

SCRATCH (MASS) DIALS: TIME FOR A REASSESSMENT

CHRIS H K WILLIAMS

As we all know, scratch dials (primitive early sun dials) survive in a bewildering variety of forms. They are the earliest time indicators to survive in any appreciable number – thousands have been recorded, not only in England but across Europe. As such it is most surprising they have not aroused more interest, appreciation and study amongst sun diallists, horologists or antiquarians in general.

I stumbled upon scratch dials by accident. Whilst researching the horological history of my local parish – Charing, Kent – I became aware that the local church had a barely visible scratch dial.¹ It was first recorded by Gerald Winzar in the 1970s. Failing health curtailed his recording activities and his partial Kentish survey lay dormant for 30 years until his widow afforded me the honour of bringing it into the public domain.² During these researches, I quickly devoured the classic scratch and mass dial texts – Horne, Greene and Cole. These only further aroused rather than satisfied my curiosity.

Soon after I joined the BSS. I was immediately struck by two facts. First, the Mass Dial Group's dedicated recorders had compiled a massive national database: a resource of enormous potential awaiting systematic analysis and investigation. Secondly, BSS members' interest in scratch dials appears surprisingly muted. A recent survey³ reported "...mass and Saxon dials are in a rather lowly 14th [out of 17] place, mass dials in particular seemed rather unloved...". Only humour, competitions and poems were less popular, and not by much! Examination of unpublished survey returns indicates that although 36% of respondents declared modest or strong interest in mass dials, 45% had little or none.⁴

Each fact of itself is surprising: valuable data does not usually remain uninvestigated for long in the modern age; also given that scratch dials and their predecessors account for the bulk of sundial and horological elapsed history, a less muted interest is only to be expected. Together the facts are paradoxical and anomalous. The uninvestigated potentiality of the database is surely the means to revive interest and appreciation. Most standard views and current received wisdom can be traced back to the interwar years. A reassessment is long overdue.

As a contribution to rehabilitating scratch dial interest and reviving scholarship, the mass dial database is being analysed. It is of a scale, coverage and detail that cannot but contain copious embedded information. Mathematical and

statistical methodologies hitherto unapplied in the study of scratch dials have been deployed. As a consequence, it is possible to rigorously address and answer in a quantified fashion questions such as

- How many dials have been recorded and how are they distributed by type?
- How many dials were there originally?
- How and why have dials been lost?
- How many dials remain to be discovered?
- How and why did dials change and evolve?
- What did dials look like originally?
- Why do we see multiple dials on churches?
- How and when were scratch dials affected by scientific sundials and clocks?
- Are there regional patterns, and if so, why?

As a result, a much fuller and richer insight into scratch dials – both their original prevalence, use, appearance and evolution as well as their eventual fate due to new technologies, church rebuilding and the elements – is emerging. Scratch dials have much to tell us that hitherto we have not heard.

Whilst a review of the scratch dial literature and much analysis has already been completed and some initial thoughts aired⁵, there is still considerable work in progress. It is planned that a complete and detailed write-up of all my researches be published eventually as a BSS monograph. In the interim, I am grateful for the Editor's suggestion and kind invitation to share briefly some of my findings on a regular quarterly basis.

REFERENCES AND NOTES

1. CHK Williams: 'Charing Clocks, Clockmakers and Clock-keepers' Parts I & II, *Archeologia Cantiana*, CXXV & CXXVI, 183-202 & 87-114 (2005 & 2006). See also 'The Church Clocks of Charing, Kent' *Antiquarian Horology*, 29, 371-396 (2006). These articles exhaustively list from medieval to modern times all known evidence, physical and documentary, of sundials associated with Charing Church.
2. CHK Williams: 'The Scratch Dials of Kent', *Archeologia Cantiana*, CXXVII, 333-356 (2007). Gerald Winzar's recordings have since been donated to the BSS archive.
3. BSS Readership Survey Results, distributed with *Bull BSS*, 18 (iii), (2006).
4. Returns provided courtesy of the Editor. Respondents ranked their interests from no interest (1) to very interested (5).
5. See note 2. Copies available via Tony Wood or the Editor.

HISTORICAL OVERVIEW OF THE LISTING/RECORDING OF ENGLISH SCRATCH (MASS) DIALS

CHRIS H K WILLIAMS

Over 5000 English scratch dials have been recorded. Whilst scratch dials have been found throughout Europe, even the higher mainland country listings are only in the lower hundreds. The longevity and extent of scratch dial listing and recording has been a particularly English activity.

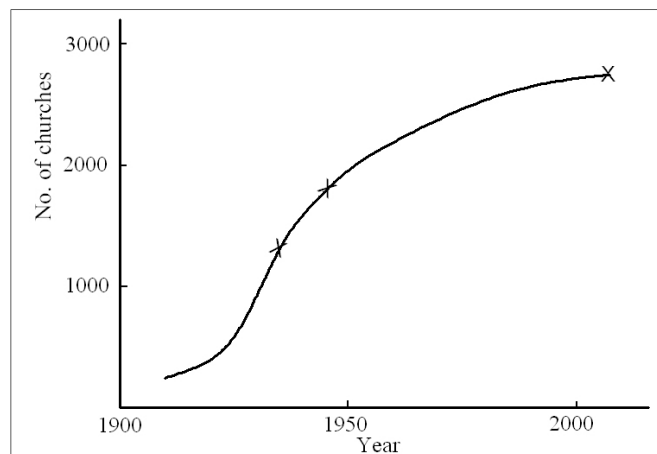
Four distinct historical periods can be discerned

1. Scratch dials first came to the notice of antiquarians during Victorian times.¹ Their work tended to be piecemeal and unsystematic. Considerable uncertainty surrounded their interpretation as sundials. Some even questioned whether they were dials at all.²

2. In some senses the interwar period marked the heyday of scratch dial study. Its achievement is encapsulated by Horne's classic study and Cole's synthesis. Horne³ completed the first thorough and exhaustive county⁴ survey – to this day it serves as a benchmark. In addition to collating hitherto published listings, Cole also took into account those that were unpublished. In his citations Cole⁵ names approaching 50 individuals (far beyond recognised authors in the literature) as well as several "...and others" mentions. One can only conclude the active research community was in excess of 50. In 1935⁶ there were 1350 and in 1945⁷ 1800 churches with listed scratch dials. It became universally agreed they were primitive sundials, and their purpose and development was deduced – albeit on an outline presumed basis rather than an academically rigorous one.⁸

3. Turning to the post-war period, one might be excused for thinking the scene was set for the pioneers' achievements to be crowned and embellished. It never happened. Lone individuals laboured in isolation, painstakingly listing and recording within their own counties. Much of this went unpublished and were it not for the subsequent focus provided by the BSS much more would have been lost.⁹

4. The BSS Mass Dial Group under the leadership of Edward Martin¹⁰ and Tony Wood, fuelled by an instinctive recognition of how many dials had been, and were being lost, prioritised the detailed recording of surviving dials. By 2007 the number of known churches with dials had increased to almost 2800. Approaching 5500 individual dials have been listed – most of which have been recorded in detail by the BSS. The Mass Dial Group has averaged about 10 active members, just a fraction of the inter-war community.



Notes

1. x marks statistical benchmarks. Cole (1935 & 1945) and BSS (2007).
2. 1935-45 by linear interpolation.
3. pre 1935 extrapolated by author's analysis of the published scratch dial listing literature.
4. 1945-2007 illustrative interpolation indicating progressive saturation effect.

The historical evolution of dial listing is shown above.

Some might be surprised at the apparent modest post-1988 contribution. In fact the BSS has ensured the survival of the entire post-war findings, both through acquiring unpublished works (thereby guaranteeing survival) and the 'rediscovery' of dials (lost in the unknown unpublished work) – note 9. In addition the Mass Dial Group has made detailed recordings of the majority of known dials.¹¹ In short, a twin achievement which history will always judge to have been monumental.

REFERENCES AND NOTES

1. An interest that extended to Saxon dials.
2. Theories included Sexton's Wheels (a device to choose fast days by chance) and mason's protractors.
3. E. Horne: *Primitive Sun Dials or Scratch Dials. Containing a list of those in Somerset*. Barnicott & Pearce, Taunton (1917). See also Tony Wood, 'Dom Ethelbert Horne. Founding Father of Mass Dial Studies', *Bull BSS*, 17(iii), 128-9 (2005).
4. The county has become the traditional statistical unit in scratch dial listing. However this article focuses on the English total; county considerations will be discussed in subsequent articles.
5. T.W. Cole: *Scratch-Dials on Churches Interim List*. The Hill Book Shop, Wimbledon (Undated, 1934).
6. T.W. Cole: *Origin and Use of Church Scratch-Dials*. The Hill Bookshop, Wimbledon (Undated, 1935).

7. T.W. Cole: 'Church Sundials in Medieval England'. *Journal of the British Archaeological Association*, 10 (3rd Series), 77-80 (1947).
8. See C.K. Aked, 'Treasures of the Church by T.W. Cole', *Bull BSS*, **91.3**, 5-12 (1991) for a somewhat harsh assessment of Cole's legacy. Without Cole we would not have such a vivid insight into the 1930s scratch dial community, nor have the historical statistical datum points that included unpublished listings.
9. The Chambers, Goodwins, Hesketh, Watts and Winzar archives, all now in the BSS library, are of course only

examples of known survivals from the 1950s to 70s: sadly an unknown quantity has been lost (or not yet found its way to the BSS).

10. A.O. Wood, 'Obituary: Edward Rankine Martin 1925-2007', *Bull BSS*, **19**(iii), 104 (2007).
11. Earlier work (before the Mass Dials Group's activities) was in the main confined to listing, with any recording being typically limited to dial position and abbreviated description. Imaging, photographic or drawing, was very much the exception.

Another Scaphe Dial By Mary Watts

Douglas Bateman

Elizabeth Hutchings wrote about a sundial pedestal by the prolific potter Mary Watts (1849-1938) and included a photograph of a scaphe dial with a cherub, which is in the Watts Gallery.¹ (The Watts Gallery in Compton, Surrey, contains a remarkable collection of paintings and sculpture by G F Watts. The gallery was a runner up in the popular BBC series Restoration.) Not far away in Farnborough, Hampshire, there is a similar dial although it has suffered from over 90 years of weathering.

The dial has a plaque on the pedestal that states *In memory of our dear friend Edward T Busk pioneer of the stable aeroplane who died by fire in the air on 5th November 1914. Erected by the staff of the Royal Aircraft Factory.* The Factory became the well known Royal Aircraft Establishment and the house journal recorded in 1971 that Edward Busk was one of the greatest British aviation pioneers. He joined the Royal Aircraft Factory in 1912 and devoted much of his time to the mathematics and dynamics of stable flight. In addition, he was in charge of chemical, metallurgical and physical research, and test work. He died at the age of 28.



A former Director designed a wooden pedestal and "bought a small sundial to go on it from an antique shop in Chelsea" to be a suitable memorial. The pedestal eventually decayed and the dial was moved in 1970 to overlook a small lily pond created near one of the main gates. The site has been extensively redeveloped (the Royal Aircraft Establishment no longer exists as such) and the dial is now in the safe keeping of the Farnborough Air Sciences Trust, a small and active museum dedicated to the history of aviation and aerospace in Farnborough, where Britain's first man powered flight took place on 16 October 1908.

REFERENCE

1. Elizabeth Hutchings: 'Isle of Wight Mystery Sundial Solved' *Bull BSS*, **19**(iii), pp.112-113 (2007).

THE GEOGRAPHICAL DISTRIBUTION OF SURVIVING ENGLISH SCRATCH (MASS) DIALS

CHRIS H.K. WILLIAMS

Although English scratch dials survive by the thousand,¹ their occurrence is far from uniform. Before establishing this, three salient features regarding the data employed in this and subsequent articles warrant specific mention.

A primary objective has been to base analysis on the totality of information available. Accordingly, a composite database has been compiled that includes, in addition to the BSS Mass Dials Group's records (c. 5000 scratch dials), all other sources judged to be substantive – some 35 independent listings.² For every church, the number of dials listed by each (dated) source is noted and cross-referenced to detailed recording information.³ It is thus possible to exhaustively interrogate the entire national database.⁴

Although the county has been the traditional focus of study, it has not been a stable currency – the BSS uses current county boundaries, the literature a wide variety of vintages. Clearly, establishing and consistently investigating a composite national database requires unchanging boundaries. It was decided, essentially on grounds of pragmatism, to adopt the historic pre-1832 parish and county boundaries.⁵ In particular, it most closely accords with the original distribution and number of medieval churches, i.e. where scratch dials are to be found. The strongest argument in favour of current boundaries – familiarity – will be lost with future local government reform.

Sadly, almost the entire corpus of earlier work has lost part of the information originally available because, with very few exceptions, churches without scratch dials were not reported.⁶ Whilst this reflects the natural human tendency to report hits rather than misses, statistically each is as valuable as the other and both are required. How else are churches without dials to be differentiated from those not yet examined?⁷ Happily, by contacting individual recorders, it proved possible to redeem the situation for several counties.⁸ As a consequence, half the counties in the composite national database include full listings of churches without scratch dials.

Returning to the distribution of surviving scratch dials, the simplest and most revealing indicator is the proportion of medieval churches with one or more scratch dials (Fig. 1).

