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Mapping the Nation: Landscapes of Survey and the Material Cultures of the Early Ordnance Survey in Britain and Ireland

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ABSTRACT

Starting its work in 1791, the Ordnance Survey (OS) was a supranational organisation responsible for creating high quality and accurate topographic maps of the nations of Great Britain and Ireland. The detailed and rigorous field observations and geodetic operations of OS field-surveyors have left many traces in the landscape, but despite much careful and critical historical study of OS maps, and their wide use as sources in local studies and fieldwork, the material impacts and influences the OS had on British and Irish landscapes has been generally overlooked. This paper redresses this by exploring the 'landscapes of survey' created through the OS's trigonometrical and levelling operations for the first half of the nineteenth century. The paper first sets out how 'excavating' large-scale historic OS maps in digital mapping platforms provides a basis for identifying survey sites in the landscape, and how the positioning of these sites by the OS, both on the map and in the landscape, can uncover past survey practices and 'ethnographies of cartography' in the field. The second part of the paper focuses on the monuments used and created by surveyors to ensure a sound geodetic basis, examining OS survey sites as 'material cultures'. Together, both parts of the paper make a case for greater recognition of the *landscape legacies* of the OS, a 'survey heritage' which has international significance in reflecting the OS's lasting contributions to scientific survey and geodesy, as well as for its role in shaping Britain and Ireland through mapping the nation.

KEYWORDS

Landscape archaeology; field surveying; ordnance survey; survey heritage; history of cartography

Introduction

I pored over the one-inch map for hours, trying to read it like a document written in a foreign language, but I got nowhere with it. Yet I remained convinced that it would tell me a great deal if only I could find the key. (Hoskins 1967, 16).

Maps and mapping are closely bound with the study of landscapes. In both landscape history and landscape archaeology in particular, the methodological basis of fieldwork, interpretation and presentation is the map. This is because as a source of information historic maps are seen to capture the appearance of a landscape for a specific moment, or period, while as a final product, or output, a map is usually used to represent a past landscape. This mapping approach can be traced in the Anglophone 'landscape history' tradition from the 1950s onwards, inspired by W. G. Hoskins' *Making of the English*

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Landscape (1955). For example, the advice offered by Hoskins' contemporary and counterpart, Beresford (1957, 19), in his *History on the Ground*, stated unequivocally 'the traveller'—that is the would-be landscape historian—ought to be 'armed with maps ... in order to explain or confirm what he [*sic*] noticed in the landscape'.

This focus on the map as a guide to the landscape in the field was further continued by a host of other 'how to' guides and methodological treatises in the Hoskins and Beresford tradition, a genre which characterised English landscape history and archaeology through the 1960s, '70s and '80s (e.g. Hoskins 1967; Aston and Rowley 1974; Aston 1985). Indeed, for Aston and Rowley (1974, 59) this emphasis on maps and mapping in the practice of historical and archaeological landscape studies was uncompromising: 'by far the most important document to the fieldworker is the map, both as a source and as a tool', they stated. This principle remains strong to this day (see Muir 1999; Rippon 2004). In all these examples, the procedure involves working from map to landscape, and then from landscape to map. The map, in this sense, mediates how a landscape, whether rural or urban, is both read and understood.

In Britain and Ireland, the maps that dominate this process are the ubiquitous large-scale Ordnance Survey (OS) map series, particularly at scales of one inch to one mile, six inches to one mile and 25 inches to one mile (Hindle 1998). With their various revision dates across the nineteenth and twentieth centuries, these map series provide a series of snapshots of landscape changes over time, enabling the visualisation of a series of layers, for example, of changing field and settlement patterns and structures, as well illustrated by classic studies such as Brian Roberts' *Making of the English Village* (1987), which used OS nineteenth-century six-inch maps as a basis for analysing and classifying village forms. Similarly, the larger scale 1:2500 plans of the OS are seen as a reliable basis, for studying urban forms through 'plan-analysis' and for mapping out the changing shape of towns and cities by urban morphologists (Conzen 1968; Slater 1990; Lilley 2000). Such analytical approaches to the use of OS maps have become embedded also in the techniques used in characterising landscapes for the purposes of Historic Landscape Characterisation (HLC) across Britain and Ireland, both in town and countryside (Aldred and Fairclough 2003, 22–4; Lambrick *et al.* 2013, 29–31).

For desktop landscape study then, as well as for fieldwork, the historic OS map series have played a key role in how historic landscapes are interpreted and analysed. It is crucial too, of course, to recognise that the map as a mode of landscape representation changes through time as well as the landscape it represents. Map-making is not a static process but undergoes constant technical and aesthetic modification and innovation over time (see Delano Smith and Kain 1999; Andrews 2009). Paying close attention to the history of map-making thus ought to form an integral element of the practice of landscape history and archaeology, and this requires careful and thorough study not just of the maps and their makers, but also of the field-surveyors whose trigonometrical and topographical groundwork had underpinned the OS maps that are so relied on as source and tool in the intellectual and practical pursuit of landscape histories and archaeologies.

Mapping the nation

The study of landscape history and the study of cartography are rarely brought together it seems. Map historians focus on what is *on the map*, and less so what is *in the landscape*. Yet,

there is scope to bring the two together, all the more because one informs the other. Maps and landscape have been brought together, for example through artistic and architectural enquiry, in studies that have examined how mapping has shaped urban forms and design, or in areas such as cultural and historical geography where the map provides a means for understanding power and authority in the landscape (Matless 1998; Cosgrove 1999). The history of the OS of Great Britain and Ireland has received much comment from this perspective, particularly in Ireland in the nineteenth century, through studies of the naming of places in the landscape and the cultural politics of this process (see Doherty 2004; Ó Cadhla 2007).

The links between the OS and British national identity – ‘of being British’ – have also been examined (Parker 2009, 36), particularly for the twentieth century (see Hodson 1991; Hewitt 2010). There has been detailed study of the history of the OS as a *supranational* mapping organisation (e.g. Andrews 1976; Oliver 2014), as well as careful scrutiny and analysis of the many kinds of maps produced by the OS over more than two centuries (e.g. Harley 1975; Seymour 1980; Owen and Pilbeam 1992; Hellyer and Oliver 2009, 2015). What has been lacking is what might be called a landscape history – or archaeology – of the OS, looking in particular at the impacts of survey work itself on the landscapes being surveyed. Thus, although historic OS maps have long been used in historical analysis, how *landscapes* were shaped by the act of *map-making* is largely overlooked both in Britain and Ireland.

