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An Ordnance Survey problem which was of continuing interest to the late Brian Adams and which he was only partly able to elucidate was the geodetic basis of the one-inch (1:63,360) Old Series. His most important published work on the subject, ‘Parallel to the Meridian of Butterton Hill – do I laugh or cry?’, was written in 1993, and provided a plausible ‘solution’ for the earlier sheets to be published, up to 1824-5.1 However, it certainly did not report all his thoughts and discoveries, and the writing of the present essay is partly prompted by the discovery in his papers of an unpublished note, ‘Delamere update’, dated 31 August 1993.2 A secondary reason is the desirability of exploring some less-known aspects of Old Series sheet lines in advance of writing about the ‘lost’ survey of south-west Scotland of 1819-28.

A caution must be voiced at the outset. Much of this article is conjecture, and sometimes conjecture built upon conjecture; it is often not as empirically based as was Brian Adams’s work and, whilst it seeks both to explore areas which he did not write about, and to exploit a discovery of his which has not been published explicitly hitherto, readers must not expect work of his thoroughness and quality. I am a historian; I am not mathematician.3 Indeed, I hope that apparent imperfections and improbabilities will inspire some mathematically-minded reader to take up where Brian Adams left off.

What is known about the construction of the Old Series

In summary: no-one has ever doubted that published Old Series sheets 91-110 were laid out on the origin of Delamere in Cheshire (latitude 53° 13’ 17"274 N, longitude 2° 41’ 03"562 W), but the origins (no-one has ever suggested that there was just the one) of sheets 1-90 are more problematic. Brian’s findings in his ‘Butterton’ article were that: sheets 1-9, 47-52, 64-70 and 83-86 were constructed on the Greenwich meridian (0°), sheets 20-33 were laid out on the meridian of 3° west, sheet 10 was on that of 1° east, the eastern sheet lines of the vertical column of sheets from 11 to 87 were related to 0°, and the western sheet lines of sheets 17-19 were related to 3° west. The remaining sheets were more complicated, with the possibility of further origins being used, and no ‘answer’ was offered. Whereas the two groups using 0° and 3° west have sheet lines which consistently form right-angles at the corners, this is not always so for some of the other sheets. (The basic layout of the Old Series sheets as first published are shown in Figure 1.)

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1 Brian Adams, ‘Parallel to the Meridian of Butterton Hill – do I laugh or cry?’, Sheetlines 38 (1994), 15-19; reprinted in Brian Adams, Projections and origins London: Charles Close Society, 2006, 48-42. I use the date ‘1824-5’ advisedly as, though ‘Part X’ of the Old Series, the eight sheets covering Lincolnshire, is dated March 1824, the maps were only ready for sale about a year later: see Introductory essay by J B Harley in Harry Margary, The Old Series Ordnance Survey maps of England and Wales, Volume 5, Lympne: Harry Margary, 1987, xxvi-xxvii.

2 ‘B.W.A.’, ‘Delamere update’, unpublished typescript, 31 August 1993, prepared for Yolande Hodson: copy in Charles Close Society archive at Cambridge University Library (330/1/1) [i.e. box 330, piece 1/1]; photocopy in writer’s possession.

3 Mathematics: CSE grade 1 and ‘O’-level grade 5 [the latter with the assistance of the formula for quadratic equations written on my shirt cuff], 1971; History: ‘A’-level grade B, 1973, B.A.Hons. II.i 1981 and D.Phil., 1986, both at University of Sussex.
What Brian did not discuss, and of which there seems to be no record of his investigating, was the dimensions of Old Series sheets. Whilst those in the three central columns were obviously somewhat irregular, being squeezed between the ‘0°’ and ‘3°’ groups, those in the two flanking groups might be expected to be of a standard size. But what? The question of sheet sizes turns out to be closely related to the adoption of the meridian of Delamere for the Old Series.
Sheet lines and sheet sizes
A simplistic solution to a complicated problem

I now move to an apparent digression. Thanks to a visit to another Brian, the late J B Harley, in November 1983, I became interested in the episode of the survey at the two-inch (1:31,680) scale of some 930 square miles (about 2400 square kilometres) of south-west Scotland made between 1819 and 1828. The unpublished drawings resulting from the work were destroyed in 1940, and references in print to this episode are few, though it gets half a page in ‘Seymour’.\(^4\) A chance reference to engraving in the surviving correspondence made me wonder what sheet lines might have been used.\(^5\) One possibility was a separate set of sheet lines for Scotland, as indeed happened when work on the published one-inch of Scotland began in the 1850s; another was the extension northwards of the sheet lines for Old Series sheets 1-90. Indeed, it may be significant that an advertisement of 1820 refers to newly published sheets of Pembrokeshire and Kent as part of ‘the General Survey of Great Britain’.\(^6\) The earliest known index showing sheets 91-110 as we know them can be dated to the turn of 1839-40, and it was possible at this time that a ‘new start’ was made for sheet size and meridian, as north of the row of sheets 85-90, the top of which lay on a line passing a little to the north of Preston and Hull, there was no constraint from what had been published already.\(^7\) As will be seen later in this essay, the ‘new start’ was only part of the explanation. If independent sheet lines were contemplated for Scotland then there was no possibility of recovering them, short of discovering a ‘missing’ document, of a sort which any realistic historian knows hardly ever does turn up: none has and, as will be apparent later, it is unlikely that one could. However, if it had been intended to continue the mixed-meridians layout of Old Series sheets 1-90 north of the Preston-Hull line, then it ought to be possible to deduce the sheet line layout approximately by extrapolation, at any rate for the area of interest in south-west Scotland, provided that the sizes of the individual sheets in the group 1-90 could be ascertained.

\(^4\) W A Seymour (ed.), A history of the Ordnance Survey, Folkestone: Dawson, 1980, 103: this section was written by E J S Parsons. The reference to the destruction of the drawings in 1940 is in a handwritten annotation to a list of Ordnance Surveyors Drawings dateable to c.1857 in The National Archives [TNA], Public Record Office [PRO] OS 3/28.

\(^5\) Hobbs to Colby, 20 February 1821, in OS letter-book, TNA PRO OS 3/260. [I became interested, if not obsessed, with sheet lines after realising in 1977 that the one-inch Fifth Edition had two layouts, the second of which never appeared on a map-cover index (and, indeed, as I found out later, in very few other places).]


\(^7\) This is a portrait-shaped index, and earlier states attribute the engraving to J A Harrison. The earliest known copy is in TNA PRO WO 55/961, and accompanies a report from Colby to Inspector-General of Fortifications [IGF] of 28 February 1840. It lacks quarter-sheet lines, which have been added to a copy accompanying Colby to IGF, 18 March 1840, also in WO 55/961. The lack of quarter-sheet lines could be taken as indicating that engraving was only begun during February: it could equally mean that obsolescent stock was being used. Even if the engraving of this particular index was only started early in February 1840, its real significance is in its recording the decision to adopt the familiar layout of sheets 91-110 in northern England, which must have been taken in principle some months earlier, in order to enable the necessary calculations of sheet positions to be made. Two other early copies are in TNA PRO T1/4060, one signed by Colby on 11 July 1840 [in paper 16925], the other accompanying a copy of Colby to IGF, 5 December 1840 [in paper 28200]. The predecessor of this was a landscape-shaded index showing sheets 1-90, with an extrusion covering much of the rest of mainland Lancashire and Yorkshire; the earliest known copies (in TNA PRO MPH 1/43) are dateable to the turn of 1833-4, and originally accompanied Colby’s ‘Precis’ of January 1834 (in TNA PRO WO 44/614). The treatment of the ‘stars’ indicating progress with publication in the flanking lists of sheets suggest that this index was originally prepared early in 1833; one copy (map ‘G’) indicates 56 as still in preparation, and the stars indicating 45 and 73 to be published look like emendations. This index is characterised by showing sheet 68 as still a conventionally-sized ‘0’ sheet divided into four quarters, and sheet 58 as containing a single, ‘south-east’, quarter-sheet: does this latter indicate an intention that was never realised?
It might be thought that it would be easy to measure the sizes of each of sheets 1 to 90 from paper copies with a ruler: in practice this is fraught with difficulty, not least because the originals were printed on a copper-plate press and have undergone paper shrinkage, which differs on every sheet between the horizontal and the vertical and between each individual impression struck off. In the 1850s and early 1860s nearly all the sheets had latitude and longitude values added in their margins, but my mathematics were not equal to the necessary computations. So I devised a method which depended on obtaining sheet-corner positions on the (Transverse Mercator) National Grid. The method was:

1. Identify a feature – usually a parish church – close to each corner of each sheet (including the quarter-sheets) which appeared on both the Old Series and on modern one-inch mapping with the National Grid, and obtain its reference correct to 100 metres.