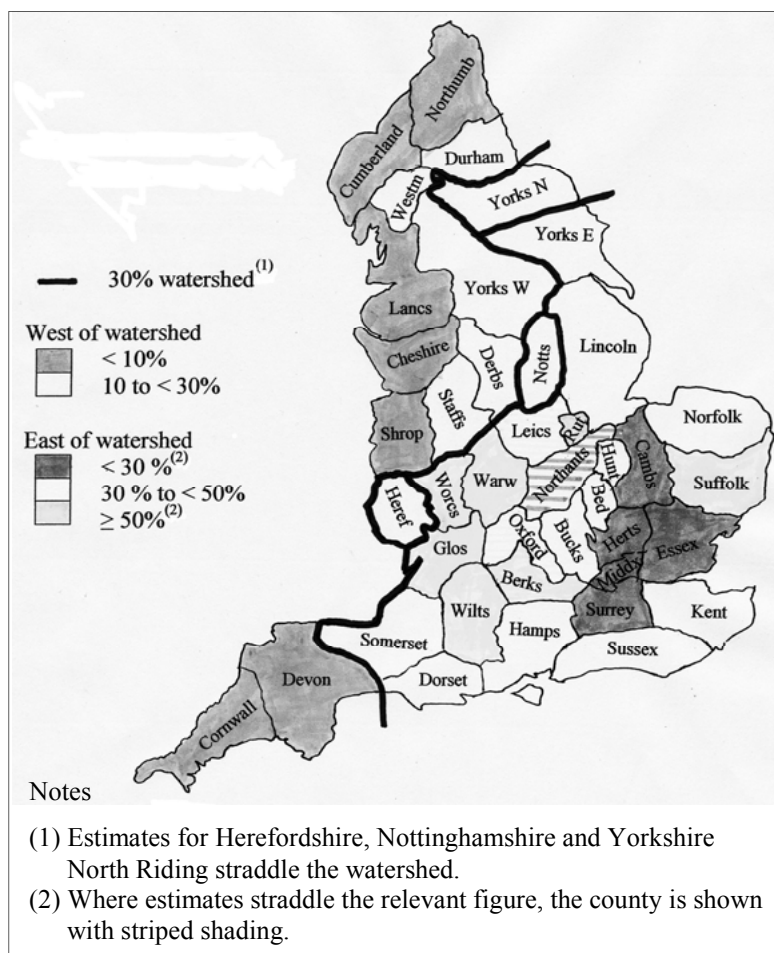


Fig. 1. Geographical distribution of medieval churches with surviving scratch dial(s).

Estimating this for each county is very much a tale of two halves. For the well surveyed half,⁹ where effective survey rates exceed 80%,¹⁰ this can be directly estimated from the number of churches with and without scratch dials. Given the high survey rates, these are very accurate and reliable estimates.

For the remaining half, the proportion of churches with scratch dials cannot be estimated directly. For these counties we neither know the number of churches without dials nor the effective survey rate. That said, an indirect method of estimation is possible with the assistance of a statistical relationship established for the well surveyed counties. Fig. 2 shows that as the proportion of churches with scratch dial rises, the more dials there are on those churches. Whilst this relationship is neither perfect nor absolute, it does, when

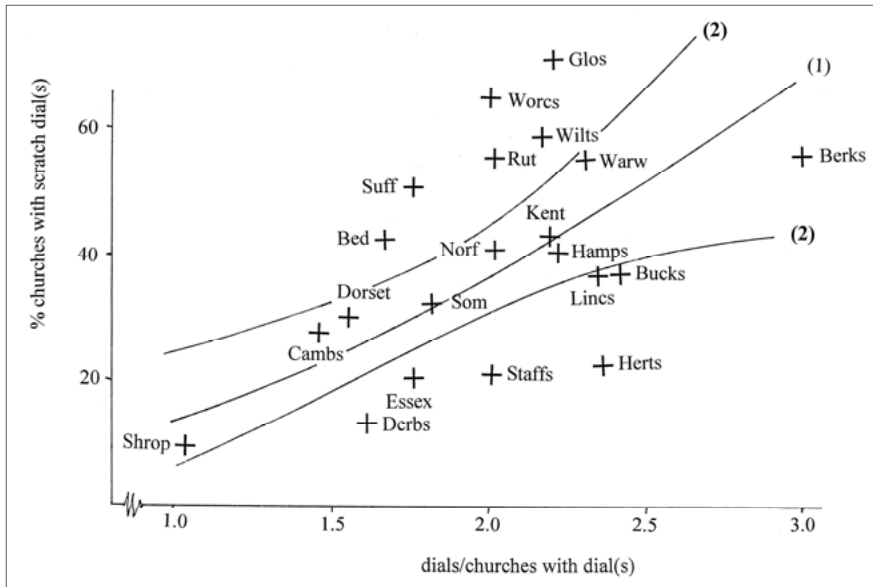


Fig. 2. Relationship between percentage of medieval churches with scratch dials and average number of dials on those churches.

Notes:

- (1) Estimated by standard least squares regression for the 21 well surveyed counties.
- (2) Statistical range with theoretical 90% chance that the true figure lies within it.

combined with such information as we have for the less certainly/less well surveyed counties,¹¹ permit a range estimate to be formulated.¹²

There is a marked watershed and regional clustering in the distribution of surviving scratch dials (Fig. 1). East of the watershed, scratch dials typically survive on more than 30% of medieval churches, with a hot cluster of over 50%, but also a cold cluster failing to achieve the watershed level. West of the watershed, survival rates collapse. Although the area has less evidence of systematic surveying than to the east, the consistency and pattern of the picture painted leaves little doubt regarding its veracity. Most of these counties have less than 20% of medieval churches with scratch dials, with a very low (under 10%) fringing cluster – an English fringing cluster extending into Wales, Scotland and Ireland.¹³ Whilst various ideas might immediately spring to readers' minds – e.g. the fringing and cold clusters correlate with the geologically oldest and home counties respectively – the implications of the surviving distribution for either original scratch dial prevalence and/or their subsequent loss must await future articles.

REFERENCES AND NOTES

1. Chris H.K. Williams: 'Historical Overview of the Listing/Recording of English Scratch (Mass) Dials', *Bulletin BSS*, 20 (i), 11-12, (2008).
2. Brevity dictates their citation must await the (forthcoming) monograph.
3. This permits, as will be seen throughout this series of articles, numerous insights and summary information to be extracted e.g. the overlap or otherwise between county listings indicates the extent of their coverage and quality, dated listings potentially indicate dials that have been destroyed, dials that have been moved can be totalled and each dial can be systematically categorised.
4. Rather than rely on one county or the experience of a single recorder – a marked tendency in the literature.
5. As mapped and listed by The Institute of Heraldic and Genealogical Studies. See C.R. Humphrey-Smith, *Atlas & Index of Parish Registers*, Phillimore, (2003).
6. Only four counties have a significant number of churches without scratch dials reported in the literature. The BSS does not record churches without dials.
7. With implications starker than may be immediately apparent. Neither the extent of surveying nor the proportion of churches with dials can be directly or definitively estimated.
8. Especially Ian Butson and John Lester (7 & 4 counties respectively). Also Bob Adams, John Ingram, Gordon Le Pard, Peter Ransom, Lyn Stilgoe, Chris Williams and Tony Wood ('their own' counties).
9. Identified in Fig. 2.
10. A county's survey rate is the number of churches listed with and without scratch dials divided by the number of historic parishes. The latter is the maximum number of medieval churches a county can be expected to have had, not all of which have (wholly) survived. The effective survey rate is based on those churches with not insignificant medieval components. Information established by inspection, architectural studies, or N Pevsner *The Buildings of England* series (provided by recorders note 8) suggests eligible churches fall short of the number of parishes by between 5-20%.
11. The average number of dials (on churches with dials) is of course known for the less certainly/less well surveyed counties thereby permitting Fig 2 to be applied. The Fig 2 range (for the proportion of churches with dials) can be cross-checked with other information (especially the number of recorded churches with dials and qualitative assessment of survey coverage/reliability) and if necessary adjusted. In fact this indicated that many of the hitherto apparently less certainly surveyed counties are likely to be reasonably well surveyed. It can be estimated that 90-95% of surviving English scratch dials have already been found. The two counties with the greatest number of dials (more than 50 each) yet to be discovered are Yorkshire and Sussex.
12. The entirety of the data and analysis underpinning this article will be published in a forthcoming BSS monograph. This will include detailed tabulations for each county and a full explanation of the technical statistical procedures employed.
13. Less than 20 scratch dials are known in each of Wales, Scotland and Ireland (BSS records). See also M. Arnaldi, *The Ancient Sundials of Ireland*, BSS (2000) and W. Linnard, 'Welsh Scratch Dials', *Archaeologia Cambrensis* (forthcoming). Although there must be doubts how well surveyed these countries are, known dials imply an exceeding low survival even by English fringe standards.

gold size mixed with yellow paint. Loose leaf is very awkward to work with, for it is so thin as to blow away in the slightest air current or breath, but is preferable when gilding V-cuts as there is no backing paper to hinder moulding the gold into the forms. It is still tricky to get the gold to the bottom of a deep cut, as when carrying the cut piece of leaf on the gilder's tip to the work there is an almost irresistible tendency for it to catch on and stick to the tacky sides of the sized cut before it reaches the bottom; as it has no strength at all it then tears leaving gaps uncovered. One can try to gild each face of the cut separately but even so there is the tendency to catch; I am an amateur, and it will take me years of practice to overcome this. One of the beauties of polished slate as a material – as opposed to riven slate or more porous stones – is that it is so fine grained and impervious that one can paint and gild precisely over the edges of the cuts onto the surface and simply rub the surplus off using plenty of water and fine abrasive paper (carborundum, wet and dry) after leaving the paint and size for a few days to harden.

Peter and I had hoped that the School workshop would be able to contribute to the work with the gnomon and fixings, but in the end this was not possible and I made these myself, all of stainless steel. A big lathe with a coolant pump



would have saved a lot of time here! The gnomon is made of 10 mm rod threaded M8 and screwed at the appropriate angle into a 32 mm boss which I turned and fitted into the slate with a locating pin, epoxy, and held by an M12 nut behind the dial. I hope it will survive the school environment, but if it should be damaged the long gnomon bar could be unscrewed and a replacement fitted. The dial is held by four collars, turned from 32 mm bar and threaded M10 on to stainless expanding bolts set into the brick wall.

Will, a builder employed by the school, was instrumental in putting the dial up, and I must thank two friends; Alan Davies for supplying offcuts of stainless steel, and Ken Lee for letting me use his lathe and workshop and for his unstinting help with fixing the dial.

On Midsummer's Day 2007, 21st June, the School held a small party to unveil the dial which we had erected two days earlier. Christine's family pulled off the covering cloth at exactly 4pm and, although clouds and rain predominated that day, two minutes later the sun kindly emerged for a few seconds to prove that the dial did show the correct time – a most satisfying conclusion to a very rewarding project.

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ENGLISH SCRATCH (MASS) DIALS: THE RAVAGES OF TIME

CHRIS H K WILLIAMS

It has always been recognised that not all scratch dials have survived. Since the earliest recorders it was surmised that those barely visible dials in poor condition were but the latest cohort to be on the verge of destruction due to weathering. Also it was realised that church rebuilding, a shorthand covering repairs to restoration, must have taken an additional toll.

For the first time it is now possible to scientifically estimate the rate of dial loss. The composite database¹ permits two quantitative indicators of dial loss: both are statistically very reliable as each is based on an analysis embracing a quarter of all dials ever listed. Together they reveal dial loss to have been considerably higher than scratch dial recorders or students have hitherto realised or envisaged.

A measure of twentieth century dial loss can be calculated directly from previously listed dials subsequently found to be lost. A comparison for well-surveyed counties with their

pre-war listings² indicates an annual dial loss of 0.5% – one dial a fortnight! Continuation of such an exponential loss would halve those surviving (currently c.5000³) by 2150.

Given the Victorian climaxing of church restoration and the cumulative impact of pollution – atmospheric and precipitative – most twentieth century dial loss can be attributed to weathering. It is probable that earlier weathering loss rates were lower but not negligible – the freeze-thaw cycle has always been with us.⁴ Whilst earlier rates may have been lower there would have been more scratch dials to weather out in earlier centuries. Overall, the contribution of weathering to dial loss has to be seen in terms of c.2000 dials per century.

Turning to the impact of rebuilding,⁵ the only directly measurable consequence is scratch dials no longer in their original position, i.e. those on non-south-facing walls or inside the church, and those that have been rotated/inverted

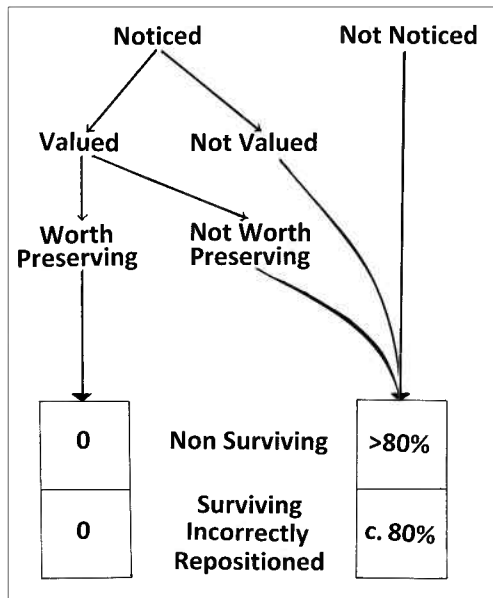


Fig. 1. The fate of moved scratch dials during rebuilding.

or are impractically high or low on a south facing wall. Analysis of the database reveals that 16.5% of surviving dials exhibit visible evidence of relocation.⁶ Although a robust reliable statistic in its own right, it does not of itself indicate lost/destroyed dials. To do that it needs to be interpreted in the context of the possible alternative fates awaiting a dial during rebuilding (see Fig. 1).

Most possibilities flow into the ‘negative’ right-hand channel. In this case dial loss can be expected to be high because of the high likelihood of the stone being turned around to use one of its other five sides, redressed, or (if it is in poor condition) demoted to rubble or infill. Those dials not lost can be expected to have a high rate of incorrect location/orientation because of a three in four chance a randomly reused stone will have been rotated plus allowance for stones reused on non-south-facing walls. In marked contrast, any dial fortunate enough to have progressed through the ‘positive’ left-hand channel would, by definition, have survived unscathed – physically, locationally, and in its orientation.