A case can therefore be made for looking at how the field-survey practices of the OS shaped the landscape materially, on the ground, and how through its topographic mapping over two centuries the OS left a legacy that comprises more than the many maps of this cherished and revered national enterprise. As well as the presence of the OS being embedded in the British and Irish national psyche, the landscapes of Britain and Ireland were also materially inscribed by the OS and stand as a ‘memorial’ to the industry and enterprise of those who surveyed and mapped each nation in such detail. This paper aims to explore these ‘landscapes of survey’, to draw attention to the importance of material cultures of cartography, a somewhat neglected in the field of landscape study, and to offer some assessment of the contribution that map and field approaches can make to histories of cartography in general, and to histories of the OS in Britain and Ireland in particular. To this end, the discussion that follows considers, firstly, the OS map itself as a ‘landscape of survey’, a record of the activity of the surveyors who created the maps. Following this, and secondly, the paper focuses on three aspects of field-survey which each left a material imprint of the OS surveyors work in the landscape in the nineteenth century: creating baselines, triangulation networks and levelling lines. These surveyor’s ‘signatures’ of the surveyors endure as relict features in the present landscape, and their archaeological study offers a deeper understanding and appreciation of past practices of surveying and of the connections forged between mapping and landscape. This involves a process that begins by ‘excavating’ the OS map.

Excavating the map: towards an ‘ethnography of cartography’

Over the past decade or so the digital revolution has reshaped how maps are used and engaged with, both publicly and professionally. Quite apart from the greater availability and accessibility of both historic and modern large-scale topographic maps through

numerous web-based mapping platforms, it is possible more or less at the touch of a few keys on a computer to compare one map with another, or overlay historic maps onto modern aerial imagery. A significant number of historic OS maps, until recently largely only publically accessible as hard copies in archives and libraries, have been scanned to provide digital raster images and are now freely available through online mapping platforms created by a range of public bodies and organisations across the UK, including the National Library of Scotland (<http://maps.nls.uk/geo/explore/>, accessed 14 June 2017) and the Public Record Office of Northern Ireland (<https://apps.spatialni.gov.uk/EduSocial/PRONIApplication/index.html>, accessed 14 June 2017). Using web-based Geographical Information Systems (GIS), known as ‘distributed GIS’, such platforms not only provides users with access to historic OS maps but enable comparison of historic maps over time, as GIS ‘map layers’.

Metaphorically ‘digging through’ the historic OS map layers within a GIS offers great potential for fieldwork in landscape history and archaeology, in locating lost landscape features for example. By being geo-referenced, mapped features are easily pinpointed and their geographical coordinates identified ready to feed into a mobile Global Navigation Satellite System (GNSS) receiver (Connolly and Lake 2006, 43, 63–4; Historic England 2015, 14–16). This combined use of GIS and GNSS once more connects the historic OS map to the local landscape the map seeks to represent. Moreover, incorporating modern aerial imagery as a further feature layer provides a way of juxtaposing the historic mapping ‘strata’ against the landscape as it is today, taking the surveyor to a particular point in the landscape to examine a site in the field. Applicable to locating and identifying in the field any historic mapped landscape features such as buildings, earthworks or monuments, this process of linking map to landscape is especially useful in ‘excavating’ the map itself and the survey practices that went into creating it. This is because the OS map is a record of its own survey history, revealed in part through annotations placed (usually) on a map’s surrounding border. Such marginalia note the dates of the map’s survey(s) and revisions that went into compiling the sheet, and typically include the date of the first survey and any subsequent resurvey work (Andrews 1976, 327–32); in Ireland, the 1830s First Edition OS six-inch maps, for example, record the name(s) of the surveyor (s) who led the original ground-survey. Each map thus has its own ‘biography’ (Harley 1987) and it is this sheet information that enables map historians to research the evolution and development of individual map series and from these construct detailed ‘cartobibliographies’ of the OS (see Harley 1975; Hodson 1991; Hellyer and Oliver 2009; Oliver 2013; Hellyer and Oliver 2015).

Sites of survey

As well as revealing cartographic histories through their marginalia, surveyors’ inscriptions on OS map sheets also reveal landscape histories, of survey *in the field*. Most obviously, the larger scale OS maps (e.g. 1:10,560, 1:2500, 1:1056, and 1:500) contain symbols drawn by the *cartographer* but which relate specifically to aspects of *survey*, including conventions for trigonometrical stations (Δ) and for benchmarks (\blacktriangledown). These ‘sites of survey’ position the places ‘occupied’ in the field by the map’s surveyors, whose survey practices, of triangulation and levelling, underpinned the map’s claims to cartographic veracity.

In his *Early Years of the Ordnance Survey*, Sir Charles Close—former Director General of the Ordnance Survey – recalled how ‘From trig point to trig point the chain was dragged ...’ (Close 1926, 120), a process not only recorded by the OS surveyors but also one which became translated onto the printed maps that resulted from their field observations. These traces of the surveyors’ work on the ground evident in the finished maps can be used to unearth an ‘ethnography of cartography’ in which the past spatial patterns of surveyors moving in and through the landscape are rendered visible to us. Examples of the early editions of the six-inch surveys of Ireland, printed from the 1830s onwards, reveal lines of benchmarks, or else spot heights, radiating out from triangulation stations, for example, or tracking across the countryside of all kinds of terrain, from enclosed fields of farmland through to open moors and unimproved pasture (Figure 1). Joseph Portlock, who was closely involved in the six-inch survey of Ireland in the 1820s and 1830s, observed:

‘Looking then at the early sheets of the Irish map, the engineer will be struck by the vast amount of data expressed upon them in regard to altitudes, and may also trace, in many cases, the gradual rise of a hill, by following the course of a chain line, and noticing the successive levels marked along it’. (Portlock 1869, 214).

The significance of the mapped trigonometrical points with radiating lines of spot heights is noted by Oliver (2014, 99, 102) as ‘little commented upon’ yet ‘revolutionary’. What these signs of survey on the map extracts also represent, however, are the sites ‘occupied’ in the course of survey work on the ground, where the OS field-surveyors measured heights and distances along ‘chain-lines’.