2. Measure on the Old Series the horizontal and vertical distance of the feature from the sheet corner, and thus obtain a National Grid reference, correct to 100 metres.

3. Tabulate the National Grid references thus obtained for each sheet corner. (In practice the values obtained were never the same for each of the four corners represented in the meeting-point of four butt-jointed sheets, and so a ‘mean’ reference was obtained for each such meeting-point.)

4. Using the National Grid references for sheet corners, and the ‘Pythagoras’ principle, calculate the distance between sheet corners and, by converting from metric to imperial dimensions, sheet sizes.

It will be apparent that, though in theory there are about 360 sheet corners (including the quarter-sheets) for Old Series sheets 1-90, this procedure cannot be used for those sheet corners which fall in the sea.

An alternative method is to trace off detail from the Old Series and fit it to one-inch Seventh Series mapping, but this has two disadvantages: first, it is much slower and second, because of the paper-shrinkage and the ‘shakiness’ of some of the topographic detail of the Old Series, the resulting ‘fit’ is often not very good.

My improvised method produced both an indication of where sheet lines extrapolated from Old Series 1-90 might fall in southern Scotland, and some dimensional information for these maps, a fragment of which found its way into one of the introductory essays for the Harry Margary facsimile. And there things rested for some twenty years.

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8 It is important to realise that at this time (winter 1983-4) I was unaware of Brian Adams’s interest, and I think that the first dealings which I had with him were in 1987, by which time I had ‘moved on’ from the Old Series sheet lines investigation; it is only his passing that prompts revival of this no doubt ramshackle method to address an important problem.

9 My thinking was that churches were more likely than other features to have been used as triangulation points, and therefore to have been surveyed in carefully. At that time no field materials relating to the Old Series were known to survive, but recently the British Library has acquired a field-book used by Edmund Crocker in 1812-13 [BLML Maps C.44.B.41], relating to the survey of country to the north of the later A4 between Chippenham and Bath, in which churches are not fixed very precisely in the course of road-traversing, though admittedly the distance of most of the churches from the roads traversed would seem to limit the scope for plottable error. However, this is a point which needs to be investigated further. [The Charles Close Society is indebted to Peter Barber for drawing attention to this most important document.]

10 Chris Higley, commenting on this procedure, points out (pers. comm.), that apart from any difficulty arising from the church or other selected feature not being mapped in its correct position, the use of six-figure grid references will lead to an error of up to 100 metres, or about 0.06 mile. If (as was my procedure) measurements on the Old Series are made parallel to the sheet lines rather than to the National Grid, a further error is introduced, of up to about 0.04 miles. ‘My summary is that it is reasonable to use your method to estimate a sheet size as, say, 23.3 miles (but not to guarantee the last digit). It would be brave to estimate it as 23.27 miles, and downright foolhardy to quote 23.265 miles!’

11 Introductory essay by J B Harley in Harry Margary, The Old Series Ordnance Survey maps of England and Wales, Volume 5, Lympne: Harry Margary, 1987, viii and xxx, n.4. [The use of the National Grid to give an average size for
North of the Preston-Hull line before 1839

**MPHH 1/239: the Ordnance Survey’s most inaccurate ‘map’?**

In March 1993 I learned in conversation with Brian Adams of the existence of a contemporary manuscript diagram which extended northwards into southern Scotland the multi-meridian sheet-line layout for Old Series sheets 1-90, characterised by the tapering of the three central columns. The location of this sensational ‘find’ was hardly obscure: the Board of Ordnance records in the Public Record Office, that ‘happy hunting ground’ of both of us. Somehow I had overlooked MPHH 1/239 when searching the catalogues for my doctoral thesis of 1982-5. Its primary function was to indicate the state of progress of Old Series survey and revision to February 1831.12

MPHH 1/239 is not easy to reproduce, and so Figure 2 is a transcript of some features of particular interest for this present essay: the sheet lines, the neat line, and the coasts, including fragments of those of Ireland and France. The original also gives the names of some towns and shows county boundaries up to just north of the Preston-Hull line.13 No sheet numbers are given on the original. Until a late stage in the writing of this essay those of us who knew about MPHH 1/239 assumed that it was unique in its content. However, a chance re-examination of two copies of ‘Plan of the principal triangles in England & Wales and part of Scotland’ (originally Plate I in volume III of the published account of the triangulation, issued in 1811), which originally accompanied Thomas Colby’s ‘Precis relating to the Survey of England and Wales’ [sic] of January 1834, showed that both had had sheet lines engraved on them very faintly, over the whole plate.14 The engraving is so faint that it looks at first like pencil work which has either faded badly or been partially erased, but on closer inspection the lines, and dots at some sheet corners, are found to be common to both copies, and to be the same sheet line scheme as is shown in MPHH 1/239.15 It would seem that at some time after 1811 it was intended to add the sheet lines of the Old Series to the plate, but this did not proceed beyond very lightly scoring the lines in preparation for being fully engraved. The scale of the ‘Plan of the principal triangles...’ is one inch to thirty miles

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12 The conversation was probably at the ‘Maps and society’ seminar at the Warburg Institute in London on 25 March 1993. A letter from Brian to me of 29 March 1993 refers to MPHH 1/239 ‘as it was originally reported to me, I think by Roger [Hellyer] from Yo [Hodson]’. A solitary reference to MPHH 1/239 in Brian Harley’s notes on the survey of south-west Scotland of 1819-28, to which I had access in 1983, suggests that he had at least noted it for investigation but, having been able to handle a considerable number of his working papers on Ordnance Survey matters prior to his moving to the United States in 1986, I know of no indication that he actually saw it. Given his thoroughness in collecting photocopies of OS-related material in TNA PRO classes WO 47 and WO 55 one might have expected him either to have acquired a photocopy or to make a note. The diagram was signed by Captain Richard Mudge on 23 February 1831, and was evidently for the information of the Board of Ordnance rather than internal to the survey organisation at the tower (in which case one would expect it to survive, if at all, in a TNA PRO ‘OS’ class).

13 The resemblance in this regard to the index engraved about 1833 and represented by maps A to I in TNA PRO MPH 1/43 is very marked, though considerably fewer towns are indicated on MPHH 1/239.14 I did examine MPH 1/43 when researching my thesis, but neither then nor on re-examination in early October 2006 did I notice the faintly-engraved sheet lines: they only ‘appeared’ a fortnight later.

14 TNA PRO MPH 1/43, maps ‘K’ and ‘L’. The map in its original state is Plate I in William Mudge and Thomas Colby, *An account of the operations... for... a trigonometrical survey of England and Wales...*, Vol. III, London: Faden, 1811, and is reproduced at a reduced scale in Harry Margary, *The Old Series Ordnance Survey*, Volume I, Lympne: Harry Margary, 1975. The engraving of the sheet lines on the two copies in MPH 1/43 is so faint as to present a considerable challenge even to digital photography.
Figure 2. Transcription of the sheet lines for the one-inch Old Series and the coast line shown on an untitled map of 1831 in TNA PRO MPH 1/239. A similar scheme in faintly engraved form can be found on two copies of ‘Plan of the principal triangles in England & Wales and part of Scotland’ in TNA PRO MPH 1/43.
(1:1,908,000) and that of MPHH 1/239 is (by comparative measurement) one inch to fifteen miles (1:950,400). Two possibilities for producing MPHH 1/239 are either, first, enlarging sheet lines and coast from a copy of the ‘Plan of the principal triangles…’ or, second, that both ‘Plan of the principal triangles…’ and MPHH 1/239 derive from a common original, now lost, which showed the coastline, the county boundaries, some towns, the triangulation stations and the sheet lines: I favour the second possibility. As in 1834 a commercial map was used to illustrate the primary triangulation of Scotland in Colby’s ‘Precis’ \(\textit{sic}\), it is possible that the ‘lost’ map containing both sheet lines and triangulation was a similarly annotated commercial map of England and Wales, which has yet to be identified.\(^\text{16}\)

Perhaps Brian Adams did not know of MPHH 1/239 in 1990, when he wrote about ‘Ordnance Survey’s most inaccurate maps’, as it is a strong contender for the dubious accolade.\(^\text{17}\) He did refer to it in his introduction to Roger Hellyer’s monograph on the OS ten-mile maps, but did not mention the extent of the sheet lines.\(^\text{18}\) We have an interesting conjunction of a ‘wildly incorrect’ coastline allied to the depiction of a geodetic operation of unprecedented geometric accuracy. Notable eccentricities include, for example, a large inlet on the Ayrshire coast somewhere around Girvan, the distinctive ‘fingers’ in the south-west of the Isle of Man, the distinctive north-east-to-south-west lie of Lundy, and the depiction of Orfordness as an island.\(^\text{19}\) As a result the sheet lines do not always fit the detail very well. A notable instance is the division between sheets 85 and 86, which is shown as passing through the tip of Spurn Head, instead of, as it should, some 7 miles (11 kilometres) to the west. (And, on the ‘Principal triangles’ version, the Greenwich meridian (discreetly terminated on the south bank of the Humber) would barely graze Spurn Head).