The fate of the vast majority of dials is likely to have been decided in the negative channel. The wide locational scatter of moved surviving dials from their original position is indicative of scant regard for scratch dials. There is no

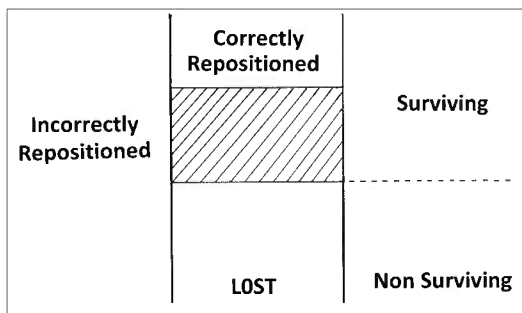


Fig. 2. Moved scratch dials – surviving and non-surviving.

known evidence they were noticed or valued prior to some Victorian antiquarians. Compared with scientific sundials and clocks, they could only be judged as exceedingly primitive.⁷ Even when and where there might have been sympathy for them, one suspects only well preserved or particularly interesting looking examples would have been conserved.

We now have sufficient quantified parameters to deduce the impact of rebuilding (see Fig. 2). The number of existing dials that survived rebuilding can be calculated from the number of incorrectly repositioned dials (the 16.5% estimate and the c.5000 surviving dial total) and the correct-incorrect repositioning split of surviving moved dials (see Fig. 1). Dials lost to rebuilding can then be calculated using the surviving/lost split of moved dials. On this basis the loss to rebuilding is estimated to be in the region of 4250 dials.⁸

The combined loss to weathering and rebuilding can thus be seen to have been devastating. However large or rich the surviving scratch dial heritage might appear to be, it is but a fraction of what once existed. Far more has been lost than survives.⁹

REFERENCES AND NOTES

1. See Chris HK Williams: ‘Geographical Distribution of Surviving English Scratch (Mass) Dials’, *Bull. BSS*, 20(ii), 75-76, (2008).
2. Some 1250 pre-war listed dials, mainly in Gloucestershire, Hampshire, Lincolnshire, Norfolk, Somerset, Suffolk and Worcestershire. See monograph (forthcoming) for listing sources and statistical procedures adopted.
3. See Chris HK Williams: ‘Historical Overview of the Listing / Recording of English Scratch (Mass) Dials’, *Bull. BSS*, 20(i), 11-12, (2008).
4. Pre-twentieth century weathering loss rates and their link to dial age will be considered further in a subsequent article.
5. For a very readable and speedy appreciation of the scale and vicissitudes of successive waves of church rebuilding see Roy Strong: *A Little History of the English Country Church*, Jonathan Cape, London, (2007).
6. Approaching 1500 dials from nine county listings (Dorset, Hampshire, Herefordshire, Lincolnshire, Rutland, Somerset, Suffolk, Wiltshire and Worcestershire). See monograph (forthcoming) for listing sources and statistical procedures adopted.
7. The fate of old clocks decommissioned in the seventeenth and eighteenth centuries is salutary. Considerable documentary evidence attests to their being scrapped or left to rust. If such was the typical fate of old clocks, what chance did old scratch dials have?
8. Although the author is inclined to the view that conscious scratch dial preservation was low, the estimate of dial loss is invariant to the level assumed. Its twin effects (on the correctness of moved dial repositioning and the survival rate of moved dials) are arithmetically offsetting.
9. Dial loss and, more importantly, its implications, will be considered further in future articles.

THE LIFE CYCLE OF ENGLISH SCRATCH (MASS) DIALS

CHRIS H K WILLIAMS

We have seen that most English churches do not have a surviving scratch dial¹ and that dial losses far exceed survivals². Whilst such findings are of interest in their own right in illuminating the status and context of surviving dials, a far greater prize would be the recreation of the past original scratch dial position. That must of course be linked to what survives; but how can the link be deciphered? The linkage is not simple. Indeed, half a millennium of scratch dial usage renders the words 'past' and 'original' at best ambiguous and, at worst, meaningless. This article develops an approach for linking the present surviving scratch dial heritage to its past.

After extensive consideration, the author is convinced the only way to discern linkage is to view scratch dial evolution as a continuous dynamic process – the net outcome of several separate independent dynamic factors. The proposed framework constitutes a single methodology allowing all known scratch dial data and influences to be simultaneously incorporated in a consistent and numerical fashion.³ It is not too fanciful to view scratch dial evolution in life cycle and evolutionary terms – scratch dials had birth, death and extinction rates; we are left with the fossils.⁴

The most enduring dynamic forces, operable both during and after the scratch dial era, are the destructive processes of weathering and church rebuilding. The true scale of *dial loss* has not hitherto been appreciated; neither has its implications. When imagining where all the lost dials might once have been, logic alone quickly persuades one they came not only from churches with, but also those without, surviving dials. Weathering and rebuilding affected all dials – it did not discriminate by how many dials a church had! Churches with surviving dials have lost some of their dials, those without have lost all of them.

Can we be sure all medieval churches once had a scratch dial? Whilst visible evidence is impossible, circumstantial evidence is abundant. As simple, low cost, easily imitated devices there were no natural barriers to the spread of scratch dials. Surviving examples alone are sufficiently numerous and geographically dispersed to indicate know-how, capability and adoption must have been universal. Allowing for lost dials, the point can be made even more strongly. Moreover, the geographically dispersed survival of Saxon dials indicates awareness predated medieval times. In combination, the foregoing considerations make the case in favour of universal scratch dial adoption overwhelming.⁵

Many more churches must once have had multiple dials than is currently indicated by surviving examples. That such was the case is statistically corroborated by the database⁶: the more dials surviving in a county, the more of its churches have dials and the more dials there are on those churches. Figure 1 illustrates the interplay between the extent of dial survival and the number of dials per church. Allowing for lost dials, the unavoidable conclusion is that churches must once have had more than one scratch dial – most had several.

The prevalence of multiple dials is evidence of dynamic processes resulting in *dial redundancy*.⁷ The need to make a new scratch dial can be attributed to several possible causes. Firstly, the shadow cast by the building of porches or growth of trees could render a dial inoperative. Secondly, events as innocuous as using a different entrance to a church or a change in the priest's dwelling place could leave a dial inconveniently located. Thirdly, as scratch dial design and appearance⁸ changed and evolved, dials would become unfashionable or otherwise considered inappropriate. Fourthly, personalisation: the desire by some vicars, if only a minority, to have their 'own' dial would leave a dial redundant for no apparent reason.⁹ Redundancy would have accumulated throughout the scratch dial era – half a millennium. In combination, these considerations suggest multi-dialled churches should be the expected norm rather than exception.

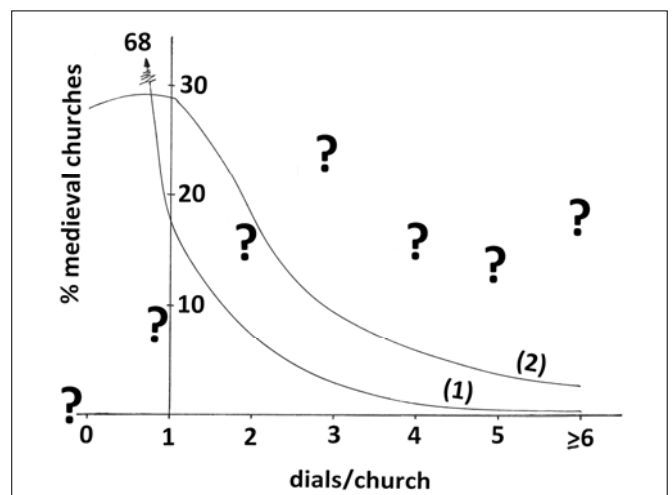


Fig 1. Relationship between the incidence of multi-dialled churches and the extent of scratch dial survival. Curve 1: Somerset surviving (30% of churches with dials). Curve 2: Gloucestershire surviving (70% of churches with dials). Curve ?: Illustrative 'original' (100 per cent of churches with no subsequent dial loss – discussed further in future articles).

The remaining dynamic process was *dial displacement* by alternative technologies—scientific dials and mechanical clocks. Exactly when they were displaced is critical to scratch dial assessment. The horological literature is surprisingly muted in its examination of either the geographical or temporal distribution of the shift from seasonal to equal hours. The classic early (14th-16th century) examples of scientific dials, mechanical clocks and documentary or literary references to equal hours have to be judged for what they are – isolated examples confined to wealthy patrons (individual or institutional) within cosmopolitan and courtly circles. They cannot be considered representative of the generality of parish churches. Examination of primary documentary sources leaves little doubt most parishes gave up scratch dial use, at an increasing rate, during the seventeenth century.¹⁰ It is clear that previous authorities were apt, when dating the demise of scratch dials, to be unduly influenced by early examples of, rather than any awareness of their general, displacement.¹¹

Pulling all the strands together we obtain a framework within which both the actual and post scratch dial eras can be jointly considered. On each and every parish church new dials would have been cut, though only a single dial actively used, until such time scratch dial usage was displaced. The displacement was a prolonged process, but most parishes converted during the seventeenth century. The maximum number of scratch dials across all churches would have been attained towards the end of their displacement, say c. 1650-1700 i.e. when new dials at the few remaining churches still using them was offset by losses at the bulk of churches no longer using them. This represents a significant turning point. Prior to c. 1650-1700 all three dynamic forces – redundancy, displacement and losses – were in play; thereafter only losses operate and the number of surviving dials progressively declines.

Remarkably, as will be evidenced in future articles, the dynamic life cycle framework we have developed, in combination with surviving scratch dial (the database) and other information, yields many quantified and dated historical insights that brings to life and recreates the scratch dial era.

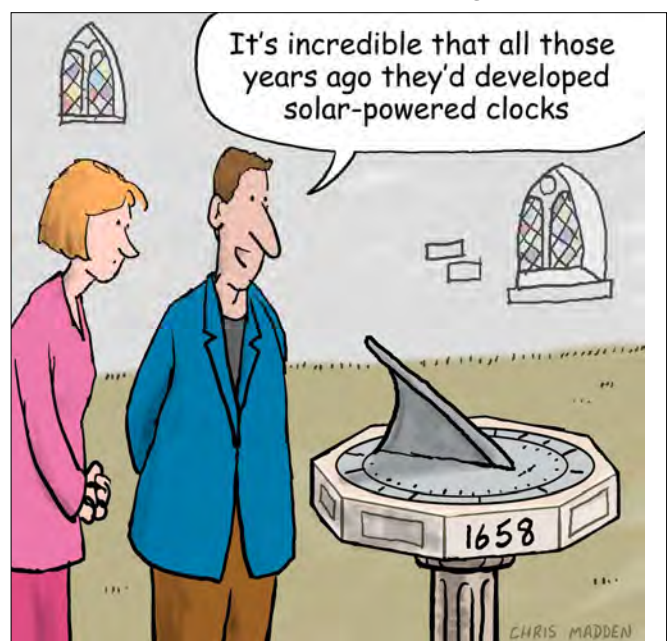
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3. Moreover, as will be seen in subsequent articles, where quantified data does not exist, it permits ranges of parameter values consistent with all other known information, to be derived.
4. Fossils are an apt analogy when we consider (in a subsequent article) the possible appearance of scratch dials when they were in use. What remains is a partial, monochrome, skeletal image.
5. Reassurance that this is correct is provided via a rigorous devil's advocate challenge. Should possible areas of non-

adoption be discerned from the pattern of surviving dials and loss estimates, formulating a diffusion model that simultaneously explains the patchy intra-county adoption, inter county adoption relativities, and their persistence throughout the scratch dial era, is mission impossible. There is no logically credible alternative hypothesis to universal adoption.

6. See Fig. 2 in Ref.(1).
7. It has on occasion been suggested in the literature that multiple dials exist because they are practice dials (by the original makers) or copy dials (by subsequent miscreants). It is not explained why practitioners did not practice in a more private manner, nor why subsequent graffiti should be so uniform/uninspired. Whilst such eventualities cannot be dismissed as never occurring, to postulate one or both to explain the prevalence of multi-dialled churches is inherently implausible.
8. To be considered in detail in future articles.
9. In judging the realism of redundancy due to personalisation, bear in mind the number of priests involved. For the author's own parish (Charing, Kent) the average incumbency was nine years between the 13th-17th centuries.
10. Kentish churchwardens' accounts are being systematically reviewed by the author. The first procurement by parishes of scientific dials or mechanical clocks is overwhelmingly in the seventeenth century. Numerous parishes never had a clock and did not procure a scientific dial until the eighteenth century (unpublished work in progress). This pattern of conversion from seasonal to equal hours is supported by the spread of clock ownership as revealed by Kent and Glamorgan probate inventories. See C.H.K. Williams 'Seventeenth and Eighteenth Century Clock Demand, Production and Survival', *Antiquarian Horology*, 28, 571-583, (2005) and 'Clock Ownership from Provincial Inventories', *Antiquarian Horology*, 30, 253, (2007).
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This cartoon by the artist Chris Madden first appeared in the BBC Focus magazine of August 2008, illustrating an article entitled 'The Last Word - I have a passion for mechanical devices that use sheer ingenuity to do what some nerd can knock off in two lines of programming' by Robert Matthews. Thanks to Jill Wilson for submitting it.

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THE MASS DIALS OF CONTINENTAL EUROPE

CHRIS H.K. WILLIAMS

Early primitive sundials – the contemporaneous equivalent to what English diallists term Saxon or scratch dials – have long been recorded across the length and breadth of Europe. How do British and Continental dials compare and relate to one another? Two issues bedevil the literature. British and Continental students were not always aware of each other's efforts; and much work is based on limited evidence with little indication of how statistically representative it might be. In consequence, whilst it is obvious and indisputable British dials are part of a shared Europe-wide heritage, details of their co-evolution is ambiguous.¹ Definitive insight awaits a systematic appreciation of surviving dials.

Accordingly, this article reviews the status of Continental listing/recording. These have always been dwarfed by their English counterpart,² almost certainly a reflection of less intensive surveying. There is no Continental equivalent to Horne, Cole, or the Mass Dial Group (MDG). By the 1960s it was known that mass dials survived across the breadth of Europe.³ The considered opinion of the MDG in 1991 was "that there were a great many in the north of France and in Germany".⁴ In 1996 it was noted there were "about 250 known Continental examples".⁵ Since then we have witnessed an apparent explosion in our awareness of surviving dials.⁶ These include both published sources and unpublished BSS listings/recordings.

In contrast to the UK, the MDG does not have a systematic programme to record Continental dials. It has, however, over the last decade, filed reports of dials encountered by its recorders (when on holiday) or notified by (overseas) BSS members. Although the filings are essentially opportunistic they still total approaching 300 dials (Table 1).