Retracing these surveyors’ chain-lines in the landscape, following their arduous tramping across fields and fell with heavy survey equipment, and standing where they once set up

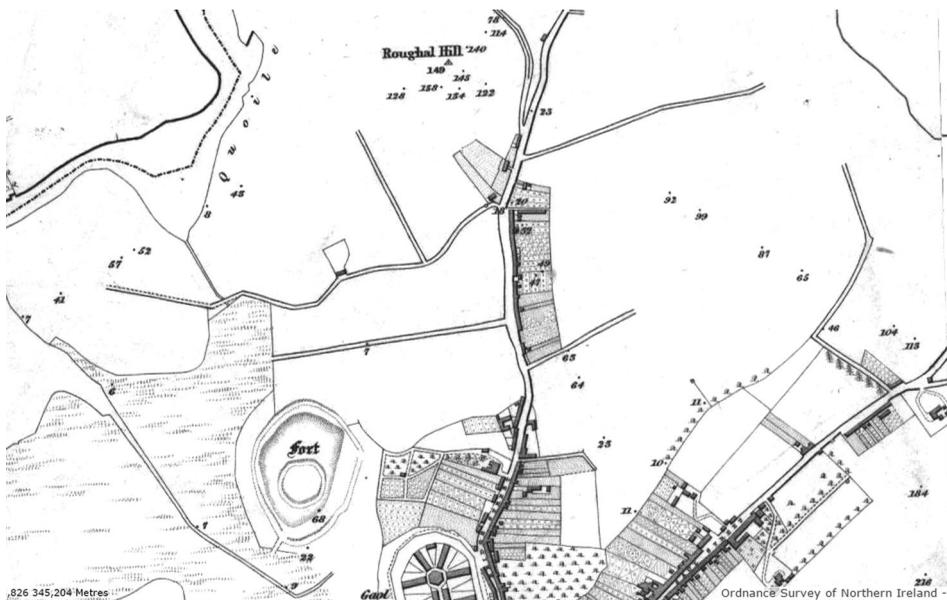


Figure 1. Extract of First Edition Ordnance Survey, six-inches to one-mile scale (1:10,560), County Down sheet 30, showing chain-lines, marked out by spot heights radiating from trigonometrical station at Roughal Hill, Downpatrick (Ireland).

their theodolites, staffs and pickets, is a sure way to begin to appreciate the task the OS surveyors faced in the field. ‘Content field-books’ were compiled at the time by surveyors to document their fieldwork also contain the details of the location of stations, chain-lines and offsets (Ordnance Survey of Ireland 1991, 20–1). Yet the maps themselves were still seen to be appropriate repositories to record ‘sites of survey’ from the field, and from these can be pieced together an ‘ethnography of cartography’. Harley (1987, 19) reflects, for example, on a particular six-inch scale map of Newton Abbot in Devon that is special to him, and considers the many ‘biographies’ connected with the map, including those of the OS surveyors whose work underpinned it. He speculates how

‘they were gazed upon - “foreigners” to a Devonshire mind—as they set up their theodolite at street corners, dragged the chain along pavements and stony lanes, and chiselled Bench Marks for altitudes on the cornerstones of buildings or on limestone walls’.

Harley stands as one of few historians of the OS to connect the map’s survey marks with the surveying practices in the field that they represent. Indeed, such is the long-standing and familiar presence of benchmarks, spot heights and trigonometrical stations on large-scale OS maps that few commentators seem to have questioned *why* they are marked on maps at all.

The principle of marking trigonometrical stations on OS maps is evident on the First Edition six-inch sheets of the Irish survey of the 1830s, and benchmarks first appear on the Second Edition six-inch sheets for Ireland, following the spirit-levelling programme first carried out across the island in the 1850s (Andrews 1976, 109). Elsewhere, trigonometrical stations appear on the OS one-inch scale Old Series maps of England and Wales from 1832 onwards, and lines of heights radiating from trigonometrical stations, following the practice of the Irish six-inch surveys, is evident from 1840 on one-inch maps for East Anglia (Hellyer and Oliver 2015, 59, 96). The presence on published maps of the field sites used as part of the surveyors’ work might also have demonstrated to users that their maps were the result of scientific observations and practices and thus trustworthy. Indeed, with regard to the OS 1830s six-inch survey of Ireland,

‘to give due emphasis to the scientific basis of the work, trigonometrical stations were marked and named, [and] spot heights, in certain cases perhaps rather too many, are strung out along chain lines ...’. (Andrews 1976, 86)

Since the maps were being created using the latest survey instruments and technologies available in the nineteenth century, so the mapped spot heights, trig points and benchmarks helped to reaffirm the scientific basis of the OS map desired by those involved in its production and promotion.

This is pertinent, as the OS lost much of its early record of field-survey of the 1800s–40s during the Second World War when its offices in Southampton were bombed and largely destroyed, a point noted by Harley (1969, viii) in his post-war edition of Close’s (1926) *Early Years of the Ordnance Survey*. This leaves the maps and landscapes as the fullest testimony of the early work of the OS surveyors and their enterprise. In using a GIS, overlaying First Edition six-inch maps onto modern aerial imagery makes clear the courses of the surveyors’ chain-lines as they levelled the land and also the terrain they had to overcome as they traversed between stations with their instruments (Figure 2). The survey sites that shaped the landscape materially more than a century ago thus reveal the processes and

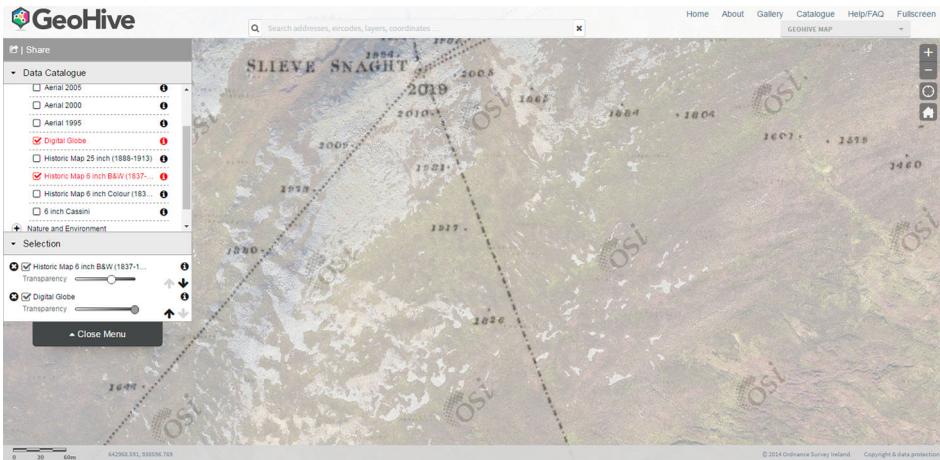


Figure 2. Extract from OSi Geohive map-viewer showing extract of First Edition Ordnance Survey, six-inches to one-mile scale (1:10,560), overlaid onto modern orthophotography, with spot heights radiating from trigonometrical station over the upland terrain of Slieve Snacht, County Donegal (Ireland) (<http://map.geohive.ie/mapviewer.html>, accessed 14 June 2017).

practices of the surveyors themselves. As ‘signatures’ of the OS surveyors in Britain and in Ireland, these landscape legacies are important, for they provide archaeological insights into the survey and field techniques used by the OS, and their material culture. While the maps and written records are recognised as a rich basis for understanding and evaluating those who ‘mapped the nation’, the tangible remains of their past activities remain overlooked by modern scholars, historians and archaeologists alike, and are deserving of more attention, both as ‘survey heritage’ and as an alternative to the archive in forging landscape histories and archaeologies of survey.