The sheet lines are also interesting. They are ‘up to date’, in that quarter-sheets, introduced by July 1829, are indicated (as they are not on the two ‘Principal triangles’ prints in MPH 1/43): yet the indication is not complete.\(^\text{20}\) Sheets 41, 42, 45, 46, 50-57, 59-63, 74, 75, 78 and 79 are duly shown ‘quartered’, but 66, 68 and 82 are each only shown with a vertical division, and no quartering at all is shown for 67, 76, 77, 80, 81 and 87-90, all of which were published in quarters. (It may be noted that in 1831 survey was either incomplete or not started in these areas.) The depiction of sheets 49 and 67 as ‘full’ sheets, extending far into the North Sea, is as on the amended ‘Principal triangles’: in the event, only the western quarters of these two were published. The configuration of the coast means that 68 can be plausibly shown as a conventionally-sized sheet: in the event it was found necessary to extend it eastwards, ‘with the result that sheet 68 is the only known entity to consist of six quarters’.\(^\text{21}\) These peculiarities are, however, relatively minor as compared with what

\(^{16}\) It was certainly not *Cary’s reduction of his large map of England and Wales...*, about 1:950,400, first published in 1796 and republished in 1821, which has a distinctly ‘superior’ coast line, though it does cover a very similar area. The map originally accompanying the ‘Precis’, and now in TNA PRO MPH 1/43, is ‘Bowles’ New one-sheet Map of Scotland...’.

\(^{17}\) *Projections and origins*, 59 ff; originally published in Brian Adams, ‘198 years and 153 meridians... (continued...)’, *Sheetlines* 26 (1990), 15-20.


\(^{19}\) These points are mostly not reproduced in Figure 2, partly for reasons of scale, and partly because their significance was only realised after Figure 2 had been prepared, in August 2006.

\(^{20}\) The earliest reference to quarter-sheets is in an Ordnance minute of 13 July 1829 in TNA PRO WO 47/1470, p.7051.

\(^{21}\) Adams, ‘Projections of the Ordnance Survey ten-mile maps’, 179; *Projections and origins*, 10. [It might perhaps be added, however, that Eton College’s year is divided into three ‘halves’: I leave it to others to decide what effect this might have had on the financial policies of, say, Gladstone (an Etonian).] As noted above, sheet 68 is still shown as divided into four quarters on the early 1830s index in TNA PRO MPH 1/43.
happens along the south and east coasts. Two sheets are effectively omitted: 32 and 39, though there is a west sheet line for 32. Sheet 10 is shown as butt-joined to sheets 11, 15 and 16, instead of overlapping them; and, as if to compensate for the omission of sheets 32 and 39, two non-existent sheets are shown to the south of sheets 5 and 9. Again, all these seem to derive from an original which showed sheet lines over the whole area of the map, and not just the land.

The real interest, though, is in the extension of these sheet lines into northern England and southern Scotland. MPH 1/239 and the two prints of ‘Principal triangles’ in MPH 1/43 would seem to answer in the affirmative one question, that of whether sheets 1-90 once functioned as part of a scheme for the whole of Britain, but poses another: given the omissions and inclusions in the south, can they really be taken seriously as an indication of what might have been? Problems are particularly apparent on the eastern side, and begin at the Humber, even before we have gone north of the Preston-Hull line. The index suggests that the north-east corner of 86 and the north-west corner of 85 lie about 7 miles out in the North Sea, whereas in fact they lie some 2.4 miles (about 4 km) inland: with sheets measuring over 35 miles west-east this is definitely a ‘plottable error’. There is therefore a ‘missing’ sheet needed to the north of the published sheet 85. This, however, can be excused (like the treatment of sheet 68), as the result of fitting sheet lines to a ‘defective’ coastline. Other eccentricities may be due to the draftsmen who transcribed the necessary data for MPH 1/239 from the putative lost common parent of it and ‘Principal triangles’: there is a ‘missing’ sheet somewhere around Whitby, and there is a redundant line in the sea running north from a point some 30 miles east of Blyth in Northumberland. On the west side, Arran fits much more snugly into a single sheet than is suggested here, and the western side of this sheet would include some of the east coast of Kintyre, but no sheet lines are shown over Kintyre or the islands to the west.

Three conclusions suggest themselves:

First, that there was at one time an intention that the sheet lines of Old Series sheets 1-90 were to be extended northwards, certainly into southern Scotland, and possibly over the whole of Britain.

Second, that therefore such sheet lines might have been contemplated, and perhaps worked out to the degree of precision exemplified by MPH 1/239 and the amended version of ‘Principal triangles’, when the survey of south-west Scotland was being made in 1819-28.

Third, that as the sole apparently surviving explicit evidence for this policy, MPH 1/239 and two prints of ‘Principal triangles’ in MPH 1/43 should not be regarded as a wholly reliable guide to the precise incidence of such sheet lines, but they do illustrate a general principle.

Assistance from the (Transverse Mercator, metric) National Grid

I referred above to my work in 1984 in extrapolating the sheet lines of Old Series sheets 1-90 northwards using the National Grid. My investigations then were confined to what was necessary for south-west Scotland – the result was very similar to Figure 2 – and it was only Brian Adams’s passing, and with it the hope that he would eventually provide as near definitive a solution as could reasonably be hoped for, given the conjunction of scanty evidence and scholarly and mathematical rigour, that has led me to revive my own improvisation. No doubt the method is ‘unsound’, and I repeat that I hope that the present essay will provoke someone with greater mathematical abilities than mine into producing
Figure 3. ‘The First Scheme’: a sheet line scheme in the spirit of that shown on TNA PRO MPHH 1/239, but worked out using the National Grid and extending over the whole of Britain.
‘something better’: but meanwhile, in Figure 3, is an extension of the multi-meridian sheet lines of 1-90 over the whole of Great Britain. It should be taken as indicative of a trend rather than an absolutely definite indication of the incidence of sheet lines in any particular area.

In order to do this, it was necessary to determine two things: sheet size, and convergence. Sheet sizes were obtained in two ways:

a) The sizes of individual sheets were determined by taking the National Grid values which I had obtained for the sheet corners, and using ‘Pythagoras’ to calculate the distances between them.

b) The same method was repeated for larger groups of sheets, and an average sheet size thus deduced.

Method (a) is useful for apparently irregular sheets, notably those in the three ‘tapering columns’ (17 up to 89, 16 up to 88, 11 up to 87); method (b) has the advantage of reducing the possibility of error, but the disadvantage of presupposing that there is a standard sheet size to be discovered.

Convergence was obtained in a similar manner, by calculating averages for columns of sheets. The original extrapolation between sheets 17/22 and 89/90 seemed to give a slightly excess value and this has been ‘smoothed’ in Figure 3. The arrangement should be taken as indicative rather than literal, but I think it shows clearly enough that prolongation northwards of sheets 1-90 gives a layout in about 200 sheets: it will be noticed that 68E is treated as a separate sheet, and another sheet has been added for the Isles of Scilly, which were never mapped in the Old Series. However, as we shall see later, this ‘solution’, involving as it does a prolongation of the ‘taper’ so that the sheet in the north of Orkney at the opposite end of the column from sheet 17 is about half the southern sheet’s width, is by no means the only possible one. Let us call it the First Scheme.