Turning to published sources these include:

- Armenia: A two week survey concluded "some forty of the principal old churches were visited, over half of which carried sundials, and there are certainly as many more."⁷

- France: In recent years the number of listed dials has increased by about 150 annually and now totals in the region of 1000.⁸
- Germany: A local study listed 21 dials.⁹
- Greece: A series of articles discuss and record 9 dials.¹⁰
- Hungary: A series of articles discuss and record 7 dials.¹¹
- Spain: Two major studies, one national and the other regional, list some 300 dials.¹²
- (Former) Yugoslavia: Two articles point to 7 dials.¹³

Country	No. Dials
Austria	4
Denmark	8
France	212
Germany	1
Norway	9
Poland	1
Spain	25
Sweden	1

Table 1. Continental mass dials in MDG Files.

Source: A.O. Wood, personal communication.

How should all this evidence be interpreted? Perhaps the most obvious and longstanding general feature is the sheer geographical spread of mass dials; a feature reinforced by more recent work. The 'extension' into south-east Europe is particularly noteworthy. It establishes the presence of mass dials on Orthodox, as well as Western, Christian churches. Recent sightings have even ventured beyond Europe. Two scratch dials have been recorded on the Armenian Church in Jerusalem.¹⁴ Two dials have also been reported in Mexico, undoubtedly a Spanish colonial import.¹⁵ All of this is consistent with a shared common heritage, and that such dials were in widespread and common usage.

There are strong reasons for believing the true number of surviving Continental dials to exceed, by a significant factor, this article's 2000 or so dials. Most obviously, because of linguistic and search constraints, not all actual listings have been included. More importantly, the listings

indicate they are the product of incomplete surveying – both inter-country and intra-country regional variations in the density of listed dials imply significant geographical variations in the level of surveying: furthermore the large increment of recent listings, particularly in France and Spain, suggests survey rates well below saturation. Continental listings appear low because not all churches have been surveyed. The much higher English listings reflect the fact it is the first country to be (virtually) fully surveyed.

It has been established that only a small fraction of English scratch dials have survived the twin rigours of weathering and rebuilding into present times.¹⁶ Although comparable conclusive Continental analysis is not yet feasible, anecdotal evidence abounds – the poor condition of many dials suggests many more have already succumbed to weathering; the frequent mention of repositioned dials attests to the impact of rebuilding. Whilst variant views might be held on the extent to which Continental conditions might have somewhat attenuated or compounded the English level of dial loss, there is no reason to doubt Continental dial loss has also been substantial.¹⁷

Whilst some robust general conclusions can be made at this stage, much remains to be done. A motivation for this preliminary review was the hope it might stimulate interest and assistance. The future agenda might fall into three parts:

- A comprehensive register of hitherto listed dials. The author is prepared to act as a post box to compile a full catalogue of sources.
- Extension of Continental surveying. As surviving evidence is constantly deteriorating, it is to be hoped accelerated progress will prove possible.
- Analysis of listed dial data. The author is undertaking a detailed analysis of England's database. Currently only France appears to have the statistical potential¹⁸ to warrant similar analysis. The extent to which this might be possible is being assessed with the collaborative assistance of Denis Schneider.

We will only really understand mass dial evolution in a European context when we know the genuine similarities and differences – both in what survives and might once have existed – across Europe.

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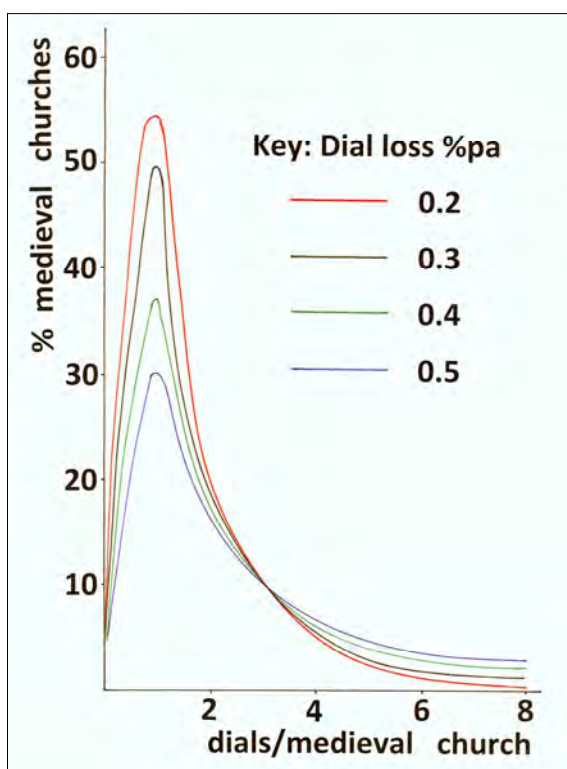
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17. We can be certain of one contributor to dial loss being relatively higher on the Continent – war damage, especially in Germany and east Europe. We should also be mindful of the impact of Ottoman occupation in south-east Europe.
18. This is a technical statistical matter of sufficient representative data. Only France has the 'feel' of potential adequacy-size of database, its rate of increase, and retrievable survey rates.

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THE PREVALENCE OF ENGLISH SCRATCH (MASS) DIALS c.1650—Part 1

CHRIS H K WILLIAMS

By utilising the data and methodologies developed in earlier articles, this paper establishes a benchmark for c.1650. Broader discussion and consideration of the regional dimension is deferred to Part 2. Circa 1650 is of special interest because scratch dial displacement (by scientific dials and clocks) was then virtually complete; consequently their number was at its maximum with subsequent evolution explicable solely in terms of dial loss.¹



Notes

1. Loss rates are applied to the median (% of medieval churches with listed surviving scratch dial(s)) grouping of the well surveyed counties. (See Chris H K Williams: 'The Geographic Distribution of Surviving English Scratch (Mass) Dials', *Bull BSS*, 20(ii), 75-6, (2008)).
2. Dial loss impacts all churches and all dials equally.
3. The surviving distribution is both shifted and stretched to the right and represents the higher dials/church portions of the c.1650 distributions.
4. The lower dials/church portions are derived via mathematical consistency constraints – ie each distribution has an average dials/church equal to that implied by total dial loss, is uni-modal, and relates coherently to those of different loss rates.
5. An allowance of 5% represents the earliest cases of displacement (cathedrals and churches attached to, or within earshot of, religious houses) whose former scratch dial(s) were lost prior to c.1650.

Fig. 1. Frequency distribution of scratch dials per church c.1650 for variant loss rates.

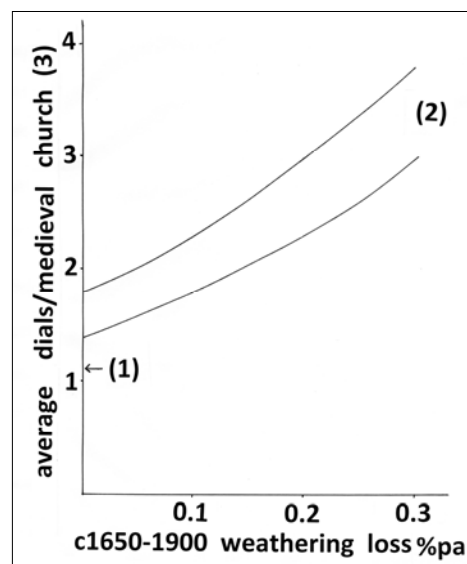
Loss rate c.1650 to listed surviving % pa	Dials lost post c.1650 %	Dials/church c.1650 ¹	
		Average No.	≥6 % churches
0.2	45	1.7	2.5
0.3	60	2.3	10
0.4	70	3.2	20
0.5	80	4.0	30

Note

1. The median grouping of Bedfordshire, Hampshire, Kent and Norfolk has an average of 0.8 listed surviving dials/medieval church with 1.25% of churches having 6 or more dials.

Table 1. Summary scratch dial measures for variant assumed loss rates.

The c.1650 prevalence of scratch dials consistent with the surviving incidence is mapped, for variant assumed dial loss rates, in Fig. 1 and Table 1. Not surprisingly, as the assumed loss rate increases, the surviving incidence becomes consistent with both an increasingly higher original average number of dials per church as well as an increasingly higher proportion of churches with multiple dials.



Notes

1. The 1900 level (1.1 dials/medieval church) is based on listed surviving dials (Table 1 note) and twentieth century dial loss.
2. Circa 1650 levels for 0.1-0.2% pa range of building loss (the curves) on variant c.1650- 1900 weathering loss rates.
3. Cross referencing average dials/church to Table 1 and Fig. 1 permits the associated frequency distribution and overall dial loss (average % pa and cumulative) to be interpolated.

Fig. 2. Average scratch dials c.1650 using estimated loss rates.

Certain elements of dial loss have been estimated.² The combined weathering and church rebuilding loss amounted to 0.5% pa in the twentieth century. The loss over the centuries attributable to rebuilding is some 0.1-0.2% pa.³ The implications of these estimates for the c.1650 reconstruction are shown in Fig. 2.

The major remaining uncertainty relates to pre-1900 weathering for which no direct estimate is currently possible. That said, related information and considerations can help to narrow and bound our uncertainty. Twentieth century weathering can be calculated as a residual - (0.5 minus 0.1 to 0.2)% pa. It is probable that twentieth century church rebuilding was below the historic average. After the Victorian climaxing of restoration some attenuation was only to be expected, not to mention the cumulative impact of a wave of crises⁴ culminating in the current pressing backlog of necessary repairs. Actual twentieth century weathering may well have been above the 0.3-0.4 % pa residual. On the other hand, pollution during the twentieth century can be expected to have increased the rate of weathering above the pre-1900 rate.

How relevant are recent (to pre-1900) weathering rates? Much more so than might be apparent at first glance. Whilst intuitively it might be supposed much lower rates of weathering applied in the past as dials were then so much younger, on reflection this turns out to be unconvincing. In brief, this arises for two reasons. Firstly, redundancy led to dial age being spread throughout the entire scratch dial era, not concentrated at its commencement. Secondly, it is the oldest dials that weather out. As a consequence the average age of surviving dials advances at a major discount to the passage of time.⁵

The evidence has been presented with sufficient transparency to facilitate readers applying their own judgement. The author is inclined to the view that c.1650 there were on average between two and three scratch dials per church.⁶

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2. Chris H K Williams: 'English Scratch (Mass) Dials: The Ravages of Time', *Bull BSS*, 20(iii), 110-111, (2008).
3. The estimate of building loss (*ibid*) is in the form of the number of dials relative to those surviving. It can be converted into an equivalent annual loss rate given the average age of scratch dials. The main text range assumes an average age starting between 1400 and 1600. Although the average age is not currently known, dial age is less than implied by earlier studies when due regard is paid to the completion of (rather than the earliest) displacement, the cumulative impact of redundancy, and the high rate of loss inevitably culling the oldest dials most-all significantly reduce the apparent perceived average age of surviving dials.
4. Two world wars, interwar depression, and financial pressures on the ecclesiastical economy spring to mind.
5. It can be shown on not unreasonable assumptions that the average age of surviving dials in the twentieth century was less than 100 years older than the c.1650 – 1900 average, and that a surprisingly high proportion of dials surviving between c1650 – 1900 were older than the twentieth century average.
6. Greater precision is contingent on extracting the age structure and weathering rates of dials from the database. It is hoped a cross sectional analysis of dial survival by type will permit this. If so we can return to this paper in the future in a less qualitative fashion.

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NEW DIALS

The Corner House, Wanstead High Street

Strange geometric patterns incised in plaster, enigmatic grotesque work, unidentified initials in terracotta – all this has been lovingly restored in recent work at one of Wanstead's most interesting buildings, the Corner House (1890).

When I approached architect Jason Harris about the possibility of adding a sundial to this heady mix, he was delighted. It turned out that the decoration on one of the gables (facing 63° West of South) was beyond restoration, and he had been wondering what to do with it anyway.

For aesthetic reasons we limited the hour coverage from 11 to 6 (any more would have disrupted the symmetry). For more mischievous reasons, and in keeping with the mystery of the building, we decided to replace the hour marks with symbols. In due course an explanation panel will explain what hour each symbol represents, without revealing their overall hidden meaning. [The editor would be pleased to know if you can crack the code!]

Producing such a dial, in situ, was not going to be easy, but luckily we had the right person to do the job, a local expert in pargeing and incised plaster-work, Marc Delea. Since it would be impractical to delineate the dial directly onto wet plaster, we decided first to lay it out on the hard under-



THE PREVALENCE OF ENGLISH SCRATCH (MASS) DIALS

c.1650 – Part 2

CHRIS H K WILLIAMS

By using the current incidence of surviving scratch dials and dial losses in the interim, a c.1650 benchmark was established in Part 1.¹ We have also seen regional variability in the incidence of surviving dials.² How do the two reconcile?

A definite pattern exists in the geographic distribution of surviving dials (Fig. 1). There is a marked watershed. To the east, in excess of 30% of medieval churches have dials, except for a ‘cold’ cluster. To the west, survival declines rapidly to a fringing cluster in which most counties have well under 10% of churches with dials – an English fringing cluster extending into Ireland, Scotland and Wales.

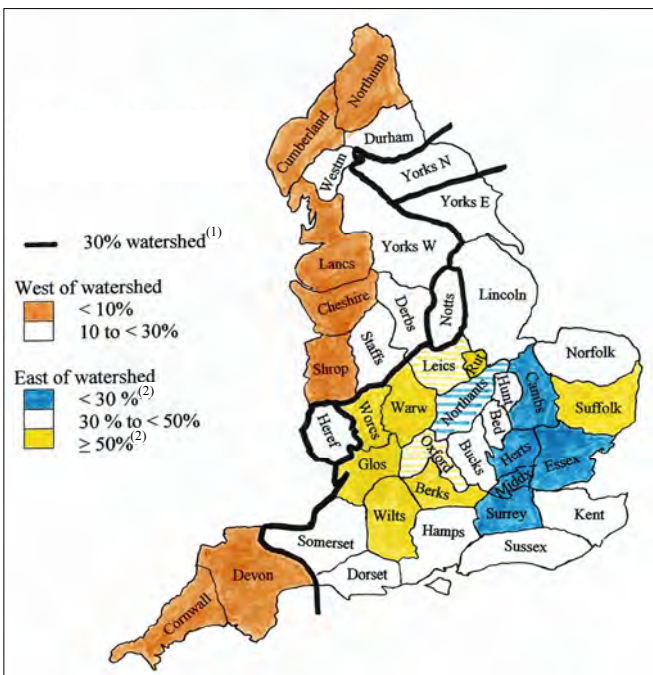


Fig. 1. Geographical distribution of medieval churches with surviving scratch dial(s).