Levelling the land: towards an ‘archaeology of survey’

The early work of the OS in Britain and Ireland in the nineteenth century was ‘monumentalised’ in the landscape by the physical sites the surveyors constructed. These sites and monuments relate to the scientific aspects of survey work that went into creating OS maps during the nineteenth century, described by contemporaries in their accounts, by the early Director Generals (DGs) of the OS, such as Major-General Colby (DG from 1820 to 1846), as well as those of the Royal Engineers who worked for them, such as Joseph Portlock and Thomas Drummond (see Portlock 1869; Close 1926). Indeed, such was the recognised significance and novelty of the survey work at the time that detailed scientific treatises and memoirs were compiled and published on various facets of the enterprise, including accounts written of the setting out of baselines for the primary triangulations, the locations of trigonometrical stations (and computations derived from observations made from these), and details of the benchmarks used in the primary levelling of Ireland and Great Britain (e.g. Mudge and Dalby 1799; Mudge 1801, 1804; Mudge and Colby 1811; Yolland 1847; James 1855, 1861). As well as these compendia and written ‘memorials’ to the OS, the same baselines, trigonometrical stations and levelling lines were also intended to stand as enduring *physical* memorials in the landscape. Taken

together, these textual and material records of the OS's fieldwork delineate an 'archaeology of survey', a sphere of enquiry encompassing the physical impacts and imprints of the early OS surveyors that, like their maps, still stand as monuments to the effort they made to newly capture the nation cartographically in ever more geodetically detailed and accurate form.

Baselines and burials

The laying out of baselines, and very accurate and careful measurement between two fixed points in the landscape, was the very foundation of trigonometrical survey, on which the calculations for the whole triangulation network depended. For the early OS, a series of baselines was set out at locations around Britain and in Ireland which were linked to the network of 'primary' trigonometrical stations. In her 'biography' of the OS, *Map of a Nation*, Hewitt (2010, 126) refers to the baseline at Hounslow Heath (Middlesex) as 'the bedrock of the national triangulation that underlay every single Ordnance Survey map', and 'cartographically speaking, the most important spot in the British Isles'.

Now the site of Heathrow Airport and housing estates, the Hounslow baseline had first been measured by General Roy in 1784, but was re-measured during the national triangulation programme begun in Spring 1792 under William Mudge, 'superintendent' of the Ordnance Trigonometrical Survey' (OTS) from 1798 until his death in 1820 (Skelton 1962). This re-measurement of the Hounslow baseline also signalled a deliberate shift to 'monumentalising' the survey process by incorporating in the landscape tangible and enduring markers. Mudge himself acknowledged this at the time. Describing in meticulous detail the process of erecting two new baseline terminal markers, Mudge wrote that 'it became necessary to re-establish them in a more permanent manner'. The earlier 'wooden pipes' set up by Roy had decayed over the intervening seven years and Mudge replaced them with 'heavy iron cannon' set up vertically over where Roy's earlier markers had been (Mudge *et al.* 1795, 437–40). These baseline markers at Hounslow Heath still stand in the landscape today, lasting monuments to Mudge and his men. There are other baseline markers elsewhere, created with a permanence in the landscape and similarly intended by the surveyors of the time to be enduring memorials to their work, including the Lough Foyle baseline on the northern coast of Ireland in County Londonderry.

The Lough Foyle baseline is described in detail by William Yolland (Yolland 1847). He was not one of the surveyors involved in its measurement in 1827–8 but 'an able and popular officer' favoured by Thomas Colby, the successor to Mudge as superintendent of the OTS (Close 1926, 53, 153). The site selected in 1824 by Colby for the baseline for the primary triangulation of Ireland was a low-lying coastal area, similar topographically to the littoral sites chosen previously in England and Wales for similar purposes by Mudge, at Misterton Carr in 1801 and Rhuddlan Marsh in 1806 (Mudge and Dalby 1799, 38; Mudge and Colby 1811, 82). Unlike these other locations, however, Colby's Lough Foyle baseline was to receive a revolutionary new system of measurement, created by Colby himself, and subsequently used in India by George Everest, using metal bars ('compensation bars') instead of the 'Ramsden's chains' earlier employed for baseline measurements in England and Wales (Portlock 1869, 257–81). Colby's 'compensation bars' enabled a much more accurate measure to be made of the baseline begun in 1827 (see Taylor 1962).

As part of the process of measurement on the ground a series of ‘base towers’ were also constructed along the 7.89-mile (12.7 km) baseline alignment. Like Mudge’s cannon at Hounslow Heath, Colby’s towers still stand. Two towers were constructed to mark the ends of the baseline, both marked on the First Edition six-inch scale sheets. The southernmost one at Ballykelly protected by iron railings and a stone wall, (Figure 3) was carefully drawn and measured, and appears as the final engraved plate in Yolland’s (1847) detailed account of the measurement of the baseline. From this contemporary illustration, the tower’s perfectly circular plan-form is clear, with a wall enclosing an earthen mound and a centrally-positioned buried chamber which marked the exact end-point of the baseline (Figure 4).

The precision and exactitude of the technologies used to measure and demarcate the Lough Foyle baseline represented not just a significant shift in the surveyors’ desire for accuracy but also a desire or permanence, to set up a monument that will endure. The size and shape of the base-towers at Lough Foyle bear more than a passing resemblance to prehistoric burial mounds. This was at the time when ‘antiquities’ were gaining their attention as landscape features to be mapped on the six-inch surveys, following an instruction from Colby in May 1826 (see Andrews 1976, 86–7). More generally too, cairns sited on hilltops were repeatedly used for the locations of trigonometrical stations across Britain and Ireland, as described by Henry James, a contemporary of Yolland’s, who recalculated the ‘Principal Triangulation’ of the OS in the 1850s and published descriptions of the stations used, including the Lough Foyle base-towers, stating:

‘These stations are marked by dots made with the point of a needle in platina wires, eighth of an inch in diameter, run with lead into holes 1.5 inch in diameter and 6 inches deep, bored into blocks of Dungiven sandstone, 4 feet square and 20 inches deep. These blocks are laid in cement above other and similar blocks roughly chiselled, and placed on beds of solid masonry. The whole at each station is enclosed in a chamber of masonry 6 feet square, with walls 2 feet thick and 3 feet deep, covered over with a lid of flagstone, with bolts and rings passing through them, by which they may be removed with safety to the dots. On the upper surface of the flags cross lines are drawn, with the crosses vertically over the dots. This masonry is covered over with a tumulus of earth; and a circular wall 2 feet thick, with eight internal buttresses, is built as a base for an iron railing 4.5 feet high, enclosing a space 30 feet in diameter’ (James 1858, 26).