The sheet sizes of the earlier Old Series sheets

Whilst it is well known that published sheets 91-110 of the Old Series were laid out to standard dimensions, of 36 × 24 miles (190,800 × 126,720 feet; about 57.94 × 38.62 km) on the ground, it is also well enough known that the basic size for the sheets south of the Preston-Hull line, outside the three central tapering columns, was slightly smaller. At first this seems curious, but only if we allow our thinking to be conditioned by later practice, and the use of the mile as the basic unit for the laying-out of Ordnance Survey map series after about 1839 and before the use of variously the yard and the metre for grid-related sheet lines after 1914. This includes the six-inch (1:10,560) mapping, on which work began in Britain in 1841, which was based on a standard sheet size of 6.00 × 4.00 miles (map area 36 × 24 inches), and which in turn, by a processes of division, determined the sheet sizes of the larger scales which were introduced later.

Though the survey for the six-inch used personnel who had been producing similar mapping in Ireland since 1825, detail procedures differed in some respects in Britain. One of these was sheet size: in Ireland the standard was equal to 32,000 × 21,000 feet (6.06 × 3.98 miles; about 9.75 × 6.40 km) on the ground.22 This suggests that, whatever may have been used later, in the mid to late 1820s the unit was the foot, and indeed this makes sense if we

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22 J H Andrews, *A paper landscape: the Ordnance Survey in nineteenth century Ireland*, Oxford University Press, 1975, 76; Adams, *Projections and origins*, 80. Andrews’s statement (loc. cit.) that ‘these [were] the round numbers which gave the closest approximation to a sheet size of 3 feet by 2 feet’ may be an example of hindsight.
bear in mind that the results of the various base measurements, from Hounslow Heath in 1784 to Lough Foyle in 1827, and beyond, were given in feet, as were distances between trigonometrical points. As will be apparent below, the size of the Irish six-inch sheets, with a height:width ratio of about 1:1.52 appears to have a bearing on Old Series sheet sizes. Thus, given that the mile was evidently not the basis for as near as Old Series sheets 1-90 got to a ‘standard sheet size’, it would seem sensible to explore the possibility of a ‘rational’ size based on the foot. This I duly did, using the National Grid values.

However, the results in feet are not convincing, and suggest a ‘standard sheet size’, based on those sheets using the 0° meridian, of about 186,750 feet west-east by about 122,725 feet south-north (35.37 × 23.24 miles; about 56.91 × 37.40 km). This does not have the neatness of 180,000 × 120,000, 192,000 × 126,000 (the one-inch equivalent of 32,000 × 21,000 for the six-inch) or even 186,000 × 124,000 or 187,500 × 125,000.

Using the National Grid meant that part of the work had to be undertaken using metric units, and it then occurred to me that I was performing the wrong conversion. It is well known that the metric system was devised in the 1790s on the assumption that the quarter-circumference of the Earth from the equator to a pole was a certain distance. Dividing this assumed distance by 10,000,000 gave what we know as the metre: it was a neat example of the age of reason, whereby a system of measurement would be derived directly from the size of the earth, rather from something so variable as the size of a man’s stride or of his foot. (The value of 10,000,000.0 metres for the quarter-circumference has since been found incorrect, and a value of about 10,002,000 metres is more generally acceptable, but this does not invalidate the original logic.) Since for a long time the quarter-circumference of the Earth had been divided into 90 degrees, each of a little over 69 miles, a possibility was that, by a similar principle to that which created the metre, the sheet size was somehow related to the length of a degree of latitude, given that one-third of a degree of latitude is slightly over 23 miles. (And one minute of latitude is equal to one nautical mile.) It is possible to test this in two ways. One is by using the National Grid values, which produce an average north-south dimension of 122,655 feet or about 23.23 miles between the north-west corner of sheet 85 and the south-west corner of sheet 6. Another is using the latitude and longitude values which were added to most Old Series sheets after 1851. These were presumably calculated with reference to knowledge of the construction of the Old Series which appears no longer to be extant. That for the south-west corner of sheet 6 is about 51° 5' 25" north, 0° 4' 37" west; that for the north-west corner of sheet 85 is about 53° 47' 00" north, 0° 4' 53" west. The latitudinal distance of about 2° 41' 30" is sufficiently close to 2° 40' 00" to suggest that a provisional value was used to determine the ‘standard’ sheet size. Such a provisional or approximate value would be wholly consistent with what is known of the construction of the early Old Series sheets, as remarked on by Brian Adams in his ‘Butterton’ article. Having thus determined a height for the

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24 For the completeness of the record: bearing in mind that the London-Paris triangulation of which the Hounslow Heath base operation was a part, was an Anglo-French operation, I also tried converting my foot values into toises (1 toise equals 1.949 metres). This suggested that the toise wasn’t the answer either. (The idea is not completely fanciful, for a scale of toises was provided on plates I and VII (of baselines) in William Mudge and Isaac Dalby, An account of the operations... for... a trigonometrical survey of England and Wales..., Vol. I, London: Faden, 1799: these plates were originally engraved in the 1780s for Roy’s account of the operations).

25 Sheetlines 38, 17; Projections and origins, 50.
sheets, it would be easy enough to determine a width, suitable for double-elephant-size paper, of 1.5 times height. That the sheet widths thus deduced vary slightly from 1.5 times the height might, again, be attributed to the use of approximations, giving a general effect rather than rigorous exactness; however, the ‘explanation’ appears to be more subtle.

Taking to the coast

At this point we may note that Sir Charles Close, in *The early years of the Ordnance Survey*, described the Essex sheets as 34.75 × 23 inches. This gives a height:width ratio of 1:1.51. It is not known how Close obtained this figure: quite possibly it was by measuring a copy with an ordinary ruler, without checking the ruler against a scale-bar printed on the map, never mind any more sophisticated checking. Measurement of sheet 2 as reproduced in Volume I in the Harry Margary facsimile gives dimensions of about 34.95 × 23.14 inches, but the scale-bar measures 4.92 inches for 5 miles. Applying the implied compensation of multiplying the paper measurements by 1.0162 gives dimensions of 35.516 × 23.51 inches/miles. This is much closer to the sort of result obtained for ‘0°’ sheets using the National Grid method described above (about 35.37 × 23.23 inches/miles). An interesting result of both Close’s figure and mine is the ratio of height to width. Were both height and width to be based on a value for latitude, a ‘rational’ dimension would be 0.3333 recurring of a degree of latitude in height by 0.50 of a degree of longitude at the Equator (equal to 1 degree of longitude at 60° north: the width of half a degree of longitude at the Equator is about 34.55 miles), so that height and width would be in the ratio of 1:1.50. An alternative would be to adopt a width based on a certain ‘neat’ number of minutes of longitude at a certain latitude. At first this does not fit the likely dimensions of the Old Series Essex sheets very comfortably, unless the width was based on either (a) 50 minutes of latitude at about 52° 15' north (i.e. about 9 miles (14 km) to the north of the top of the Essex maps), using early twentieth century values, or (b) derived from a length of a third of a degree of latitude of about 23.23 miles (instead of about 23.03 miles), which gives a value of about 35.37 miles at around 51° 50' north, i.e. fairly close to the midway point of the Essex group. I think that (b) is the most likely answer, and that the size of the Essex sheets is based on a sheet size of 50 minutes of longitude by 20 minutes of latitude at about 51° 50' north. The height:width ratio of 1:1.52 of the Irish six-inch suggests a translation of the standard Old Series one-inch sheet size into six-inch Irish terms, related now to the foot, or thousands of feet.

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26 As part of the preparation for this essay I also investigated the map of Kent published by Faden in 1801, using Ordnance materials. The ‘tracing’ method was used to obtain 100-metre National Grid references for the three sheet corners lying on land: this suggested a size of about 180,500 x 121,600 feet (34.18 x 23.03 miles; 55.01 x 37.06 km). This is quite close to the ‘third of a degree of latitude’ size (121,515.78 feet using a value of 10,000.0 km for the quarter-circumference), and might be worth someone’s further investigation.