Notes

(1) Estimates for Herefordshire, Nottinghamshire and Yorkshire North Riding straddle the watershed.

(2) Where estimates straddle the relevant figure, the county is shown with striped shading.

The c.1650 benchmark is based on the profile of surviving dials in the median grouping of counties – all east of the watershed, as well as the estimated loss rate extracted from the totality of surviving dials – overwhelmingly east of the watershed. So the benchmark represents the average east of the watershed situation, reflecting the average current surviving incidence and the average rate of dial loss in the interim. In fact half the counties east of the watershed (a

quarter of all counties) are within 10% of the benchmark – having lost about two-thirds of their original c.1650 dials. Other counties have more or fewer surviving dials: such variation must reflect variability in dial loss and/or the original c.1650 incidence of dials. Our assessment of this is most easily appreciated against the twin yardsticks of attributing the entire variation to either differential dial loss or differing initial dial endowment (Fig. 2). This merits detailed consideration and cross referencing with Fig. 1 before reading on.

Regional variation in the adoption of equal hour technologies (scientific sundials and clocks) might be expected, via their impact on the timing of scratch dial displacement, to have affected c.1650 dial incidence. As c.1650 incidence reflects dial accumulation over half a millennium and most parishes displaced scratch dials in the seventeenth century,³ significant inter-county variation in incidence can only have arisen from systematically differing displacements in earlier centuries.⁴ There is no evidence suggestive of those counties listed above the benchmark grouping (Fig. 2) adopting equal hours systematically differently from the latter i.e. the benchmark dial incidence should prevail. The ‘cold’ cluster correlates with examples of early equal hour adoption; it is probable early displacement reduced incidence for some of these counties. For the remaining counties listed below the benchmark grouping (Fig. 2), the evidence suggests most were late adopters i.e. there should be more not fewer dials than the benchmark. The yardstick for varying original dial incidence is utterly implausible! Variability in the incidence of surviving dials is almost entirely due to differing dial loss rates.

The most coherent interpretation of the data is that, to the east of the fringe, benchmark dial incidence approximated the c.1650 reality (apart from some attenuation within the ‘cold’ cluster and supplementation west of the watershed), with a wide range of subsequent dial loss. Differential dial loss is attributable to many factors including weather, building stone, urban spread and Victorian restoration.⁵ We cannot, on the data alone, be as conclusive for the fringe: few surviving dials and a virtually absolute loss is consistent with any original incidence! Given the inherent implausibility of non-universal adoption,⁶ (what credible barriers could have quarantined the fringe from both the universal contemporaneous presence of dials to the east and the earlier presence of Saxon dials?), considerations other than complete loss warrant investigation to explain the paucity of surviving scratch dials.

Post c.1650 dial loss		Historic county (2)	c.1650 dial incidence	
Com- parative dial loss	% c.1650 dials lost (1)		Average dials/ medieval church (3)	Com- parative incidence
Low	35 to <40	Berkshire Gloucestershire	5	High
	40 to <50	Oxfordshire↓ Wiltshire Worcestershire	4	
	50 to <60	Rutland Warwickshire	3.5	
Close to benchmark	60 to <70	Bedfordshire Buckinghamshire Hampshire Huntingdonshire Kent Leicestershire↑ Lincolnshire Norfolk Suffolk Sussex Yorkshire East Rid.	2.5	Close to benchmark
High	70 to <80	Dorset Herefordshire↓ Nottinghamshire↓ Somerset Yorkshire North Rid↓ <hr/> Hertfordshire* Northamptonshire*↑	1.5	Low
	80 to <90	Cambridgeshire* Durham Essex* Staffordshire Surrey* Westmoreland Yorkshire West Rid.↑	1	
	90 to <100	Cheshire Cornwall Cumberland Derbyshire Devon Lancashire London* Middlesex* Northumberland Shropshire	<0.5	

Fig. 2. Variable c.1650 dial incidence vs. differential post c.1650 loss.

Notes

- (1) Calculated from surviving and c.1650 benchmark incidences.
- (2) Key to symbols
 - Some estimates straddle loss ranges. ↑ or ↓ indicate whether a county could be in the category immediately above or below.
 - The watershed is marked =====
 - Counties below ===== are west of the watershed apart from the ‘cold’ cluster identified by an *.
- (3) Calculated from surviving dial incidence and benchmark post c.1650 dial loss.

day, most churches do not have a dial; formerly they were universal. Moreover our benchmark shows most churches had several. The benchmark is a reasonable approximation for most of England. The geographic variation in surviving incidence reflects a wide range of loss rates, not original incidence. The major exception is the fringe. Here the data is insufficient to infer the past, and there are grounds for supposing (universal) mass dials were not typically scratched into the churches’ fabric. In future articles our focus will turn to developments within the mass dial era itself.

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3. C.H.K. Williams: ‘The Life Cycle of English Scratch (Mass) Dials’, *Bull BSS*, 20(iv), 164-5, (2008). Furthermore (discussed in subsequent articles), the estimated c.1650 frequency distribution does of itself indicate a predominantly seventeenth century displacement.
4. The horological literature on the timing and extent of equal hour adoption is surprisingly muted. It is confined to documenting examples. These have been thoroughly examined for any indication of systematic regional differences.
5. It is easy to hypothesise how such factors might plausibly explain dial loss variation. Circumstantial evidence abounds in the literature. Their importance is often indicated by large intra county variations in survival. Each factor is capable of measurement; indeed there may be relevant data in related fields of endeavour. More directly derived loss estimates with explanatory causation are possible.
6. Williams: *Op. cit.*
7. A.O. Wood & F. O’Carroll: ‘A Celtic Quartet’, *Bull BSS*, 20(ii), 84-7, (2008).
8. L.P. Burge: ‘The Crowan Dial, First Impressions’, *Bull BSS*, 14 (iv), 168-170, (2002). A.O. Wood & P. Powers: Letters, *Bull BSS*, 15(i), 15-6, (2003).

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Earlier students, Cole and to a lesser extent Horne, argued scratching was intended to ease dial (re)decoration. Would scratching occur if another method was more practical? Much of the fringe, the geologically oldest parts of Britain, has an uncompromising local building stone. The alternatives are separately hung mass dials, or templates for the (re)painting of ‘painted only’ dials. There is corroborating evidence for this. Five loose dials (two Irish and single Cornish, Welsh and Scottish examples) have been recorded.⁷ Their fragility and negligible intrinsic value must result in a very low survival rate. Their confinement to the British fringe is noteworthy. Whilst not all of these examples are universally accepted as vertical mass dials,⁸ collectively they indicate what could have been commonplace for churches with an uncompromising fabric.

In conclusion, we have sufficient data to statistically decode the past in incredible detail. Only a small fraction of dials still survive. What does presents a misleading picture. To-

THE ENGLISH SCRATCH & MASS DIAL ERA: THE EVIDENTIAL PERIOD c.1250 TO c.1650

CHRIS H K WILLIAMS

Hitherto, much of our focus has been on the fate of surviving dials in the post scratch dial era. The analysis of dial loss has allowed us to reconstruct the end (c.1650) of the scratch dial era. This and the next article develop, within the context of the life cycle model (LCM),¹ a picture of the scratch/mass dial era itself. It is a preliminary view on two counts. Firstly, it confines itself solely to prevalence – dial types and their evolution will be examined in subsequent articles. Secondly, to the extent that the analysis of dial evolution permits the age structure of dials to be inferred, the parameters of the LCM can be derived with greater precision than in this article.

The earliest church fabric to survive in non-negligible quantities dates from the twelfth and thirteenth centuries. This coincides with the Great Norman Rebuilding – a rebuilding of epic and unparalleled scale.² Within fifty years of the Conquest, the Normans had begun rebuilding every

major church in England.³ The Rebuilding was also monumentally destructive, sweeping away what pre-existed – Saxon churches and Saxon dials. They were replaced by larger churches, and more of them as 6-7,000 Saxon ecclesiastical units increased to 10-11,000 medieval parishes. It is difficult to overemphasise the architectural/rebuilding revolution visited upon the land; the per capita investment involved remained unsurpassed until the industrial age.⁴ Such was the scale and nature of the discontinuity wrought that we can presume that c.1250 each church had one new scratch dial. Whatever pre-existed was almost entirely destroyed and replaced. Out of a total of some 5,500 listed/recorded dials only about 50 are thought to predate 1250. It is thus in a very literal sense that c.1250 – c.1650 constitutes the mass dial era's evidential period.

What can be said about individual components of the LCM? Most obviously the number of dials/church (Fig. 1) increased (equivalent to 0.2–0.3% pa). Regarding dial loss due to building, circumstantial evidence abounds. The oldest church fabric is invariably in the nave or chancel, with later medieval additions in the form of aisles, porches and transepts. Some half to two-thirds of all Norman churches subsequently underwent substantial rebuilding in the Early English, Decorated or Perpendicular style(s) before the Reformation.⁵ Churchwarden accounts are testament to the fact that not insignificant periodic repairs and alterations were an ongoing feature of the sixteenth and seventeenth, and presumably earlier, centuries. All this rebuilding, alteration and repair must have been most destructive of scratch dials. Considered reflection does not suggest a lower rate than our earlier, essentially post scratch dial era, estimate of dial loss attributable to rebuilding (0.1–0.2% pa)⁶ is appropriate. Indeed, a case can be made that rebuilding dial loss in medieval times exceeded that of the post dial era. Turning to weathering loss, as dial age was close to zero in 1250 and subsequent aging diluted (by loss to rebuilding and new dials) it must have been zero to low (by post c.1650 standards) for most of the evidential period.⁷ In combination therefore overall dial loss would have been of the order of 0.2% pa.

A major determinant of the c.1650 dials/church profile is the temporal profile of scratch dial displacement by scientific dials/clocks. The lower a church's scratch dial count, the earlier (*ceteris paribus*) its displacement of scratch dials. The other determinant of the c.1650 dial profile is the joint statistical interplay of redundancy and loss: as such, the

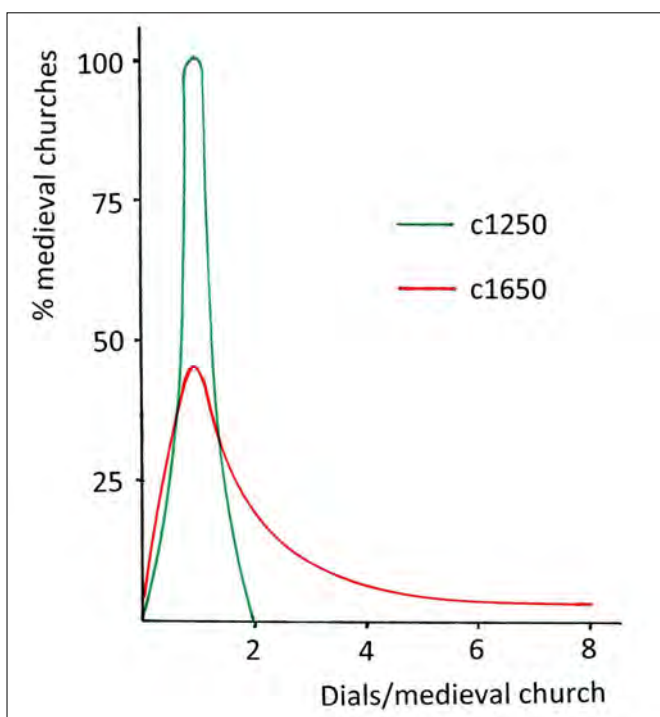


Fig. 1. Scratch dials per church in the evidential period.

Notes:

- (1) Due to the Great Norman Rebuilding the evidential period began with all churches having one dial (see maintext).
- (2) By the end of the evidential period there was an increase in both the number of dials – 2 to 3 per church on average – and their dispersion (see Chris H. K. Williams: 'The Prevalence of English Scratch (Mass) Dials c.1650 – Part 1', *Bull BSS*, 21(ii), 43-4, (2009)).

high dials/church tail reflects the concurrence of above average redundancy and below average loss (vice versa). The c.1650 incidence of low dials/church thus reflects below average redundancy combined with above average loss as well as earlier displacement.⁸ Churchwarden accounts indicate the seventeenth century was the main concentrated period of displacement.⁹ The c.1650 profile, with about half of all churches having three or more dials, is consistent with that. It is also more than suggestive that earlier displacement was not uncommon. Any assessment at this juncture is (for reasons explained earlier in this paragraph combined with not knowing when the last dial in use on a church became obsolete), more a matter of judgement than precision. That said, assuming all churches with no dial, most with one, and some with two had displaced scratch dials prior to the seventeenth century, suggests that about a third of all churches had done so.¹⁰

It can be seen that dial redundancy emerges as the largest single component of the LCM during the evidential period. Clearly redundancy must offset both the increase in dials and dial loss (a combined total of 0.4–0.5% pa). Allowing for the progressive displacement of scratch dials, the true rate of redundancy (in churches that still used them) was in excess of 0.5% pa. The in-use lifetime of the average scratch dial was thus in the region of 100 years.

To conclude, it is the overall picture portrayed by the LCM, rather than the magnitude of current estimates of its individual components – all hopefully subject to further refinement – that is the important and crucial message. The scratch dial era was far more dynamic than previous students were apt to realise. The very fabric on which dials were incised was not permanent; the actual usage of any dial nothing but transient. The overwhelming impression is one of continual churn. Dials were continually being destroyed by rebuilding¹¹ – the probable fate (by 1650) of half the dials of the Great Norman Rebuilding. If a dial was not destroyed whilst in use, it was most probably abandoned and replicated rather than displaced by newer technologies. It can now be appreciated that, in addition to surviving dials having been decimated in the post dial era, life was no less uncomfortable in the scratch dial era itself. Even then it was the fate of most dials to be culled by abandonment or destruction.