Not only do the precise measurements of the monument itself parallel Colby’s own exactitude of the baseline mensuration in 1827–8, but the very words used, ‘chamber of masonry’ and ‘tumulus of earth’, describe the tower’s construction in ways that ape the terms used for Irish field monuments Colby had instructed upon in 1826. With the Lough Foyle base-towers described analogously to prehistoric burial chambers, and



Figure 3. Lough Foyle baseline, base-tower situated at Ballykelly (County Londonderry). Photo author.

MEASUREMENT OF THE LOUGH FOYLE BASE.

PLAN

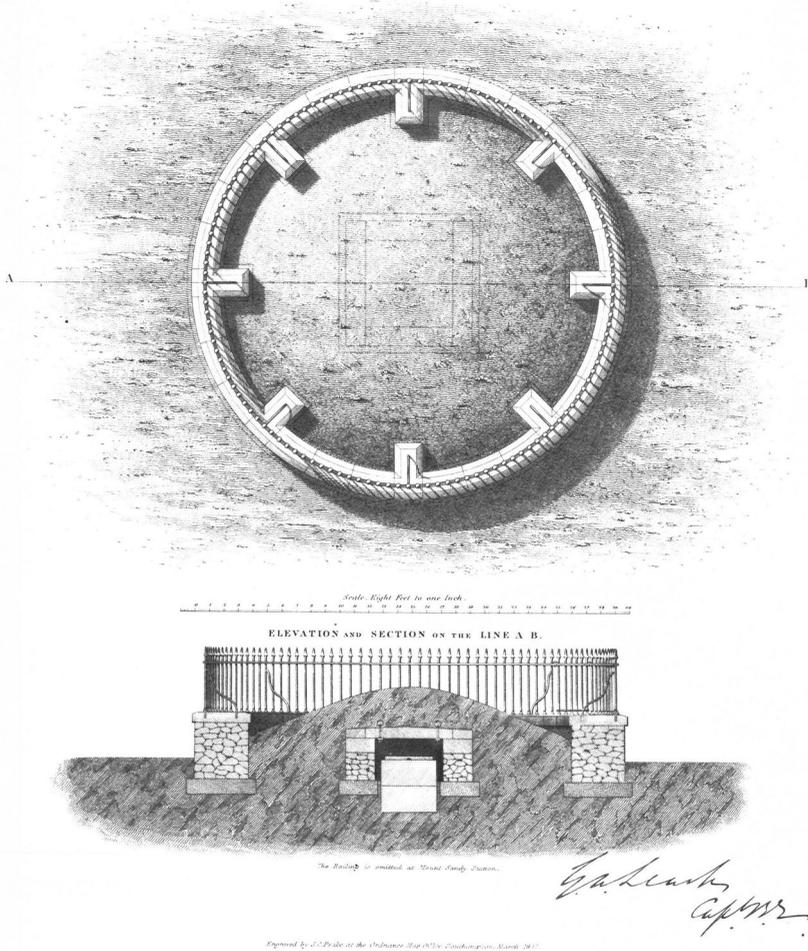


Figure 4. Section and plan of base-tower of Lough Foyle base-line (Plate XIV), reproduced from William Yolland, *An Account of the Measurement of the Lough Foyle Base in Ireland* (1847).

similarly constructed, it seems that there was a subconscious yet conspicuous attempt being made to monumentalise the surveyors' work in the landscape and so create enduring memorials to their triangulation of the island of Ireland.

Cairns and camps

As well as base-towers, so important for calculating and verifying supranational trigonometrical surveys, the 'Principal Triangulation' that underpinned the large-scale mapping of the OS relied on a network of 'stations' which together formed a single trigonometrical framework spatially-binding insular Britain and Ireland, thus spanning these two

neighbouring islands (and their newly ‘united’ nations) and binding them into one unified and unifying overall geodetic ‘web’ (Figure 5). Lower lying lands (e.g. eastern England) required the surveyors to set up their heavy, 200 pound (c. 90 kg), 3-foot (0.92 m) ‘Board of Ordnance’ theodolite on church towers (as at Norwich and Naughton), while further north and west, in more upland parts of England, Scotland, Wales and Ireland, it was higher ground and hill tops which were ‘occupied’ by those involved in undertaking the trigonometrical survey work. These are the ‘stations’ listed by Mudge, for example, in his series of volumes describing the annual progress of ‘the Trigonometrical Survey’ between 1791 and 1809 (for Britain), and summarised later too by James (1858) (for Britain and Ireland).

James’ descriptions of trigonometrical stations (e.g. in Ireland) reveal in some cases the re-use of an existing prehistoric hilltop cairn, as at Vicar’s Carn (the station sited ‘on the summit of a large cairn of small stones known by this name’) (James 1858, 39). Yet, in other cases the description makes clear that a new cairn for the survey had been constructed, as at Sawel in 1827:

‘A centre stone, 3 feet long, 2.75 feet wide, and nearly 1 foot thick, and marked with a hole, rests between the tops of the frameposts, is wedged tightly with stones, and further secured by mortar; on this was erected a staff, and around it a pile of stones and turf 15 feet high and of rather greater diameter, was built’ (James 1858, 34)

and at Slieve Snacht, in County Donegal, where in the same year a new cairn was constructed

‘... on the highest part of the mountain at the east end, is marked by a stone about 2 feet square, having a hole 2 inches deep drilled in its centre, with a pile of stone, 14 feet high and 50 feet in circumference at base, erected over it’) (James, 1858, 36).

In these examples the survey work undertaken in the field involved not just measurement and observations between stations, often under arduous conditions (e.g. as vividly described by Portlock (1869)), but also on-site engineering and construction work, creating the new survey stations substantially, by building them out of stone and wood in order to secure the theodolite and create a permanent landscape feature in the same form as the hilltop cairns built by the ancients.

