. The antiquarian Hayman Rooke commented on the ancient state of the woodland here[96] and among sketches preserved in the Derby Local Studies Library is one of 'an ancient work in Birkland near the Budby quarter'.[97]

The processed LiDAR survey shows the survival of extensive earthworks beneath the tree cover of the Birklands and Belhaugh Hays over an area of *c.* 6.5 km^2 (FIG. 12). These comprise embanked fields, smaller enclosures and trackways on a co-axial pattern. The most coherent pattern lies within the Belhaugh woodland on the southern edge of Thoresby Park (FIG. 10). Here a block of long narrow fields can be seen aligned WNW–ESE with cross-banks dividing the fields and a series of double-banked trackways, *c.* 10 m wide, separating blocks of as few as two, or as many as seven, fields. A series of small enclosures (2,500–7,000 m^2) fit into the centre of the pattern with more coherent blocks of fields to

[92] Crutchley and Crow 2010; and cf. Gethin and Toller 2014; Wilson 2015, 303–7; Davies and Driver 2015, in recent editions of this journal.
[93] Crow 2008; cf. Wombwell, South Yorkshire and Whitwell, Derbyshire: Forest Research 2012; South Downs, West Sussex: Eve 2014; Berkshire Downs: Levick 2015.
[94] Challis *et al*. 2011; Bennett *et al*. 2012.
[95] e.g. positive/negative openness: Doneus 2013.
[96] Rooke 1799.
[97] Gaunt 2008.

https://doi.org/10.1017/S0068113X17000046 Published online by Cambridge University Press

FIG. 10. Belhaugh Hays ancient woodland on the Thoresby Estate in Sherwood Forest (extent shown on FIG. 12). Air photograph (Google maps) and LiDAR DTM with tree cover removed showing earthworks surviving in the woodland. (*LiDAR data courtesy of Environment Agency under Open Government Licence 3.0*)

https://doi.org/10.1017/S0068113X17000046 Published online by Cambridge University Press

the north and south. The fields are generally 60–80 m wide and 160–215 m long (although cross-banks are not as clearly evident, so few entire fields can be defined). One small enclosure, slightly misaligned but otherwise integral with the field-system, hints at more complexity in development than the apparent uniformity would imply.

The pattern is immediately suggestive of the brickwork-plan system as side-by-side comparison makes clear (FIG. 11). Cropmarks recorded immediately to the west are somewhat patchy but can be seen to continue the same alignments and there is clear continuation here of one of the trackways. To the north the cropmarks are better with a more extensive group of enclosures recorded. The alignment of the fields matches those within Belhaugh Hays to the south and can be seen to align directly on short lengths of earthwork preserved in woodland along a former avenue in the parkland.

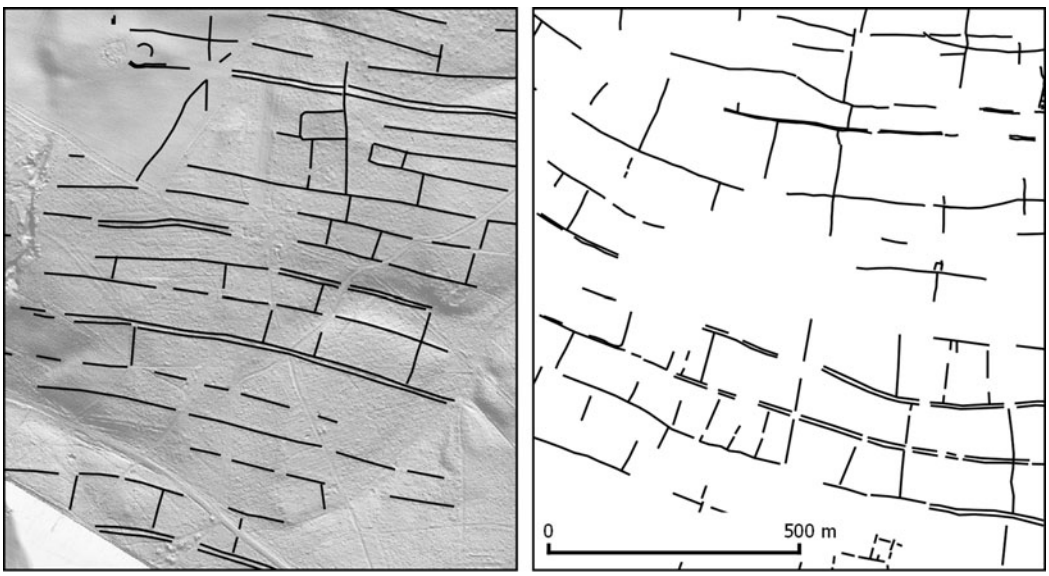

FIG. 11. Comparison of the field-system earthworks at Belhaugh Hays, SK 637 689 (left) with the brickwork-plan cropmarks at Barnby Moor, SK 652 851 (right).