28 A possible qualification is that paper is known to distort differently as between the horizontal and the vertical. Indeed, but to make a check it would be necessary to obtain dimensions from a map of known dimensions (a county six-inch engraved sheet of 36.0 × 24.0 inches suggests itself) printed on the same type of paper as that used for the early impressions of the Essex sheets: and as the first county six-inch sheets were only printed from 1846 onwards this does not seem to be practicable. The figures which I quote in Richard Oliver, *Ordnance Survey maps: a concise guide for historians*, second edition, London: Charles Close Society, 2005, n.17 on pp 27-8 suggest a difference of about 0.67 per cent between horizontal and vertical measurements on one-inch quarter sheets printed in the late nineteenth century. This difference does not seem to be to be significant enough to qualify seriously my argument in the text.

But why, it might be asked, use a height:width ratio of about 1:1.52 rather than 1:1.50, and introduce the complication of width based on a certain length of longitude at a certain latitude? I put it forward that the ‘answer’ lies in an aspect of early OS history to which, perhaps, insufficient attention has been paid, though the ‘basic facts’ have been in the public domain since at least the time of the publication of Volume I of the Harry Margary facsimile in 1975. Everyone, I think, accepts that Faden’s Kent was an independent production. It then seems to be accepted that, having decided to do its own publishing, the Ordnance set out with a national vision: after all, those four Essex sheets were originally published as ‘Part the first of the general survey of England and Wales’. This, however, is another instance of allowing hindsight to cloud our judgement. Whilst the publication of mapping covering Essex was seen as the start of a much larger project, of covering the whole of England and Wales (Scotland evidently came into the picture later), it is a good deal less clear that these four sheets were intended as a first instalment of a national sheet line scheme.

There are three ‘proofs’ of this. The first is a subtle one, and is that the early states of the plates were either unnumbered, or else bore numbers differing from those familiar today: sheet 48 was originally ‘IV’. In that scheme of things, sheet 47 would have been ‘III’; I and II could be, and were, left unchanged when they were used as the starting point for a national numbering scheme. The second ‘proof’ is more obvious: the border. This is designed so that, if the four sheets are mounted together as one, the composite is surrounded by a ‘keyboard’ border with latitude and longitude values. Most of the surviving early copies are in this form, mounted as four-in-one composites. However, independent sheets only have the border on the ‘outside’, and in this they follow the practice of Faden’s Kent and other such county mapping; on the inside there is no border, and only a relatively short distance – about 0.4 inch or 1.1 cm – between the neat lines and the edge of the plate, which is enough for legally-necessary publication notes which would be lost when the sheets were cropped for mounting as single county maps. The same practice can be seen on multi-sheet county maps, from the later eighteenth century to the Greenwoods in the 1820s.

The third ‘proof’ is perhaps more contentious. On the north, west and south sides the Essex boundary comes to within about one or two miles of the neat line, and by this means it is just possible to fit in the Tower of London (unnamed) at the western extremity of sheet 1, but on the east side the east neat line of what was later known as sheet 48 is about ten inches further east than it need be were the object only to map Essex, the easternmost point of which is at Harwich: the easternmost point on sheet 48 is Orford Ness. This suggests to me that it was decided to take advantage of the possibilities of the large copper plates needed to accommodate a sheet height of about 23.3 inches/miles by extending the cover eastwards to include as much as possible of the coast north-east from Harwich, and south of a line extended east from the north-west corner of the future sheet 47. A sheet width equal to 50 minutes of longitude at the approximate mid-latitude of the four sheets (admittedly on a faulty basis) gives a mathematical neatness to what seems to have started out as something of

30 Incidentally, the height:width ratio of this map is about 1:1.48. It might be worth investigating height:width ratios of such ‘county’ mapping further, in case any apparently ‘significant’ or ‘rational’ relationship emerges. After all, some of those behind these projects, such as Faden, ‘aimed high’.

31 See Margary, *Old Series*, Volume 1, 1975, xxxviii–xxxix. The apparent lack of any sheet number on early printings can be readily explained by most of the surviving copies being mounted as composite sheets of the whole of Essex, in which case the sheet number, being placed to the right of the prolongation of the right (east) neat line, would be lost in mounting. If the logic of, in effect, ‘reusing’ Essex sheets I and II as sheets I and II of a national system is accepted, then the apparently strange progress of Old Series sheet numbers in snaking columns seems much closer to ‘logical’.
a spatchcock, of mapping extending along the coast from the Tower – the symbol of London’s defence – to the vicinity of Orfordness.\textsuperscript{32} The meridian of Greenwich was presumably adopted for construction of the Essex mapping because of relative ease of construction: it is certainly not central.

Although it is quite common on commercial one-inch county maps of the later eighteenth and earlier nineteenth centuries for there to be some mapping of detail outside the county boundary, completion of detail to the neatline is unknown: given the irregular shape of counties such ‘filling up’ would have greatly increased the costs of surveying and engraving. There is, however, a partial exception: Faden’s Kent, which is completed to the neat line on the north only, thereby completing cover, so far as the basic concept of a map of Kent permitted, of the strategically important banks of the Thames.\textsuperscript{33} It was a logical step for the Board of Ordnance, who unlike commercial publishers such as Faden were not troubled by considerations of cost recovery, to decide to complete its county one-inch maps to the neat line, but the experience of Essex may have suggested that a great deal of extra engraving would thereby be entailed, and that it would be much better to have a national series, independent of county boundaries as far as possible. The Essex sheets would therefore graduate from being a set of county maps to the starting-point for national sheet lines. This concept was complicated almost immediately by the putting in hand of the engraving of the mapping of Devon, the layout of which is a curious compromise between a county-oriented layout, as witness the neat fitting in of the eastern and western extremities of the county, and a national layout, as witness the north and south sheet lines. The result of joining Essex to Devon was the three central ‘tapering’ columns.

If a national sheet line scheme had really been considered when engraving of the Essex maps was put in hand, around 1802, then one might have expected one that treated London more satisfactorily. The Cassini 1:86,400 Carte de France of 1744-93, ‘a performance highly celebrated’,\textsuperscript{34} had its origin at the Paris Observatory (and advertised the fact, including sheet-corner co-ordinates in toises on the published maps), with the result that sheet 1 had Paris pretty much at its centre. We look in vain for any such neatness in the Old Series sheet lines if we try to think of them as nationally conceived from the outset.

I suggest therefore, in default of a more convincing explanation, that the original sheet-size concept for the Old Series was based on a somewhat haphazard definition of the length of a degree of latitude, divided by three.

**Delamere**

*So why – and when – Delamere?*

By 1820-1, when the engraving of sheets 85 and 86 was in hand, sheet lines on this putatively latitude-related basis determined the broad outline of any arrangement up to the Preston-Hull line. However, there was some scope for detail adjustment.

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\textsuperscript{32} A complication not to be discussed here (and rarely if ever referred to in print) is that when sheets 49, 50 and 51 were published in 1836-7 they included at their foot a narrow strip of territory previously published on sheets 47 and 48. In 1838 sheet 48 was republished, thoroughly revised, in quarter-sheet form, thus making a neat join with sheet 50 to the north; at about the same time the north and north-east parts of sheet 47 were re-engraved to join neatly to sheet 51, but without re-engraving the original border: as a result, the re-engraved detail in sheet 47 was effectively ‘stretched’.

\textsuperscript{33} This was a very definite outcome of the agreement between the Ordnance and Faden as to the engraving of the map: see Mudge and Dalby, *An account...*, I, xii-xiii.

\textsuperscript{34} Mudge and Dalby, *An account...*, I, xiii.
I have said that the earliest known sheet line index showing sheets 91-110 as published can be dated to about the turn of 1839-40. This can be interpreted as suggesting that the decision to make a complete break with the ‘system’, or lack of it, exemplified by sheets 1-90, in favour of a standard sheet size related to the mile and on the meridian of Delamere, had been taken not long before. However, there are two peculiarities about this use of Delamere. One, noted long ago by Winterbotham, is that it is noticeably too far to the west for England and Wales considered as a whole (and, he might have added, even more so for sheets 91-110 considered as a self-contained block), but is ‘just right’ for the whole of Britain: the other is much less commented on, and that is that the Delamere origin lies outside the area of sheets 91-110 for which, it has been largely assumed hitherto, it was originally adopted. The use of Delamere would thus appear to have differed from usual OS practice, which was to use an origin inside the block for sheets referred to it, even if it is not quite central: for example, 0° and 3° for two blocks of the Old Series. Given the state of OS geodetic work by the late 1830s, it is at first difficult to see why Delamere should have been adopted at so late a date: the primary triangulation station on Great Whernside, for example, would have been much more central. However, it is apparent from the work of Brian Adams that Zenith Sector stations, for which precise observations for latitude were made, were favoured: and this would imply the meridian of Burleigh Moor. However, if Delamere is rather far west for Old Series 91-110, Burleigh Moor is definitely very much east.