The monumental scale of some of these hilltop trigonometrical stations remains evident in the field today, as at Slieve Snacht, as well as in Scotland at Creach Bheinn in Argyllshire. The latter formed part of a chain of trigonometrical stations positioned along the western fringes of Scotland (Walker 2013), from which observations were made in the 1820s under Colby to corresponding hilltop stations in the north and east of Ireland (Portlock 1869, 154). In the case of Creach Bheinn, not only was a station constructed on the summit but also a ‘camp’, one of a number in Scotland that have gained the sobriquet ‘Colby’s camps’, though by no means all were built under his auspices (Thorner and Oliver 2011). Located at around 850 m elevation on Creach Bheinn in a ‘shallow saddle’ just below the station, the features of the survey camp are themselves built on a monumental scale, particularly ‘a large windbreak wall about 2.5 m high protecting the west side of the camp’, together with ‘a small dry-stone structure around 3.5 m square’, which ‘served the joint functions of guard and cook-house’, and ‘four low stone circles representing the footings for tents’, now scheduled as a monument of national



Figure 5. 'Diagram shewing the principal triangulation for the Ordnance Trigonometrical Survey of Great Britain and Ireland', Henry James, *Ordnance Trigonometrical Survey of Great Britain and Ireland* (1858, volume 2).

importance by Historic Scotland (<https://canmore.org.uk/site/23114/creach-bheinn>, accessed 14 June 2017). (Figure 6a and b). A contemporary illustration of the camp at Creach Bheinn (Figure 7), printed in the *Aide Memoire to the Military Sciences*



Figure 6. (a) The survey camp at Creach Bheinn (Argyllshire, Scotland) in topographic context (photograph from Canmore/Historic Environment Scotland (<https://canmore.org.uk/site/23114/creach-bheinn>, accessed 14 June 2017) (b) Stone-built structures at Creach Bheinn survey camp (Argyllshire, Scotland), (Photo. Tony Kinghorn).

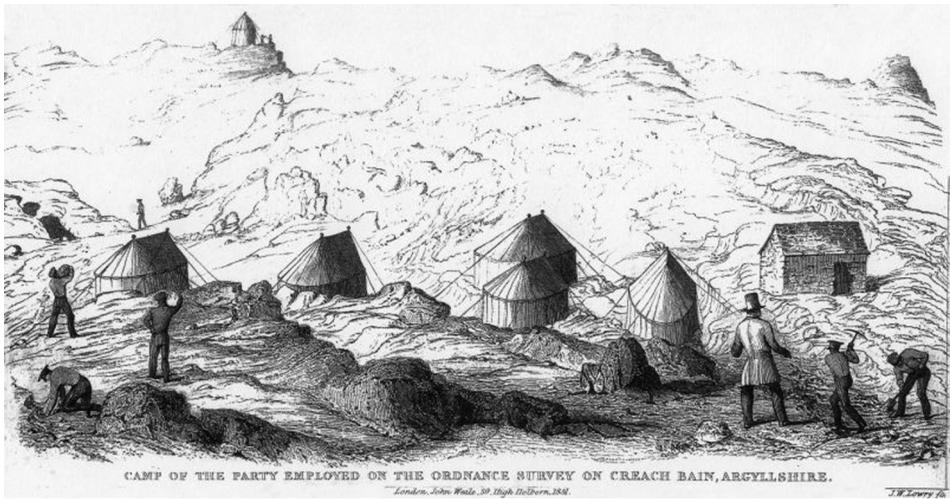


Figure 7. ‘Camp of the party employed on the Ordnance Survey on Creach Bain, Argyllshire’, engraving in James Weale, *Aide Memoire to the Military Sciences*, volume III (second edition, London, 1862), 615.

(Weale 1862), reveals not only the contemporary occupation of the station and camp by the survey team, but signals, too, the wider significance of the work of the OS in British military training around the time that the primary trigonometrical stations were being resurveyed and recalculated, as described by James (1858).

While the OS camp at Creach Bheinn has statutory protection, comparable survey camps and stations located elsewhere await closer study and identification. Overlaying of historic OS large-scale maps with modern aerial imagery offers a means of reconnaissance to locate such sites, as with Slieve Snacht in County Donegal, where the large stone cairn on the summit, described by James (1858, 36), appears to be accompanied (like Creach Bheinn) by a range of stone-built structures, of similar forms and scale (Figure 8). Most probably, these structures on the summit of Slieve Snacht represent the remains of the survey camp occupied in 1825 by Thomas Drummond as part of the initial triangulation of Ireland under Colby. Indeed, letters sent at the time from Drummond to Colby refer to a camp situated on the summit. On 28 October 1825, for example, Colby was informed, in somewhat heroic terms by Drummond, that ‘The tent is now up and in a few minutes the wall round it will be completed, so that we may consider ourselves safe against any storm ...’. Two weeks later, 12 November 1825, Drummond again communicated to Colby from Slieve Snacht, reporting

‘Of the termination of our labours the letters from Divis [a station near Belfast] will already have apprised you ... At the last we had nothing remaining but the lamp tent and the walls of the cooking house. I believe that we should have been compelled to abandon the hill but for the efforts of the men ...’ (in Close 1926, 75).

The letters thus identify particular structures which, judging from the archaeological remains visible on Slieve Snacht, compare with the forms of camp structures identified at Creach Bheinn. That both hilltop trigonometrical stations have similar stone-built structures and features is surely significant and suggests that ‘Colby’s camps’ await archaeological discovery and evaluation beyond Scotland.

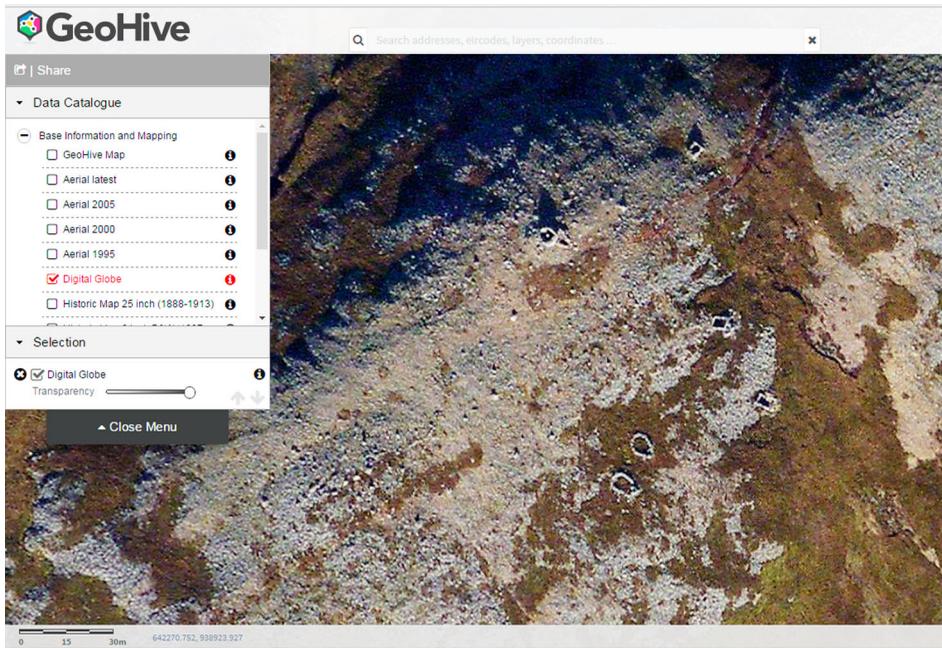


Figure 8. Circular- and square-shaped stone-built structures, including cairn of trigonometrical station, situated on the summit of Slieve Snacht (County Donegal), orthophotography from OSi Geohive map-viewer (<http://map.geohive.ie/mapviewer.html>, accessed 14 June 2017).