REFERENCES AND NOTES

1. In the LCM, the number of scratch dials on a church is determined by the combined interplay of dial loss, dial redundancy and dial displacement. See Chris H. K. Williams: 'The Life Cycle of English Scratch (Mass) Dials', *Bull BSS*, 20(iv), 164-5, (2008).
2. The Rebuilding encompassed military and ecclesiastical infrastructure plus the personal requirements of the new alien aristocracy. See E. Fernie: *The Architecture of Norman England*, OUP, (2002); H. M. Thomas: *The Norman Conquest: England after William the Conqueror*, Rowman and Littlefield, (2008).
3. E. Fernie: 'Architecture and the Effects of the Norman Conquest', in Eds. D. Bates & A. Curry: *England and Normandy in the Middle Ages*, p105-116, (1994).

4. J. C. Holt: *Colonial England 1066-1215*, London, (1997).
5. G. Hutton & O. Cook: *English Parish Churches*, (1976); J. J. Scarisbrick: *The Reformation and the English People*, (1984); R. Strong: *A Little History of the English Country Church*, Jonathan Cape, London, (2007).
6. See Chris H. K. Williams: 'The Prevalence of English Scratch (Mass) Dials c.1650 – Part 1' & 'English Scratch (Mass) Dials: The Ravages of Time', *Bull BSS*, 21(ii) & 20(iii), 43-4 & 110-111, (2009) & (2008).
7. It is hoped that cross sectional analysis of the database will permit the age structure of dials and precise (pre and post 1650) weathering rates to be estimated. Interim work in progress is encouraging.
8. To disentangle the two effects requires both the mean and variance of both loss and redundancy rates. Currently we have some average loss estimates mainly for the post scratch dial era, with the prospect of their enhancement (note 7). Average redundancy can only be estimated as an algebraic residual in the LCM. Loss and redundancy variances are, sadly, beyond retrieval.
9. See note 1 reference.
10. Depending on the extent to which the parameters of the LCM can be estimated with greater precision and detail, it might be possible to derive (or establish limiting bounds of) the temporal profile of displacement.
11. Any prior expectation of a 'normal' rate of weathering loss has been obviated by the impact of the Great Norman Rebuilding (main text). By destroying virtually all pre-existing dials it 'artificially' rendered weathering impotent until such time as dial age recovers. Incidentally, the true significance of the Rebuilding lies not in its impact on weathering, but that it allows us to numerically specify the c.1250 number of dials and their age (one per church and zero respectively). Without that, analytically insightful as the LCM might be, in terms of a complete numerical solution of all parameters it is, technically, underidentified. Students of scratch dials have real cause to thank the Normans!

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The Sun-Dial at Wells College

Henry Van Dyke (1852-1933)

The shadow by my finger cast
Divides the future from the past:
Before it, sleeps the unborn hour,
In darkness, – and beyond thy power:
Behind its unrelenting line,
The vanished hour, no longer thine:
One hour alone is in thine hands, –
The NOW on which the shadow stands.

Wells College is in Aurora, New York. But does the dial still survive? Van Dyke wrote other sundial poems (equally bad!) though it is this one that appears on modern dials.

JD

THE ENGLISH SCRATCH & MASS DIAL ERA: ORIGINS TO c.1250

CHRIS H. K. WILLIAMS

Compared to the subsequent (c.1250 – c.1650) evidential period,¹ we are considering a much longer elapsed time, whose origins are lost in the mists of early history, with surviving evidence some two orders of magnitude less abundant – a mere 50 Saxon dials have been recorded.² Obtaining a full and accurate picture from such limited evidence poses two questions. The specific context of what survives; and, just as – if not more – important, the context of what has not (see Fig. 1). Recorded Saxon dials cannot be considered representative, and any survival (not yet found) of other (more primitive) mass dial types is exceedingly unlikely. As surviving direct evidence yields a partial and potentially misleading picture, this article also considers the more indirect evidence, factors hitherto bypassed in the dialling literature.

The prime contextual element is that of the churches with which mass dials are associated.³ On the basis of written records (primarily Bede) there were at least 100 churches in England by 700. Given the fragmentary nature of original sources and the recorded number of monasteries and bishops, this must be but a small (yet unknowable) fraction of the churches by then established. Documentary sources indicate almost all were built of timber; few of the earliest churches were of stone, usually recycled Roman material. The typical early pattern was for monasteries, initially established with royal but subsequently also aristocratic patronage, to act as a base from which a network of dependent churches developed. Not all of these had a full time permanent priest. An accelerating trend towards localism began in the eighth century as lesser lords established their own local estate churches.⁴ Many if not most churches were too small for their congregation which gathered outside around the cross. The Domesday Book refers to some 3,000 churches. Detailed research indicates that allowing for those omitted results in an estimate of 6-7,000 at the time of the Conquest.⁵ Only about 400 churches are now thought to contain any Anglo-Saxon fabric, three-quarters of which can be dated to post-950.⁶ That so little survives reflects both the original preponderance of timber churches and the destructiveness of the Norman rebuilding.

Only the most distinguished and important churches were (re)built in stone. All others were of timber. As indeed was all non ecclesiastical Anglo-Saxon building, including all that for royalty – a reality mirrored in the entire Old English

building/construction vocabulary relating to wood.⁷ Churches were the first, and for a very long time the only, departure from timber construction. Even when the tenth and eleventh centuries were witnessing a boom in stone church building, and even if overall expenditure on stone building exceeded that in timber, it is probable most churches were still (re)built in timber.⁸

As most Saxon dials were obviously associated with stone churches, they mainly date to the end of the Saxon period. Recorded dials occur on about 10% of churches with some Anglo-Saxon fabric. Depending on their original incidence there is a maximum attrition over the course of a millen-

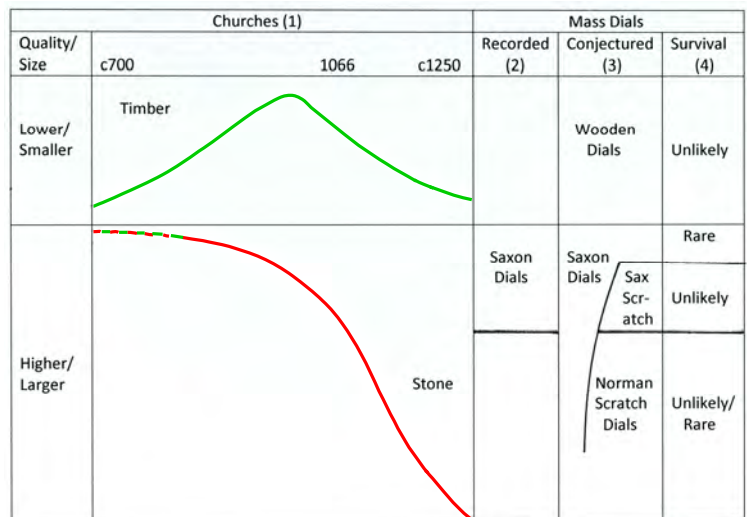


Fig 1. Categorisation of Anglo-Saxon mass dials and churches.

Notes (see main text for discussion)

1. Indicative evolution of churches; their total is represented by the gap between the curves. Most churches were of timber and small. The Great Norman Rebuilding simultaneously destroyed most of what pre-existed and accelerated the trend towards larger higher quality stone churches.
2. This article uses the term 'Saxon dials' as it has come to be understood in the literature – high quality carved mass dials. They were associated with high quality churches, primarily a feature of the later Saxon period.
3. Predicated on dial universality, predominance of timber use, and the virtually complete destruction of original dials. Saxon dial survival might reflect their continued use and manufacture in Norman times. The possibility of Saxon scratch dials cannot be excluded.
4. Survey rates suggest visible survivals have been found. Any additional evidence requires archaeological retrieval and would be of a 'one-off' nature.

nium of 90%. At just 0.25%p.a. this is substantially below the loss to be expected for scratch dials of such great age.⁹ But Saxon dials are not scratch dials; they are carved, many deeply, many in relief. That is why they have survived; being more robust not all have weathered out, being artistically attractive they have better cheated rebuilding's destructive nature. Any scratch dial is most unlikely to have survived; none has yet been recorded.¹⁰ Did all late Saxon stone churches have a mass dial? Statistically all we can infer is that unless the majority originally had a Saxon dial their survival rate is implausibly high. As the highest quality churches, is it not inconceivable they were without a mass dial? If not a Saxon dial then at least a scratch dial.

Fig 2. The Celtic dial at Clynog Fawr, Caernarfonshire. It is presumed to have been originally located within the nearby monastery founded by St Beuno in the seventh century. Photo by Mike Cowham.



Looking beyond late Saxon stone churches (i.e. to most of the elapsed time and the vast majority of churches), there is limited British evidence in the form of incised/carved dials on freestanding stone columns thought to have been originally erected in the vicinity of churches. Recordings, with one exception, are Celtic (Fig. 2) – a dozen Irish (spanning the seventh to twelfth centuries), a pair of Welsh, and an Isle of Man dial(s).¹¹ Only a single, stylistically very different, English example at Bewcastle (dated to c.700) is known.¹² Most Celtic dials can be linked to an important monastic site. Clearly England had fewer and later sites of comparable stature. Even so the disparity in recordings is glaring. There can be no doubt these were very expensive dials, limited to churches of ecclesiastical import or with indulgent patrons. These would have been the largest and best of timber churches and the earliest to be (re)built in stone. Dials of such quality would not have graced the typical small timber church.

What, in terms of mass dials, happened at the vast majority of Anglo-Saxon churches – the humble wooden church in need of frequent rebuilding? The only absolutely certain fact is that not an iota of direct evidence has yet been found. The *a priori* case for the universality of mass dials has already been presented.¹³ Exhaustive statistical analysis has

demonstrated its validity in the post-1250 evidential period. We have also noted that a majority of late Saxon stone churches must have had Saxon dials. Can we, in the face of a virtual absence of any other recorded dials, presume universality? How far back might it be reasonable to do so?

Recorded freestanding stone dials, of themselves, prove sundials were familiar objects within British monasteries from at least the seventh century. Although Celtic rather than English, monasteries were the intellectual international internet of their day. Given their central role in propagating English Christianity, as well as the particular contribution of Irish monasteries, it must be taken as axiomatic that sundials were from the outset well known to the English church. Time was always a matter of particular interest to the Church; both the hours to organise the day, and the calendar to determine Easter. Bede's temporal deliberations and mention of sundials are well known.¹⁴ A related concern was the broadcasting of time; Pope Sabinianus (604-6) issued a Bull stipulating bells mark the canonical hours.¹⁵ It is also essential to recognise that time indication was not the only, or even (especially in the Church's early days) the primary, function or purpose of dials. They need to be interpreted within their contemporary artistic/cultural traditions. As such a symbolic role is only to be expected, most obviously via allusions to the sun. Sundials could have been part of the Christian riposte to, or accommodation of, pagan iconography.¹⁶

The paradox between the indirect evidence indicative of widespread awareness, need and use of sundials with the almost nonexistent direct evidence of survivals, can only be reconciled if the predominant material medium of dials was not stone. The locally available repertoire of vernacular craftsmanship was confined to timber.¹⁷ It would have been the economical resource most naturally called upon to make dials for the vast majority of Anglo-Saxon churches, just as it was for the churches themselves. What did wooden dials look like? Probably similar to their stone cousins. Wooden crosses close to churches were common. These could easily accommodate a sundial, in exactly the same way as the Bewcastle Cross.¹⁸ Again mirroring their stone cousins, it is easy to imagine dials made from wood boards. Wooden dials undoubtedly ranged from the crudely incised to the intricately carved.¹⁹ For most of the Anglo-Saxon period timber was the only structural material; stone only began to make significant inroads in late Saxon times, precisely when the frequency of recorded Saxon dials becomes non negligible.

Interpreting the Anglo-Saxon era is thus not just a simple matter of examining its surviving dials. Recorded Saxon dials are a highly skewed sample illuminating, probably reasonably accurately, one specific corner – mass dials at high quality late Saxon stone churches. The rest is in effect a black hole. Any recordings not attributed to the late Saxon period constitute another even smaller and more skewed sample. The two usual reactions to limited data – it is a



Fig 3. Saxon (left, Bishopstone, Sussex - photo by Mike Cowham) and scratch (right, Waltham, Kent - photo by Tony Wood) dials compared. Although equivalent in purely functional terms, the Saxon dial is of a much superior aesthetic quality. Note the

- use of a specially chosen, as opposed to a normal structural, stone;
- fine carving, rather than crude incising;
- elaborately carved decorative frame;
- inclusion of a carved inscription.

reflection of original absence, or await additional evidence – are both misplaced. Whilst it is hoped additional evidence will come to light, the discovery of Anglo-Saxon scratch or wooden dials would be an archaeological triumph.²⁰ But it is totally unrealistic to expect any such evidence will ever be found in sufficient quantity to discriminate between the two competing hypotheses – were mass dials uncommon or were they (near) universal with the evidence destroyed in the interim? There is no alternative to going beyond direct dial evidence; not to do so would be unscientific.

Is there any way of assessing the validity, beyond that of the factors on which it is predicated, of this article's conjectured hypothesis? A true hypothesis invariably gels with other data and resolves interpretive conundra. Were the mass dials of Saxon times as different from their medieval successors as indicated by what is generally accepted to be Saxon dials versus scratch dials? (Fig. 3.) If they were it would be a degree of retrogression not mirrored in any other contemporaneous field of artistic or cultural endeavour. A convincing explanation why sundials alone should be so prone to severe relapse is not obvious. In our conjectured hypothesis medieval scratch dials had equivalent Anglo-Saxon ancestors. And the true descendants of Saxon dials, the upmarket – the best there is – statement, are clocks and scientific sundials not scratch dials. Turning to another example, exhaustive statistical analysis has established mass dial universality post-1250. Although the data do not exist to prove it earlier, why universality should be as late as c.1250 is not obvious. Our conjectured hypothesis removes such problems, pushing any non universality back towards the origins of Christianity. One cannot consider the Anglo-Saxon period without the Canterbury pendant seasonal hour altitude dial, dated to the tenth century, coming to mind.²¹ Made from silver and gold it is an upmarket product. Less well known is that a virtually identical dial, made of bog-oak and bone, survives.²² The use of wood is noteworthy *per se* and because it suggests portable dials were common, both of which are fully consistent with our conjectured hypothesis.