But once again we may be looking the wrong way down the telescope; we suppose that Delamere was chosen in the late 1830s purely for use with sheets 91-110, and that it was serendipitous that it was convenient for first the remainder of England and Wales and then the whole of Britain, when first Old Series sheets 1-90 and then the original engraved one-inch of Scotland came to be replaced, after 1872 and about 1919 respectively.

There was another reason, and Brian Adams discovered it. That he did not publish it, and that there is only a veiled reference elsewhere, can be set down to his great care, and wish not to publish this aspect of Old Series construction until he had researched further. Given the heavings, twisting and writhings of the sheet lines in the three central tapering columns this is indeed understandable. Nonetheless, in August 1993 he ascertained that ‘the dividing line of Old Series 90/89 can be followed right down to that of 42/43 along a Popular Edition grid (or two-mile square) line, albeit with some slight wavers on either side, thus confirming that the work along that strip was certainly laid down on the Delamere origin’. It is well known that the Popular Edition was constructed on Delamere, and further investigation shows that the dividing lines between Old Series sheets 78/79 and 74/75 and between sheets 56/60 and 57/59 are also parallel to Popular Edition squaring lines.

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36 For a nice example of such an assumption expressed by the present writer see the introductory essay by J B Harley and R R Oliver in Harry Margary, The Old Series Ordnance Survey Maps of England and Wales, Volume 8, Lympne: Harry Margary, 1991, viii.
37 This point is not invalidated by the 1:2500 mapping on at least two origins – Stafford Castle and Otley – having been superseded by new origins – Dunnose and Danbury respectively – before those places had been covered by the 1:2500: it was purely a policy change, to reduce the number of county origins. See Projections and origins, 77-8.
39 Yolande Hodson, Popular maps, London: Charles Close Society, 1999, 66: ‘Delamere was... used as the origin for a great tract of Britain in the north-south direction, extending from Gloucester to Fife’. The quotation follows ‘Delamere update’ closely, and the limitation northwards may have been influenced either by ‘Plan of the principal triangles...’ of 1811 or by TNA PRO MPHH 1/239.
40 ‘Delamere update’, CCS Archives 330/1/1.
Figure 4. ‘The Second Scheme’: a sheet line scheme designed, north of the Mersey and the Humber, to cover those parts of Britain to the north with sheet lines on the Delamere meridian which would, as nearly as possible, butt-join to Old Series sheets 85-90.
The tests of paralleling squaring lines on the Popular Edition and also of measuring the angles of sheet corners make it clear that a substantial part of the Old Series mapping of Wales and north-west England is laid out on the Delamere meridian. The sheets in question are 42, 56, 59, 60, 74-79 and 90 plus those parts of the row of sheets from 43 to 89 adjoining the sheets to the west, most of sheets 41 and 57, and the upper parts of sheets 87-89. A telltale sign of a change of meridian, made explicit on the southern sheet of the ten-mile map, is the displacement, by somewhat over a mile, of the west sheet line of sheet 59 (point R in Figure 5), as compared with that dividing sheets 57 and 58 (point S in Figure 5): sheet 58, like sheets 38-40 to the south, apparently used $3^\circ$ west.

Thus, so far from explaining how it was that Old Series sheets 91-110 were laid out using an origin outside their area, we have to explain why, apparently, it was decided to abandon the sort of layout implied in Figure 3 in favour of the familiar one. I here refer the reader to Figure 4, which I call the Second Scheme, and which, north of the Preston-Hull line, uses the Delamere meridian and two standard sheet sizes: $27 \times 24$ miles for those three central columns north of the three ‘tapering’ columns, and $36 \times 24$ miles elsewhere. Unlike the First Scheme in Figure 3, the sheet positions are fairly soundly based, with sheet corners plotted using the National Grid data on post-1945 issues of the one-inch Popular Edition of Scotland; this map was constructed on the meridian of Delamere using standard sheet lines, and alternative sheet line arrangements can readily be calculated, as has been demonstrated by Brian Adams.\textsuperscript{41}

\textit{Sheet 42 reached via Sheet 86}\textsuperscript{41}

It is important to note that the Second Scheme is designed to illustrate a theory, as to an otherwise ‘lost’ intermediate stage in the evolution of the familiar sheet lines of Old Series sheets 91-110, rather than as a provable fact. If readers are content to accept that the principle was adopted, but was not necessarily worked out in any detail, and certainly not to the extent illustrated in figure 3 (the coast line of the putative ‘lost’ map that is the parent of both the ‘Plan of the principal triangles…’ and MPHH 1/239 would make such a proceeding questionable on the basis of the data available in the 1830s), then I shall be content. Unfortunately, lack of the necessary OS working papers means that the ‘Second Scheme theory’ is unlikely even to be satisfactorily proved or conclusively disproved.\textsuperscript{42} In 1829-31 there was still much survey and revision to be undertaken south of the Preston-Hull line, and there would be no operational need to work out the details of the Second Scheme for some years to come.

Careful readers will observe that the Second Scheme appears to depend on the tops of Old Series sheets 87, 88 and 89 each being precisely 142,560 feet, or 27.00 miles (about 43.45 km) across. This is indeed so, and is illustrated in Figure 5 and the subjoined table. Had I chanced upon this using my method of National Grid references I should have put it down to at best a coincidence and more likely to the fundamental unsoundness of my method. Having it discovered by Brian Adams puts a different complexion on the matter: ‘I


\textsuperscript{42} The only hope for anything ‘new’ from this period would be something that ‘turned up in a cupboard’ as and when OS moves out of its present premises into new ones in a few years time. As those premises only date from the late 1960s such an expectation would seem somewhat optimistic. I am also pessimistic of cupboards in retired OS employees’ homes producing anything, bearing in mind actuarial considerations. The possibility of something having been overlooked in The National Archives now seems remote.
put it forward, with an absolute minimum of doubt, that the entire sheet line systems of the New, Third and Popular Series of E&W, together with the Popular of Scotland, depend on the north-west corner of Old Series 86… the northern borders of 87-89 were all made exactly 27 inches/miles, and the next row were set out so that 92, 93, 88, 87 all meet at a single point, as do 91 SW, 91 SE, 90, 89.  

The thoughtful will also say that this creates a problem, in that the sheet line dividing sheets 17/20 and so on to the north, which Brian Adams demonstrated were pretty certainly on 3° west, surely dictates that dividing sheets 42/43 to 89/90. This assumes however, that the sheet lines run straight: in practice, there seems to be a subtle bend somewhere in the lower part of the division between sheets 42 and 43 (indicated approximately by point T on Figure 5), marking the transition from a division between sheets related to 3° west to one

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43 ‘Delamere update’, CCS Archives 330/1/1.
Key for figure 5

<table>
<thead>
<tr>
<th>point</th>
<th>sheet corners</th>
<th>distance from Delamere</th>
<th>distance from 87NE-ne, 86-nw</th>
<th>distance from 91SW-se, etc</th>
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<td>522,720 W</td>
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<td>90NE-nw</td>
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<td>?</td>
<td>?</td>
</tr>
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<td>427,680 W</td>
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<td>237,600 E</td>
<td>665,280 E</td>
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</table>

In the ‘sheet corners’ column, upper case indicates quarter-sheets, and lower case indicates sheet corners: thus ‘91SW-sw’ indicates the south-west corner of sheet 91 SW. Distances are given in feet west (W) or east (E) of origin.

based on 2° 41' 03''562 west, i.e. Delamere.\(^{44}\) It certainly must have been very convenient that what we know as the tops of sheets 87, 88 and 89 could each be made exactly 27 miles or inches wide, and one can only conjecture at how this was arrived at. The following process is suggested:

First, it is apparent that having several meridians is inconvenient, particularly as joining together the ‘tapering’ sheets in county groups, with the sheet lines not parallel, is likely to prompt comments from customers.\(^{45}\) Also, a sheet size derived from an ‘incorrect’ assumption of the length of a degree of latitude combined with the mapping of part of the east coast is much less satisfactory than one based on a precisely defined unit such as the foot, yard or mile, the length of which is well known (and the use of which was standardised by an Act of 1824).\(^{46}\)

Second, this suggests the desirability of adopting a new central meridian, given that the two existing meridians (0° and 3° west) are respectively too far east and west.