The Birklands to the west has been subject to more exploration in recent times. Higher-resolution (0.5 m) LiDAR survey was undertaken here by Forest Research on behalf of The Friends of Thynghowe as part of Heritage Lottery funded community projects. This revealed a wealth of features including a large rectilinear enclosure (Rooke's 'ancient work') and a circular feature, believed to be the site of the Viking era *Thinghowe*, but also 'various types and phases of earlier cultivation'.[98] The pattern of long, sinuous, parallel banks seen here is less clearly of the same character as the brickwork-plan fields. No cross-banks can be seen dividing the strips into fields and there are few indications of trackways. The one enclosure seems to stand apart on a slightly different alignment and with no clear relationship to the field banks. Overlap between the north-east of the Birklands and south-west of Belhaugh is minimal (the extensive spoil heaps of Thoresby Colliery intervene at the crucial point) but is sufficient to suggest a continuation of alignments. The scale of the earthworks and width of the blocks defined (again averaging 60–80 m) matches those to the north-east and, seen alongside the processed data for Belhaugh (FIG. 12), there seems little doubt that this pattern represents further extensive survival of brickwork-plan field-system earthworks extending from the river Maun in the south almost to the river Meden in the north.

[98] Forest Research 2012.

https://doi.org/10.1017/S0068113X17000046 Published online by Cambridge University Press

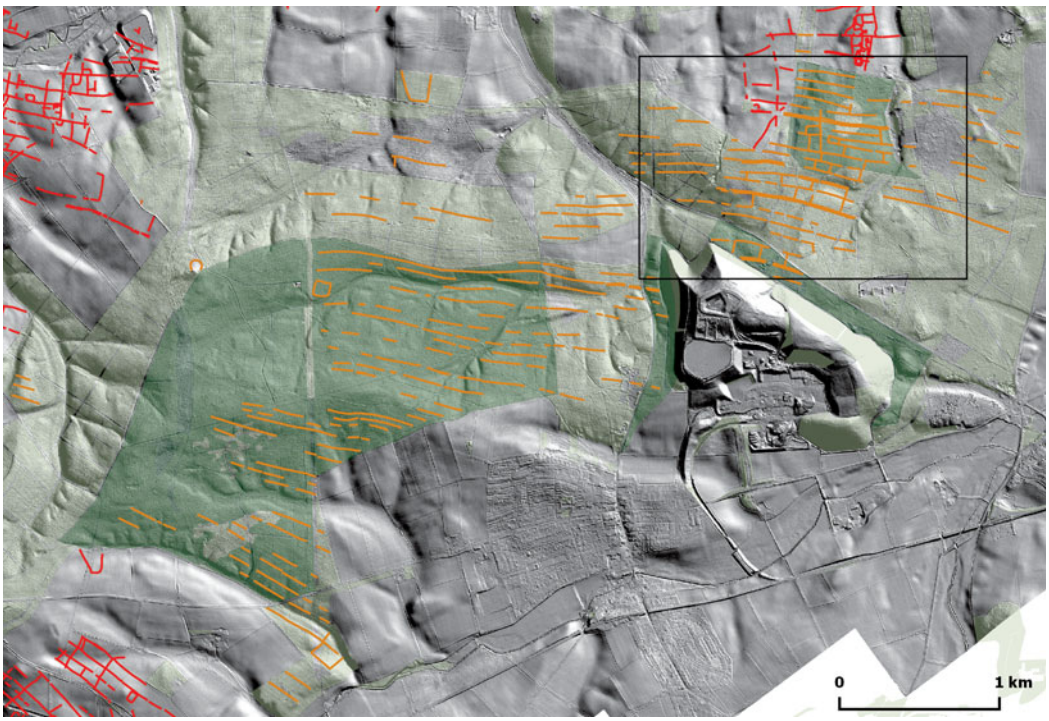

FIG. 12. Birklands and Belhaugh Hays (see FIG. 9 for location). Earthworks within the woodland (orange) with cropmarks (red). Extent of woodland (green) and Ancient Woodland (dark green) over LiDAR DTM. (*Contains Ordnance Survey data. Crown Copyright and database right 2016. Lidar data courtesy of Environment Agency*)

The survival of earthwork remains of the brickwork field-system within the Birklands and Belhaugh leads to two potentially exciting conclusions: firstly, the survival of earthwork features (and their associated ditches) of such antiquity may have significant potential to answer some long-standing questions on the inception, use and eventual abandonment of these large-scale field-systems, the latter with direct bearing on questions of continuity into the post-Roman period;[99] secondly, this may have significant bearing on the antiquity of Sherwood Forest itself, these parts at least possibly developing as early as the post-Roman period (or whenever it turns out the field-systems were eventually abandoned). Work continues on assessing the potential for wider survival and to map the extent of these features. A clear priority is ground-truthing, to characterise in the field and establish accessibility, with the aim of eventual ground investigation where possible in the hope of answering some of these outstanding questions.