Readers will have to reach their own conclusions bearing in mind that the statistically proven standard of the evidential period can never be attained for Anglo-Saxon times. Short

of a council of despair, we have no choice but to do the best possible, hence the conjectured hypothesis. Although in an absolute sense unproven, it is the interpretation that most coherently integrates four separate considerations – the characteristics of the Christian church, the dominance of timber, a plausible transition to the evidential period, and the paucity of surviving dials.

Accepting the conjectured hypothesis, would the churn (loss and replacement of in use dials) and redundancy (leading to the progressive accumulation of multi-dialled churches) typical of the evidential period have occurred? They would have manifested themselves differently. For wooden dials at timber churches, churn would have been accentuated to such an extent (by deterioration of the dial itself/frequent periodic rebuilding of the church) as to preclude the accumulation of redundant dials. In the case of stone (including scratch) dials cumulative redundancy would be muted by the comparatively short lifespan of churches.²³ An Anglo-Saxon church with two mass dials would have been unusual, more an exceptional rarity.

REFERENCES AND NOTES

1. Chris H.K. Williams: 'The English Scratch & Mass Dial Era: The Evidential Period c.1250 to c.1650', *Bull BSS*, 21(iv), pp.18-19, (2009).
2. We continue to focus on dial prevalence with style and type deferred to subsequent articles. Recorded Saxon dials have recently been reappraised by David Scott & Mike Cowham. Their monograph, *Timekeeping in the Medieval World*, is expected later in 2010.
3. Brevity precludes inclusion of much supporting material and citation of all sources consulted. Three comprehensive works are P.H. Blair: *An Introduction to Anglo-Saxon England*, CUP, 3rd Ed., (2003); E. Fernie: *The Architecture of the Anglo-Saxons*, Batsford, London, (1983); R. Morris: *The Church in British Archaeology*, Council for British Archaeology, (1983). Each contains an extensive bibliography.
4. Some had the consent of the minster, others were unilateral. Unlike minster-dependent churches these were in the private ownership of laymen – subject to inheritance, sale and purchase. A private church conveyed 'thegnlly' status plus a source of income and influence. This dual provision of minster and propriety churches created, especially as church density increased, financial and jurisdictional disputes, resulting in numerous tenth and eleventh century law codes categorising different types of church.
5. Mention of a church is incidental to the Domesday Book's purpose – taxation and ownership. The estimated number of churches takes account of the differing conventions adopted by

- the five groups of Domesday commissioners, the 1254 and 1289-91 tax surveys, and many detailed local studies suggesting around three quarters of medieval churches are on Saxon sites. See R. Morris: *Churches in the Landscape*, Dent & Sons, (1989).
6. H.M. & J. Taylor: *Anglo-Saxon Architecture Vols. I, II & III*, CUP, (1965 & 1978).
 7. 'To build' is *timbran*.
 8. St Dunstan (Archbishop of Canterbury, 960-88) is recorded building timber churches. His biographer notes that on finding a church incorrectly orientated, Dunstan achieved the desired alignment with his shoulder! See W. Stubbs (Ed): *Memorials of St Dunstan, Archbishop of Canterbury*, (1874). As late as 1020 a court chronicler saw fit to leave no doubt a church endowed by Cnut was of stone and lime.
 9. Williams: *Op. cit.* and references therein.
 10. Statistically expected Anglo-Saxon scratch dial survivals, before allowing for Norman destruction, are in single figures. Moreover, unless any survival could be definitively placed in an Anglo-Saxon horizon, would it be recognizable as such?
 11. M. Arnaldi: *The Ancient Sundials of Ireland*, BSS, (2000); W. Linnard: 'Welsh scratch dials', *Archaeologia Cambrensis*, 156, p141-7, (2007).
 12. C.K. Aked: 'Bewcastle Cross Part I & II', *Bull BSS*, 95(1) & (2), 2-8 & 10-17, (1995); K. Schaldach; 'Bewcastle Cross', *Bull BSS*, 95(3), 47 & 34, (1995).
 13. Chris H.K. Williams: 'The Life Cycle of English Scratch (Mass) Dials', *Bull BSS*, 20(iv), 164-5, (2008).
 14. *De temporibus* (704) & *De temporum ratione* (725).
 15. Efforts to locate an authoritative source for Sabinianus' alleged requirement churches have a sundial failed. The bell ringing Bull can be traced to Onofrio Panvinio (1557), papal librarian and historian. The sundial attribution appears to be a tradition established by subsequent students.
 16. It is a misconception to view Christianity and paganism in binary terms. Evidence of coexistence and accommodation abound. Some kings literally hedged their bets by supporting both. Paganism was polycentric, adopting another deity (or form of magic) was not the absolute issue it was for monotheists. Springs and wells were important pagan sites, yet many early churches were established near them. Animal sacrifices were tolerated if part of feasting rather than the ceremony. There is even evidence priests were present at the casting of spells, parts of which might even take place in church. Traces of paganism were never entirely extinguished. As late as Cnut, law codes forbade the worship of 'idols, heathen gods, the sun or moon, fire or flood, springs, and stones or any kind of woodland tree'.
 17. Until late Saxon times stone work was the alien craft, sourced via the international monastic network, as indicated by the Mediterranean influence discernable in the Bewcastle Cross' carving.
 18. It is interesting to speculate that wooden Celtic dials were made by the Celts; and that the apparent triumph in England of the Bewcastle model over the Celtic could reflect the latter becoming, at least in England, politically incorrect after the ascendancy of the Roman faction at the Synods of Whitby (664) and Hertford (672).
 19. The former dismissive view of Anglo-Saxon carpentry has been decisively rejected. See C. A. Hewett: *English Historic Carpentry*, Phillimore, (1980). During the Saxon, Norman and Early English periods the system used for timber buildings seems to have been constant. Surviving examples of craftsmanship shows a high level of skill and the use of sharp sophisticated tools. Doors used seasoned timber. Anglo-Saxon carpentry was neither embarrassed nor eclipsed by their medieval successors.
 20. On three counts. Any survival would be exceptional – wood for obvious reasons, see note 10 for scratch dials. Next any find would have to be in an undisturbed and indisputably Anglo-Saxon horizon. Finally would any (partial) survival be recognised as a dial by the archaeologists? The other potential evidence is documentary. But it is sadly true that sundials are not on the agenda of scholars who regularly read original sources, and few diallists are competent to do so. Accumulation of such evidence will be a long slow process.
 21. A.A. Mills: 'The Canterbury Pendant: A Saxon Seasonal-Hour Altitude Dial', P.I. Drinkwater: 'Comments upon the Canterbury Pendant', and A.J. Turner: 'The Canterbury Dial', *Bull BSS*, 95(2), 95(3) & 96(1), 39-44, 48 & 46-7, (1995 & 1996).
 22. Turner: *Ibid.*
 23. Almost all surviving medieval churches lived through the entire 400 year evidential period. A 400 year old stone Anglo-Saxon church would have been a rarity. Most were built in the tenth and eleventh centuries and subsequently destroyed by the Normans. Furthermore their small size can only have reduced redundancy attributable to dial relocation.

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THE ANCIENT ASTRONOMERS OF TIMBUKTOU

In his article on the replica Timbuctou Sine Quadrant (*Bull* 20(iv), pp.166-8, Dec 2008), Malcolm Barnfield described making a quadrant for use as a 'prop' to be used in the making of a film about the conservation project for the ancient astronomical manuscripts of that city. The finished film is now available as a DVD. It costs R170 (about £14) and details, together with a short preview, can be found on the website of Johannesburg Planetarium at www.planetarium.co.za/.



MRS GATTY ONLINE

The project to make Mrs Gatty's famous *The Book of Sun-Dials* available online has now been completed. It may be found at <http://tinyurl.com/y9r7r4f> (the full URL at Penn University is much longer). The website shows scans and full transcriptions of every page of the 4th (Eden & Lloyd) edition from 1900 which is by far the best.

The transcription was part of the collaborative 'Celebration of Women Writers' project so diallists benefit from a little gender bias. Thanks go to Michael Harley for bringing the project to the Editor's attention.

ENGLISH MASS & SCRATCH DIAL PREVALENCE – A PRELIMINARY COMPARISON WITH FRANCE

CHRIS H.K. WILLIAMS

As we deepen our understanding of English dials a broader question beckons. Was England typical of, or different from, the rest of Europe? Hitherto there has been no substantive or authoritative answer. The root cause has been the relative paucity of Continental evidence. French mass dial listings, recently increasing by 150-200 a year, now constitute the first corpus of Continental evidence with the potentiality of rigorous statistical analysis. This article discusses the French database and undertakes a preliminary England–France comparison.

The former state of play was outlined in our earlier review of Continental mass dial listings.¹ It discounted the significance of England's domination (by two to one) of recorded dials. England is the first, and only, country to have been fully surveyed. Whereas English listings mirror (virtually) all survivals, Continental listings understate the true level by a large factor. The review also noted that the sheer geographical spread of mass dials across the length and breadth of Europe is consistent with their widespread and common usage as well as a shared common heritage. So although any 'England different' hypothesis could be confidently rejected, any 'England typical' hypothesis was, in reality, no more than suggestive and unproven. As will be seen, comparison of the English and French databases casts a new and most illuminating light.

To the end of 2008, some 1360 dials had been recorded on 836 French churches.² Unfortunately, in common with English practice, churches without mass dials have not been specifically recorded. This is a serious loss of information – as the true sample size is unknown and because churches

without dials are just as important as those with. As a result, neither dial survival nor the survey rate can be estimated. Pending the retrieval of churches found not to have dials, the full potentiality of the French database cannot be realised.³ As neither the timeliness nor completeness of any prospective retrieval can be guaranteed, the scale of the database is sufficient to warrant immediate – albeit frustratingly constrained and partial – analysis.

In order to maximise both the proportion of available data being used and the geographic coverage achieved, a regional, as opposed to departmental, segmentation was adopted.⁴ There is a considerable variation in listing density (Fig. 1); a variation more reflective of varying survey rates than actual dial survival. In the current circumstances, it can only be a matter of judgement as to what constitutes a statistically-adequate listing. The top seven regions have been chosen for analysis.⁵ Collectively, they provide a good 'representative' geographical coverage (Fig. 2).

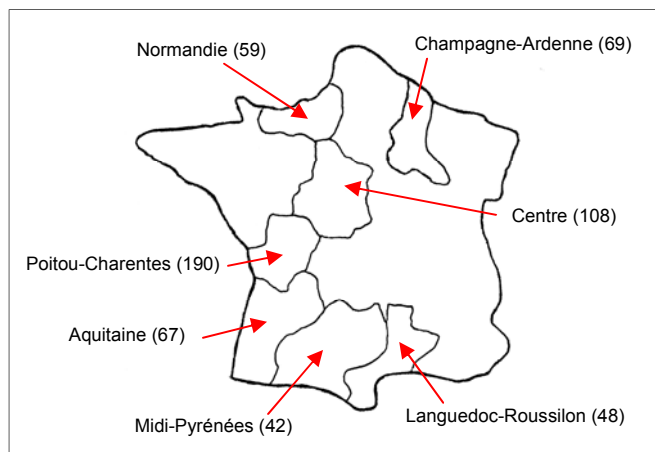


Fig. 2. French regions investigated.
Note: The number of churches with listed mass dials in 2008 are indicated parenthetically.

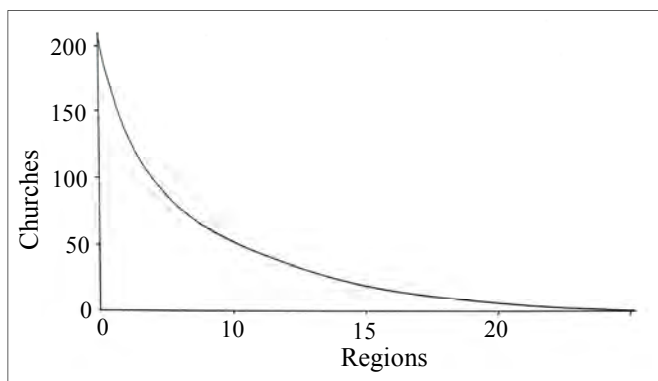


Fig. 1. French churches with listed mass dials in 2008.
Note: The distribution by department is flatter with a more elongated right hand tail (see also Ref. 4).

These regions listings are examined (Fig. 3) in the only currently feasible way – a frequency distribution for churches with dials. All the distributions have a similar profile. Variable sample size has no discernable impact. Most regions are almost identical to another. There can be no doubt that a deep underlying consistency and commonality is embedded in the listing data. Without the previously discussed enhancements to the database, we cannot take the statistical investigation of French mass dials any further. However, the full importance of this limited analysis goes

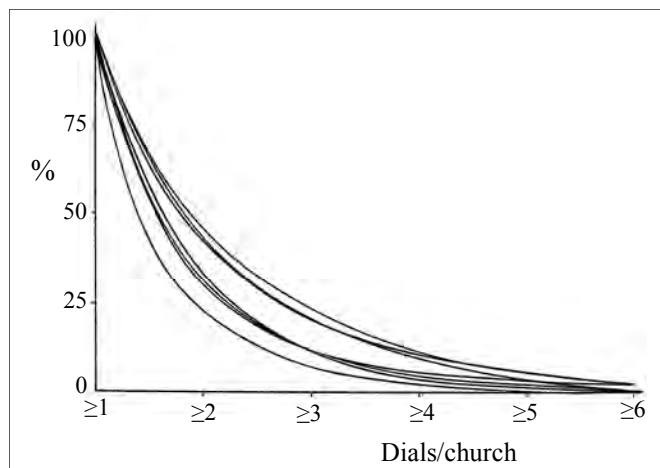


Fig. 3. French regional cumulative frequency distributions of dials per church for churches with mass dials.