Third, given the constraint of using zenith sector stations, Delamere suggests itself.

Fourth, calculations are made, extending west from the north-west corner of sheet 86 (point L on figure 5), towards sheet 90 (point B on figure 5), perpendicular to the meridian of

\(^{44}\) Roger Hellyer points out that the transition can be made out on the ten-mile index (south sheet): it is somewhere about the name ‘Ewias’, and can be detected with the aid of a straight edge.


\(^{46}\) *An Act for ascertaining and establishing Uniformity of Weights and Measures*, 5 Geo. IV, c.74, especially section I. There is a useful discussion of the various standards of length affecting nineteenth century OS work in Seymour (ed), *A history*, 141-3.
Delamere.\(^{47}\) (The north-west corner of sheet 86 is chosen because it is the furthest limit northwards of previously published mapping.\(^{48}\))

Fifth, the dividing-line between sheets 35 and 36, etc, is extended north using the \(3^\circ\) meridian to meet the new line (L-A on figure 5) related to Delamere. The result is a perpetuation of the objectionable ‘taper’.

Sixth, it is noticed that the distance west from point L on Figure 5 to the meeting point with the \(3^\circ\) west meridian is a little under 81 miles (3 x 27 miles).

Seventh, a new starting point (point C on Figure 5) is adopted, exactly 81.00 miles west of point L, and a dividing line extended downwards until it meets the \(3^\circ\) west line at point T.

Eighth, sheet lines are laid out which up to the line A-L (the Preston-Hull line) are constrained by the old standard, putatively latitude-derived, size, and the necessity of making a neat junction, at any rate on land, with already published sheets, or those in an advanced state of preparation: north of that line they can be laid out using the two new sizes, related to round miles. (Note: they can be laid out using those sizes; it is not proven either way that they were so laid out.)

It might perhaps be argued that, indirectly, such important points in Figure 5 as C, I and L all depend on the position of the Greenwich observatory (point U).

**Thomas Colby and rationality all round**

There naturally arises the question of when the Delamere meridian was adopted for much of Wales and adjoining parts of England. All the constraints on laying out were in place by about 1821-22, when engraving of sheets 36, 37, 41, 85 and 86 was in hand, and so it is unlikely to be earlier than 1822; on the other hand, the engraving of sheet 42 was in hand by April 1830, so presumably the adoption of Delamere is no later than this and, given the necessary lead-time for calculating sheet lines and producing a draft for the engravers, we can narrow the likely date to sometime between 1822 and 1829.\(^ {49} \)

We can now turn to personality, more particularly that of Thomas Colby, who was appointed Superintendent of the Ordnance Survey in July 1820 as a Captain and was shortly afterwards promoted to Major. He succeeded Major-General William Mudge, whose numerous other responsibilities meant that in recent years much of the day-to-day running of the department had devolved on Colby as his subordinate. Whereas daily routine for Colby perhaps did not change much at first, the burden of ultimate responsibility did. It is well known that the early years of his superintendency were characterised by the discovery that much of the existing survey was sub-standard, of which the withdrawal and re-engraving of the already published mapping of Lundy was only the most conspicuous example, and by the

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\(^{47}\) This is fundamentally similar in principle to what I suggested above happened with the mapping of Essex, where the line from the north-west of sheet 47 was carried eastwards until it met the coast at Orfordness.

\(^{48}\) Roger Hellyer points out that using the north-west corner of sheet 86 as the starting-point minimises the amount of overlap between the sheets north and south of the Preston-Hull line. This is indeed what happened after 1840, but an alternative would be to treat the sheets immediately north of sheets 85 and 86 as having a horizontal taper, so that their south sheet lines would be determined by Greenwich and the north by Delamere, and thereby avoid an overlap.

\(^{49}\) Dates for some of these are provided by entries in the letter-book in TNA PRO OS 3/260: a proof of sheet 37 was printed on 14 September 1821 (p.379); engraving of sheet 41 was evidently in hand by September 1821 (p.379); a proof of sheet 36 was sent out on 9 December 1821 (p.412); there was a bill for the copper plate for sheet 86 around 3 April 1821 (p.461). The drawing for sheet 43 N.W. was received by the engravers on 15 April 1830; see ‘day book’, 1827-52, TNS PRO OS 3/279, p.58. It could be that the adoption of a new meridian and sheet lines embodied in my putative ‘Second Scheme’ was prompted by the adoption of quarter-sheets and the realisation that the more northerly ones would be very narrow and strange-looking.
imposition of much higher standards. As a result, for over a decade the emphasis was on the revision of existing survey prior to publication, rather than the making of fresh survey for the one-inch Old Series map. The outcome was greatly increased planimetric accuracy, and a decided step forward in the development of the Ordnance Survey as an organisation producing mapping of a completeness and excellence which was beyond that attainable by commercial means. Another development, which in turn was partly the product of the Ordnance Survey’s growing reputation (not altogether justified if such things as the original Lundy mapping are taken into account), was the decision in 1824 that it should undertake a six-inch survey of Ireland, which was an extension of Colby’s responsibilities. His Instructions for the Interior Survey of Ireland are probably relatively well known, not least perhaps because they say practically nothing at all about what detail to survey, beyond the sweeping instruction of everything-attached-to-the-ground-except-for-the-fences, but quite minute detail on how field books, fair plans and other documents were to be arranged and numbered. What has not been drawn attention to hitherto is an apparently slightly earlier imposition of order on the survey materials for the one-inch Old Series. It is noticeable that whereas the earlier Ordnance Surveyors Drawings (OSDs) are numbered in a geographical order, starting at Lands End and regardless of date, by the early 1820s they are being numbered in roughly chronological order: evidently the numbering system was imposed at this time, just after Colby’s big promotion. The changeover from referring to the OSDs by name to referring to them by number can be seen in the surviving letter-book, which is customarily dated circa 1817 to 1822, but which includes transcripts of earlier documents going back to the late 1790s. It is at least a possibility that the letter-book is another Colby rationalisation, a gathering-together of all the correspondence and memoranda in the Ordnance Map Office which was still of relevance, started at about the time that he took over responsibility from Mudge, and added to as further correspondence was received.

If the clerical side could be rationalised and ordered, why not the mapping? In the adoption of Delamere, which I suggested above took place some time between 1822 and 1829, one can see another Colby rationalisation.

Feet, miles and the mapping of Scotland
Some answers to possibly awkward questions

It is now necessary to explain two things: first, why sheet sizes related to the mile were substituted for those based on the foot or upon dividing latitude, given that, at the same time, a foot-related sheet size was being adopted for the six-inch survey of Ireland; and second, why a sheet layout that embraced Scotland was abandoned in favour of one confined to England and Wales.

The explanation of both depends on the necessary changes being made one at a time, rather than as a single operation. The first of these was the decision to rationalise the meridians and sheet shapes and the consequent adoption of Delamere. The second was the discovery that the use of Delamere would permit the introduction of ‘rational’ mile-related

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51 These Instructions have been published twice: in Andrews, A paper landscape, 309-21, and in Seymour, A history, 367-72.
52 The history of this letterbook is obscure: I was once told (who by??) that it was found in private hands and returned to the OS some time in the 1960s. It was certainly in the OS library by the later 1960s, when J B Harley began to make extensive use of it, and was transferred to the PRO (reference OS 3/260) in the mid 1980s.
sheet lines in northern Britain. The third, which was part and parcel of the adjustment of the line between points T and C in Figure 5, was to lay the foundations of a standard sheet size which could be related to the mile, but this could only be exploited for sheets north of the Preston-Hull line. This would lead to the Second Scheme, which was designed to retain a smooth transition into the new Delamere and mile-related sheet lines in northern England and Scotland, at the expense of there still being two standard sheet sizes. The commencement of the engraving of sheet 42 indicates that this decision had been taken by 1829, *i.e.* some two years before the preparation of the diagram MPHH 1/239, which retains the First Scheme. However, this apparent contradiction can be resolved if we assume that MPHH 1/239 derives from a lost model originally prepared before the adoption of Delamere, but updated after 1829 to reflect the adoption of quarter-sheets at that time. Its purpose was less to show sheet lines and more to show the state of survey and revision early in 1831: for this purpose some inaccuracy in sheet lines would not matter too much, and it may be that in 1831 there was as yet no successor to the putative lost model from which both MPHH 1/239 and ‘Principal triangles’ derive. By the turn of 1833-4 there was a printed index which could be, and was, used to show survey and revision progress.\footnote{\emph{i.e.}, that dated to 1833 and represented by examples in TNA PRO MPH 1/43.}