The cairns and camps of the trigonometrical surveys of Britain and Ireland are thus not simply tangible legacies of a great and ambitious mapping and survey project, but offer potential for developing an archaeological perspective on the work of the OS. A few trigonometric survey sites have been archaeologically surveyed, but the visible remains at Slieve Snacht and Creach Bheinn highlight the need for more detailed field-survey of surviving structures and features, and comparative study of OS archaeology, to record standing remains and analyse fabric and form to identify common construction methods and techniques used by the military-trained engineers and surveyors who built them. Considering their links with the British military, these survey sites and monuments would repay comparative study within the context of battlefield and conflict archaeology, for example, and the impacts military training provision had on rural landscapes through the construction of training camps and practice grounds in the nineteenth and twentieth centuries (e.g. see Pollard and Banks 2006; Saunders 2012).

Lines and landscapes

Supplementing the trigonometrical networks that underpinned the mapping of Britain and Ireland in the nineteenth century was an equally significant network of levelling lines through the nation's landscape. The use of accurate spirit-levels in survey work was first undertaken nationwide in a systematic programme begun during the 1830s and 1840s and the initial levelling was completed by 1860 (Owen and Pilbeam 1992, 42–4). 'Principal' levelling lines criss-crossing the land were tabulated at the time in volumes that include

details of the locations of the benchmarks that surveyors had inscribed on buildings and other immovable structures such as bridges, gateposts, and walls, as well as the heights and distances observed on the ground through the levelling work itself. The sheer scale of this enterprise is brought home by the compendious ‘abstracts’ of levelling lines published for both Ireland and Britain (James 1855, 1861), and also by the distances traversed by the levellers, some 2000 miles (3,219km) in Ireland and 10,000 miles (16,093 km) in Great Britain, mainly using the national road network (Owen and Pilbeam 1992, 42–3).

Though perhaps less conspicuous in the landscape compared with trigonometrical survey, the levelling surveyors literally left their mark on the surveyed landscape through the benchmarks they inscribed along the routes they took. The OS benchmark is perhaps so ubiquitous and so familiar its archaeology is hardly recognised, yet it is perhaps the most widespread vestige of the work of the OS of the nineteenth century. It is a trace instantly recognisable in the field by the ‘crows foot’ – the same arrow symbol long-used on OS maps for benchmarks – and which through the subsequent levelling work of the OS, into the twentieth century, means that there is hardly a street or road anywhere in the country that is without one. An indication of this prevalence of benchmarks and their intensity is revealed in Figure 9, an extract of the OS six-inch scale map of 1897 for central Edinburgh which shows eight benchmarks all located within a c. 250 m radius of Lawnmarket and the castle gates. This example is by no means unique, and yet the ubiquity of the OS benchmark should not be taken as an indication of either their uniformity or their insignificance. Careful recording and study of OS benchmarks is instructive about the types of locations and structures chosen by the surveyors in their levelling work, and their perceived permanence, while variations in type and form of the marks themselves are indicative of the practices employed by the survey parties engaged in the levelling work. From examining benchmarks in the field, including those from the initial levelling

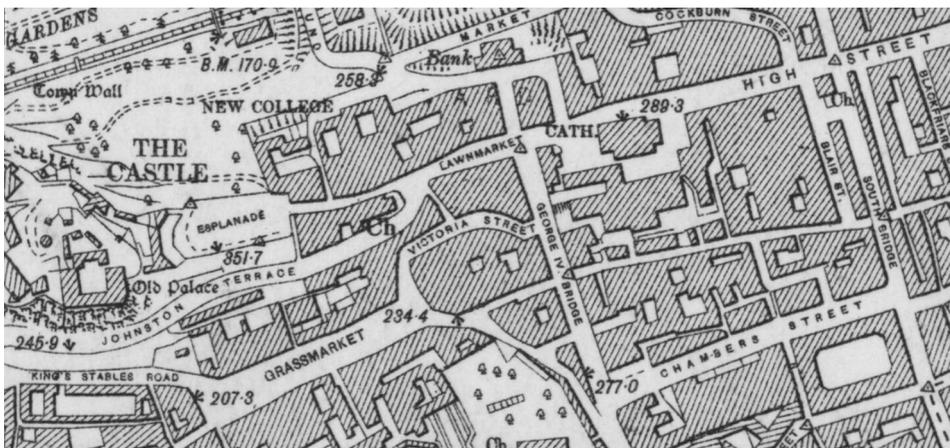


Figure 9. Prevalence of Ordnance Survey (OS) benchmarks shown on map by \uparrow symbol, with heights given in feet, in Edinburgh’s Old Town, as shown on OS 6” to one mile (1:10,560) scale sheet (Edinburghshire Sheet III.NE), published 1897 (revised 1894). The map also shows trigonometrical survey stations (\triangle) within the streets, used by the OS for tertiary triangulation. Map image © National Library of Scotland (<http://maps.nls.uk/view/75512876>).

work of the 1830s–60s, wide variations become apparent, as the four examples illustrated in [Figure 10](#) reveal. Such variations in the size and style of OS cut marks suggests survey teams left their mark in more individual ways than might be expected of a nationally-organised survey operation, a proposition that would benefit from a wider systematic study of the geographical and temporal patterns of OS levelling marks across Britain and Ireland.

With these baselines and burials, cairns and camps, and lines and landscapes of the surveyors of the OS of the nineteenth century, an ‘archaeology of survey’ begins to take shape, a basis for further study certainly, and perhaps an aspect of the OS’s influence on Britain and Ireland that has a contribution to make to the otherwise well-studied landscape



Figure 10. Examples of Ordnance Survey benchmark types: a) (top left) a bolt, with much damaged cut-mark, on gate-pillar of Bristol Temple Meads railway station; b) (top-right) a cut-mark on the East Gate at Chester, with bolt offset from horizontal level line of benchmark; c) (bottom-left) a rivet placed on stone sill above cut-mark at Leeds Cathedral; c) (bottom-right) cut-mark with no bolt, at base of bridge parapet at Mapleton (Derbyshire). All photographs taken 2016–17 by author. The examples from Bristol and Chester, are listed in James 1861, and related to the First Primary Levelling of England and Wales (1840–60). The Leeds and Mapleton examples are from later levelling operations, indicating that while benchmarks (including those without bolts) were set into vertical faces of building façades (most commonly), some, with ‘rivets’, also utilised horizontal surfaces.