York Archaeological Trust (Trent & Peak, Nottingham)
smalone@yorkat.co.uk

doi:10.1017/S0068113X17000046

BIBLIOGRAPHY

Bennett, R., Welham, K., Hill, R.A., and Ford, A. 2012: 'A comparison of visualization techniques for models created from airborne laser scanned data', *Archaeological Prospection* 19.1, 41–8

[99] cf. Rippon *et al*. 2015, 320–9.

Challis, K., Forlin, P., and Kincey, M. 2011: 'A generic toolkit for the visualisation of archaeological features on airborne LiDAR elevation data', *Archaeological Prospection* 18.4, 279–89
Crow, P. 2008: *Historic Environment Surveys of Woodland using LiDAR*, Forest Research
Crutchley, S., and Crow, P. 2010: *The Light Fantastic: Using Airborne Laser Scanning in Archaeological Survey*, Swindon
Davies, G. 2000: *Archaeological Excavation of Scrooby Top Quarry Extension, Scrooby Top, Nottinghamshire*, unpub. ARCUS report 247c
Davies, J.L., and Driver, T.G. 2015: 'Cefn-Brynich Farm: a new Claudio-Neronian fort in the Usk valley, Powys, Wales', *Britannia* 46, 267–73
Deegan, A. 1996: 'North Nottinghamshire field systems — a landscape overview', *Aerial Archaeology Research Group* 12, 18–24
Deegan, A. 1999: *The Nottinghamshire Mapping Project. A Report for the National Mapping Programme*, RCHME, Swindon
Doneus, M. 2013: 'Openness as visualization technique for interpretative mapping of airborne LiDAR derived digital terrain models', *Remote Sensing* 5(12), 6427–42
Eve, S. 2014: 'An undiscovered county? New field systems found on the South Downs', *PAST* 78, 2–5
Forest Research 2012: Our LiDAR surveys, http://www.forestry.gov.uk/fr/infd-6fkhfe (Accessed 18/05/16)
Garton, D. 1987: 'Dunston's Clump and the brickwork plan field systems at Babworth, Nottinghamshire: excavations 1981', *Transactions of the Thoroton Society of Nottinghamshire* 91, 16–73
Garton, D., with Naylor, V. 2007: 'Flintwork and medieval pottery from fieldwalking over cropmarks on the Sherwood Sandstone of North Nottinghamshire', *Transactions of the Thoroton Society of Nottinghamshire* 111, 15–32
Garton, D., with Leary, R.S., Cowgill, J., Firman, R., and Wright, L. 2008: 'The Romano-British landscape of the Sherwood Sandstone of Nottinghamshire: fieldwalking the brickwork-plan field-systems', *Transactions of the Thoroton Society of Nottinghamshire* 112, 15–110
Gaunt, A. 2008: *An Ancient Work in Birklands. A Topographic Survey of an Earthwork in Sherwood Forest National Nature Reserve*, Nottinghamshire County Council NCA-003
Gethin, B., and Toller, H. 2014: 'The Roman marching camp and road at Loups Fell, Tebay', *Britannia* 45, 1–10
Jones, L. 2007: 'Archaeological excavation of a brickwork plan field system at Catesby Business Park, Balby Carr, Doncaster, South Yorkshire 2002', *Yorkshire Archaeological Journal* 79, 17–54
Levick, P. 2015: *Later Prehistoric and Roman Landscapes on the Berkshire Downs*, BAR British Series 612, Oxford
Riley, D.N. 1980: *Early Landscape from the Air*, Sheffield
Rippon, S., Smart, C., and Pears, B. 2015: *The Fields of Britannia: Continuity and Change in the Late Roman and Early Medieval Landscape*, Oxford
Rooke, H. 1799: *A Sketch of the Ancient and Present State of Sherwood Forest, in the County of Nottingham*, Nottingham
Taylor, J. 2007: *An Atlas of Roman Rural Settlement in England*, CBA Research Report 151, York
Wilson, P. 2015: 'Roman Britain in 2014: Northern England', *Britannia* 46, 295–313