There is the parallel question of feet-versus-miles. My suggested solution lies in the different natures of the six-inch and the one-inch. The six-inch was designed to be used on, or as a substitute for, the ground where, as the graduation of the scale bars hinted, the detail of the map might need to be checked or supplemented by actual distance measurement, in feet, yards or chains; the one-inch was too small a scale to be used in this manner, but would be used for travelling and for a general synopsis of the landscape, where the mile would be the instinctive unit of measurement. There would thus be no basic incompatibility between six-inch maps related to feet, and one-inch maps related to miles, once the latter could be introduced at a suitable juncture. After all, the basic unit for estate and similar surveys in both Britain and Ireland was the chain, various lengths of which continued in use even after the Act of 1824.\footnote{Notably the Cheshire chain of 32 yards.} The standard Gunter’s chain of 66 feet was the most commonly used and a commonly used scale was 1 inch to 3 chains (1:2376), or 26.6667 inches to 1 mile, which does not bear a very neat relationship to the mile.

The second problem is the apparent contraction of the sheet line scheme and the replacement of two hypothetical standard sheet sizes by one. If my reasoning and conjecture above are accepted, then the Second Scheme layout, or concept, extending over the whole of Britain, with its two standard sizes (widths of 27-inches/miles and 36-inches/mile) was replaced by a single 36-inches/miles-width standard, familiar to us from published sheets 91-110, and confined to northern England. In fact the date of this development – 1838-9 – is significant because of six-inch developments.

In 1834 the British Association, meeting in Edinburgh, was persuaded to take an interest in the mapping of Scotland, which was felt to be wholly inadequate, and to send a memorial to the Treasury requesting faster progress for the Ordnance Survey in order to remedy this. This set in train a process which culminated in the Treasury authorising, in October 1840, the adoption of the six-inch scale for Scotland and northern England. The decision to increase the scale of survey – and, by implication, of publication – was helped along by Colby asking those Scots who were pressing for the principle of an Ordnance Survey of Scotland to consider carefully the practice of the scale at which it was to be made. From the available
evidence it seems that the Scots would have been content with what was already being done in England and Wales – two-inch survey and one-inch publication – but by 1839, assisted by specimens of what was being published in Ireland, the feeling in Scotland was that the country should be mapped at the six-inch scale. At the same time certain scientific societies in Lancashire and Yorkshire also asked for the adoption of the six-inch scale.  

When the six-inch had been adopted for Ireland in 1824 the intention seems to have been that the original survey at that scale would remain in manuscript, with hand-copying as necessary for the townland valuation that was the survey’s whole raison d’etre, and publication at one-inch. In the event, the six-inch work was soon being engraved, as this was thought to be more economical than multiple manuscript copying and, although hill-sketching was still in progress, by 1840 little else had been done towards one-inch publication. Some of the potential functions of a one-inch were being fulfilled by the county indexes to the published six-inch mapping, which were at scales varying between 1 inch to 1.5 miles (1:95,040) and 1 inch to 3 miles (1:190,080). Indeed, by 1839-40 Colby seems to have felt that, were the six-inch scale to be authorised for Scotland, there would be no need to prepare a one-inch of that country; in May 1840 he observed that the one-inch was ‘rather large’ a scale for a ‘travelling map’, and that instead in due course that function might be served for Scotland by a map at the third-inch scale. Indeed, something of the sort started to happen, in that by 1851 a quarter-inch (1:253,440) map of Wigtownshire had been produced, intended to be the first of a series of quarter-inch county indexes which could eventually be combined into a single national map. In the event both county indexes to the six-inch and quarter-inch topographic mapping in Great Britain developed along somewhat different lines, and Scotland gained its one-inch.

Colby’s suggestion that Scotland need not be provided with a one-inch map was accepted by the Duke of Wellington when, in October 1840, he was consulted on the six-inch proposal: and in these circumstances it is unsurprising that the index to one-inch sheet lines dateable to circa 1839-40 should confine them to England and Wales. Whilst he seems to have been content not to have a one-inch at all in Scotland, Colby felt that it should be completed for England and Wales, partly because those who had been purchasing the maps as they were published had a reasonable expectation of the venture’s completion, at any rate south of the border. Thus it appears that the significance of the ‘1839-40’ index showing sheets 91-110 is that they mark, not the adoption of a new sheet line system on a new

55 The originals of these memorials and Colby’s implicitly asking the Scots to consider the scale (in Colby to Byham, 16 May 1837) are in TNA PRO T1/4060. The lobbying for the adoption of the six-inch is admirably told in R C Boud, ‘The highland and agricultural society of Scotland and the Ordnance Survey of Scotland’, Cartographic Journal 23 (1986), 3-26. The reactions of members of the Highland Society to an Irish six-inch sheet (‘a kind of skeleton’) are recorded by Boud, pp 7-8.
57 Colby to IGF, 6 May 1840 in TNA PRO WO 44/702.
58 Colby to IGF, 5 December 1840 and 26 January 1841 in TNA PRO WO 44/702.
59 Wellington to Chancellor of the Exchequer, 5 October 1840, in TNA PRO T1/4060.
60 Colby to IGF, 5 December 1840 and 26 January 1841 in TNA PRO WO 44/702.
meridian, but the abandoning of the principle of a single sheet line scheme for the whole of Britain, and of a policy of consistent one-inch cover. A certain tenuous connection would be retained by a standard basic sheet size for one-inch and six-inch, albeit ‘quartered’ in practice at the smaller scale. Even if the adoption of the six-inch in northern Britain had been delayed beyond 1840, it would have been necessary to have a definite one-inch sheet line layout in place by the beginning of that year, as the practice by the late 1830s was to survey and draw at the two-inch scale by divisions of the one-inch sheet lines: sheets 93 and 94 and small parts of 91, 92 and 95 were surveyed in outline at the two-inch scale during 1840.61

So Winterbotham was right when he noted that Delamere is convenient for a single national meridian and sheet line system; but one may doubt whether he suspected that it was arrived at and put to use in the 1820s.

One final point remains to be discussed: the putative supplanting of two standard sizes, the 27 inch/mile and 36 inch/mile widths, by one, the 36 inch/mile, in the ‘1839-40’ layout, and the adoption of a mile-based rather than foot-based standard sheet size for the British six-inch shortly afterwards. The answer may be standardisation. By this time the one-inch was being produced in quarter-sheets, and it would surely be much more convenient to have one standard size rather than two: it would also reduce somewhat the amount of copper needed, when allowance is made not only for the width of margins, but also for the ‘narrow’, ‘tapering’ quarter-sheets being engraved on the same size of plate as the ‘wide’ ones.62 Given that a long-term policy of sheet sizes based on the mile had already been adopted by 1828-9, there would be some logic in adopting it for the new six-inch mapping of northern Britain, in that, as Brian Adams noted in 1991, calculations might be made in fathoms which, were reduction to one-inch needed, could automatically be reduced to feet.63

Conclusions
First, the use of the Delamere meridian for the one-inch Old Series was much more extensive than has hitherto been supposed. Second, published sheets 91-110 of the Old Series, so far from marking a new departure, appear to be merely the rump, on modified sheet lines, of a formerly much more ambitious scheme.

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61 For evidence of the final extent of two-inch survey see Colby to IGF, 5 December 1840 and 22 February 1841 in TNA PRO WO 44/702 and diagram in TNA PRO MPH 1/45. The diagram does not indicate the extent of work in sheets 91, 92 and 95, but does show sheets 91 and 92 as being surveyed at the six-inch scale: another mystery for elucidation at another time.

62 Unmounted copies of the quarter sheets in earlier states – before the early 1850s – are not often met with, but there is a good collection of examples in the Royal Geographical Society-Institute of British Geographers collection, at Eng. & Wales Gen.124-6.

thought. Both Roger and Chris have commented on an earlier draft of this essay: I am grateful to both for inspiring further thoughts, but it is needless to say that they are not responsible for any remaining shortcomings. As I said at the beginning, I hope that someone will carry on where Brian Adams left off.