histories and archaeologies of these islands. What is clear is how the early survey work of the OS was monumentalised in the landscape in ways that had not occurred before. Previously, before the founding of the ‘Trigonometrical Survey of the Board of Ordnance’ in 1792, the principal lasting legacies of surveyors of earlier centuries were the maps they had made, rather than the surveying framework manifested in monuments in the landscapes they had mapped. Unless surveyors and cartographers were directly involved in creating maps and plans in order to reshape a landscape, through engineering or construction projects, such as canal building, town planning, or landscaping estates, for example (see Delano Smith and Kain 1999, 112–41, 194–214), their material trace in the landscape was rather slight. The national survey and mapping work in the later eighteenth and nineteenth centuries, under the auspices of the nascent OS, was monumental therefore not just in its ambition and in its achievements but also in its impacts on the landscapes that were being brought under its (masculine) surveyors’ gaze, a ‘scopic regime’ of survey and surveillance that ultimately favoured the intents and aspirations of the expanding British state at a time when the 1801 Act of Union that politically unified Great Britain and Ireland was still within living memory (see Ó Cadhla 2007, 73–97).

Curiously, the OS’s cultural impact on the nineteenth century political ‘landscape’ has received rather more critical study, especially in Ireland (e.g. Doherty 2004), than its material and physical impact on these islands’ ‘cultural landscapes’ and their ‘archaeologies’ of survey practices. The material shaping of landscapes is a potent means of instilling cultural and political control over land and people (e.g. Bender 1993), and there is evidently an intellectual premise for searching out and surveying more carefully and systematically these past monuments and memorials to the OS. The call to evaluate ‘landscapes of survey’ is made not just because they have been overlooked by many archaeologists and historians, but because they represent the spatial means by which the nation was shaped and mapped nationally by the state. Not only are *maps* political instruments of governmentality and surveillance (Pickles 2004), but so too are the *landscapes* that were materially shaped by the survey work underpinning nineteenth (and twentieth century) supranational mapping programmes. Imprinted onto the surveyed landscape of Britain and Ireland, the monuments and memorials to the OS represent a visible sign, an imprimatur, of the panoptic process of ‘mapping the nation’, a tangible and constant reminder of the OS maps’ otherwise hidden geodetic underpinnings of the trigonometrical and levelling survey work undertaken *in the field*.

Surveying heritage – valuing ‘landscape legacies’ of the Ordnance Survey

Uncovering ‘archaeologies of survey’ is more than simply an academic exercise, of fieldwork and map analysis. If the work of the OS in mapping and shaping Britain and Ireland is of national and international significance, as many would argue, its ‘landscape legacies’ ought, to be given more recognition as well. Yet few sites and monuments connected with the OS’s early fieldwork have gained statutory protection. Rare exceptions aside, such as Colby’s Ballykelly base-tower, the survey camp at Creach Bheinn and Mudge’s Hounslow Heath baseline markers, OS ‘survey heritage’ remains generally unprotected and somewhat neglected.

The loss of such sites is already occurring, as is evident with the northernmost base-tower of the Lough Foyle baseline, the Mount Sandy base-tower, which has succumbed

to the Atlantic Ocean due to coastal erosion and is now destroyed. In other cases, particularly for the seemingly numerous benchmarks, redevelopment and rebuilding pose most risk, as well as erosion of the façades onto which the benchmarks were carved, something evident in the photograph in [Figure 10](#) of the cut-mark at Bristol Temple Meads railway station, the surface of the stonework having worn away leaving just the bolt protruding. While any individual losses, as with the Mount Sandy base-tower, may not seem too important it is their collective ‘group value’ of that gives such survey sites their cultural and historical significance. As this OS survey heritage gradually disappears from the landscape so too does the possibility of using it as evidence for yielding a deeper understanding of the influences the OS had in shaping landscapes across Britain and Ireland. The virtual omnipresence of OS benchmarks, and their familiarity in the landscape, further compounds an apparent lack of urgency concerning the survival of these ephemeral yet historically significant ‘signatures’ of OS surveyors, diminishing recognition of their heritage value as landscape legacies of the OS. For the upland, hilltop trigonometrical stations, their relative remoteness from development might assist in their survival, yet of course by their very nature the sites are exposed to the vicissitudes of weather extremes, and through rain and cold the impacts of erosion will take their toll. All of which surely points to a need and necessity in surveying ‘survey heritage’, sooner rather than later.

It is not that the field sites and monuments of the OS are completely ignored and overlooked, of course. There are numerous individuals across Britain and Ireland who spend their leisure time seeking out and recording OS benchmarks, for example, and adding their findings into online inventories created by likeminded enthusiasts (see <http://www.bench-marks.org.uk/>; <http://trigpointing.uk/> and <http://www.trigpointing-ireland.org.uk/>). However, the level of interest shown in the OS trig points built for the later *re-triangulation* of Britain and Ireland is not matched by a similar concern for the *earlier* OS survey sites, which are somewhat more challenging to identify and record. Many of the later concrete pillars were constructed on top of the earlier trigonometrical stations and in the process of re-triangulation the 1930s OS teams excavated the former nineteenth-century sites and located the original survey markers of their predecessors (Davies 2012, 59, 100). The OS, thus, in a sense, destroying their own ‘survey heritage’ in the pursuit of trigonometrical progress. However, a century before, the monumentalising of the OS in the nineteenth-century landscape had instead reflected the organisation’s recognition of the monumental importance of their work in mapping the nation.

With the combined use of digital survey technologies and online mapping, including readily available historic large-scale OS maps with survey sites and monuments identified on the sheets, the landscape legacies of the OS in Britain and Ireland are now more accessible and recoverable than ever before. Moreover, the bicentenary of the OS’s trigonometrical survey of Ireland is approaching; likewise, the start of levelling in England and Wales will soon to see its 200th anniversary, so there is also timeliness in recognising and valuing the OS’s ‘heritage’ in the cultural landscape. These ‘landscapes of survey’ are revealed by combining both maps and fieldwork, relating the sites of survey shown by the large-scale OS map to their locations in the landscape. From them a greater appreciation thus emerges of the material culture of the OS, hitherto overlooked yet complementing archival and historical accounts of the OS’s development and those many OS maps that were made and remade. From the new interpretations presented here, surveying this past ‘survey heritage’ has raised greater awareness of the value of these sites and monuments in the

landscape that formed a critical part of mapping the nation 200 years ago. In sum, these *landscape legacies* of the OS reveal new insights into the processes and practices of the OS surveyors as they traversed the landscapes of Britain and Ireland.

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No potential conflict of interest was reported by the author.

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