Notes:

1. The distributions cover Fig. 2 churches and are truncated (at 1) because surveyed churches without dials have not been recorded (see main text).
2. The lower bound represents Aquitaine.
3. The central band represents Champagne-Ardenne, Languedoc-Roussillon and Normandie.
4. The upper band represents Centre, Poitou-Charentes and Midi-Pyrénées.

beyond what it directly reveals about French dials to what is indirectly revealed by the data's similarity or otherwise to England's.

England and France are compared in Fig. 4. What do their 'crescents' tell us? Their similar profiles, adjacency and overlap indicate a broad underlying similarity in the pattern of surviving mass dials. Much of the two countries are identical – the regions of Poitou-Charentes, Centre and Midi-Pyrénées are the same as a third of English counties. Although the English 'crescent' has been constructed for comparative purposes, our analysis and understanding of the English database is orders of magnitude greater than that currently possible on the French. We therefore know the English 'crescent' is consistent with previous estimates of original dial prevalence and life cycle model parameters.⁶ So Fig. 4's true significance is that, by implication, similar dynamic forces must have shaped France's dial prevalence – surviving and original. This is the first real evidence that English mass and scratch dial findings are of wider European significance.

It is worth exploring what 'are of wider European significance' might mean. Beginning with what it is not: it most definitely does not mean slavish replication of all the detail of our English findings. That would be absurd. We have previously established regional English variations in dial loss, perhaps also in original dial prevalence, and suspect their presence in dial displacement.⁷ It would be a most extraordinary coincidence for this to be even approximated elsewhere. French 'crescent' regional variation overlaps, but is different. It is only to be expected that the mix of life cycle model parameters varies across the length and breadth of Europe.⁸ The European significance of English

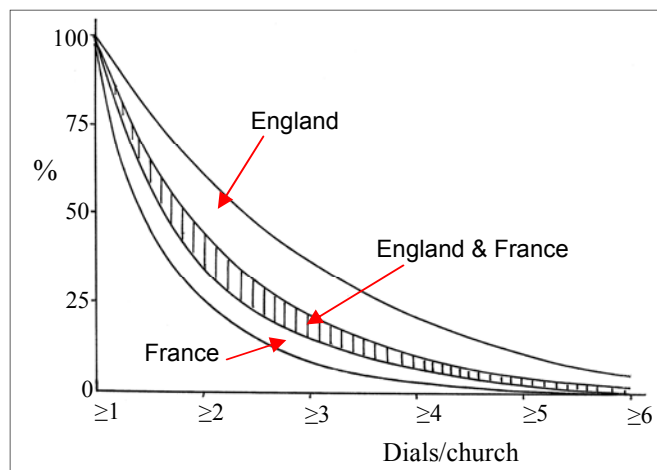


Fig. 4. England and France compared – cumulative frequency distributions of dials per church for churches with mass dials.

Notes:

1. The French 'crescent' comprises the upper and lower bounds shown in Fig. 3.
2. The English 'crescent' is definitionally identical to the French. (The full non-truncated English distributions are, of course, known.) It encompasses 80% of all counties, excluding those where dial loss is virtually absolute. Its upper and lower bounds indicate a post-1650 dial loss of 40 and 90% respectively.

findings applies not at the detailed, but at the fundamental and structural, level.

At the fundamental level the key point is the universality of mass dials; all churches once had them, most had several. This has been statistically proven for the English evidential period and the case made for earlier times.⁹ This article indicates French dial survival to be consistent with it. If it holds for England and France, why not elsewhere? If it holds for the only two countries with 'adequate' data, surely the presumptive working hypothesis should, as we await the effective surveying of the Continent, be the universality and multiplicity of mass dials.

Turning to the structural level, the earlier emphasis on life cycle model parameter magnitudes varying geographically is without prejudice to the model's validity. Mass dial prevalence is only explicable in terms of the dynamic interplay of redundancy, displacement and loss. Returning to Fig. 4, the implication is fewer surviving French dials in the areas being compared. In the absence of any French parameter estimates we do not know why. It might be due to a higher rate of loss; or an earlier displacement reducing the accumulation of redundant dials; or a slower rate of redundancy; or any number of combinations (contributory and offsetting) thereof. The life cycle model is universally valid and applicable: its parameter magnitudes are case-specific and empirical. Currently, we only have English parameter estimates; without local corroboration their 'export' needs to be handled with care.

Attainment of a critical mass threshold in French listings heralds the commencement of substantive Continental investigation. This article's preliminary analysis points to a

broad underlying similarity between the French and English databases. It thus appears our English findings – hitherto the only and for the foreseeable future the most comprehensive ones – gravitate towards the typical rather than different end of the spectrum, thereby assuming a wider European, rather than purely national, significance. It is hoped future French database enhancement will enable this article to be further developed. It must also remain a fervent hope viable data sets will accrue elsewhere on the Continent.

REFERENCES AND NOTES

1. Chris H. K. Williams: ‘The Mass Dials of Continental Europe’, *Bull BSS*, 21(i), 16-17, (2009).
2. Listings to 2007 are published in the 2008 *‘Inventaire des cadrans canoniaux de la Commission des Cadrans Solaires’*, Société Astronomique de France, (2009). Listings are by department. There is a brief description of location and appearance, but this article confines itself to prevalence. Listings in 2008 have been provided by Denis Schneider (personal communication).
3. See Chris H.K. Williams: ‘The Geographical Distribution of Surviving English Scratch (Mass) Dials’, *Bull BSS*, 20(ii), 75-6, (2008) for a fuller discussion of the implications of ‘lost information’ and its subsequent retrieval from individual recorders. It is hoped to undertake a similar exercise with French recorders.
4. With 20 regions rather than over 90 departments, small departmental listings are pooled into larger, statistically more meaningful, regional samples.

5. This draws the line at 42 churches. However, actual sample size is, because of the (unknown) number of surveyed churches without dials, somewhat higher – hopefully taking us to the point where the law of large numbers begins to bite. The seven regions account for 75% of all listings. A departmental approach on the same criterion would halve the data used.
6. The life cycle model has been the key to unlocking and understanding the evolution of dial prevalence – original and surviving. Dial prevalence is determined by the dynamic interplay of the model’s parameters – redundancy, displacement and loss – all active in the mass dial era, only loss thereafter. See Chris H.K. Williams: ‘The Life Cycle of English Scratch (Mass) Dials’, *Bull BSS*, 20(iv), 164-5, (2008). For model parameter estimates see Chris H.K. Williams: ‘The Prevalence of English Mass (Scratch) Dials c.1650 – Part 1’ & ‘The English Scratch and Mass Dial Era: The Evidential Period c.1250 to c.1650’, *Bull BSS*, 21(ii) & (iv), 43-4 & 18-9, (2009).
7. Chris H.K. Williams: ‘The Prevalence of English Scratch (Mass) Dials c.1650 – Part 2’, *Bull BSS*, 21(iii), 34-5, (2009).
8. Although dial style is beyond this article’s scope, it and its evolution, in common with all other artistic/cultural endeavours, will also have varied across the length and breadth of Europe.
9. Final ref. in note 6 and Chris H. K. Williams: ‘The English Scratch and Mass Dial Era: Origins to c.1250’, *Bull BSS*, 22(i), 14-17, (2010).

ACKNOWLEDGEMENT

It is a pleasure to thank Denis Schneider for all his assistance in collecting and comprehending the French database.

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SUNDIALS AND FORTS IN NORTH WALES

IRENE BRIGHTMER

The location of a sundial within a former fortification occurs at least three times in North Wales, the forts and the dials varying in age and type. One of them has just been recorded for entry in the next BSS Register, but the other two are already in the Register and are associated with mediaeval churches built within Roman forts. One is a very fine vertical dial, while the other is a modern mass-produced horizontal dial on a much older pedestal.

At Holyhead in Anglesey, the recently re-painted vertical dial (Fig. 1, SRN 2736) has a Welsh inscription, one of very few, and is on the south transept of the large mediaeval church. Mrs Gatty (1900) was informed that it had been written by a 6th century Welsh bard and provides the translation:

*“Man’s life, though be prolonged it may,
Draws to its close by night and day.”*

St Cybi’s Church was built on the site of an early Christian monastery of the 6th century, which itself was within the walls of a Roman coastal fort of the 4th century. The fort had been established to protect North Wales from Irish



Fig. 1. Dial on St Cybi’s Church in Holyhead, with a rare Welsh inscription.

THE EVOLUTION OF ENGLISH MASS & SCRATCH DIALS

c.1250 – c.1650

Part 1 – Dial Categorisation

CHRIS H K WILLIAMS

Although it has long been recognised that mass dials come in a variety of forms, agreement on their categorisation and evolution has yet to emerge.¹ Categorisation has not been mass dial students' finest hour. It sits most uncomfortably next to the triumph of recording. An inconclusive literature portrays an ironic position – over-interpreting the appearance of surviving dials yet under-utilising the available data. By developing a scientific approach analysing thousands of recorded dials this article (including its subsequent parts) establishes, for the first time, the pattern of scratch dials' evolution.

The father of scratch dial categorisation is Horne.² His criteria include structural positioning of the gnomon (in the body of a stone or their jointing), hour lines (above as well as below the sunrise/set horizontal, jointing used in lieu of

scratching), circle (present or absent) and holes (as well as or instead of hour lines). Horne posits 12 dial types but many more are implicit. Green,³ by elaborating all possible (sub)variants of each categorisation criterion, takes Horne's approach to its logical conclusion. Realising a complete enumeration of the resulting combinations would be a very long list, Green foregoes a formal typing. Tellingly, both Horne and Green confine themselves to quoting individual example dials rather than systematically allocating all their recordings to their categorisation(s). Had they attempted to do so, the methodological flaws inherent in their approach would have been revealed.

Data and category alignment is not a trivial matter. Without it, no categorisation can authoritatively reveal anything. For all their detail and complexity, Horne's and Green's categorisations are not mutually exclu-

sive (many dials appear to conform to more than one type) or exhaustive (some dials appear not to fit any type). No meaningful analysis is possible when the very cornerstones of logic and mathematics have not been met.⁴ Whilst each of Horne's and Green's categorisation criteria might appear useful when describing an individual dial, collectively when considering all dials they produce a 'not able to see the wood for the trees' situation!

Subsequent students sought a simpler, smaller categorisation. Cole, the remaining member of the inter-war scratch dial triumvirate, attempted one reflective of differing timekeeping systems.⁵ Others, most recently Cook,⁶ usually employed some combination of the number of hour lines and the presence or absence of circles and pock marks. The prime motivation has been the perceived need to preface the publication of a county listing

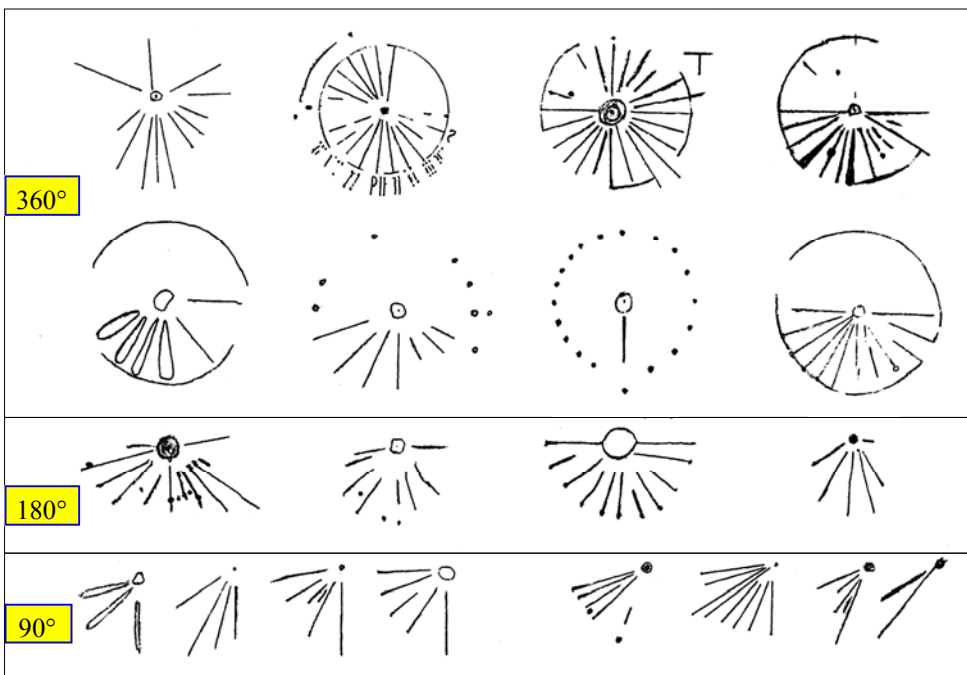


Fig 1. Using surviving scratch dials as a guide to the original appearance of mass dials.

Notes

1. Based on 3950 scratch dials with recorded images. (Earlier, and Saxon, dials are not included – see main note (1)).
2. Surviving dials are but a shadow of their former selves – see main text. All have completely lost their original painted detail and decoration. Not all painted detail need also have been scratched. Some original scratching will have been lost.
3. Surviving scratching and pock marks are used to determine whether the original mass dial encompassed 360°, 180° or 90° in terms of visual appearance. (Typical examples for each shown).
4. The implied original difference between 360° and 180° dials was one of decorative or symbolic appearance; functionally – below the sunrise/set horizontal – they were equivalent.
5. The 90° dials, in contrast to the 360° and 180° types, are all 'morning' only; the few (apparent) 'afternoon' dials are invariably fragmentary/repositioned.

with an indication of scratch dial variability. No consensus has emerged; they are invariably only illustrative, and if dials are allocated to the categorisation the results are not analysed. Clearly any proposed or implied dial evolution is, in reality, unsubstantiated. The true state of current understanding is laid bare in the mass dial section of the Society's website. It honestly adopts an agnostic stance, emphasising wide dial variety and a problematic chronology. Its discussion is framed around examples and possibilities rather than an established development and evolution of scratch dials.

Virtually the entire attention of the literature is focussed on the surviving appearance of dials.⁷ Surely our ultimate focus must be dials' original (painted) appearance and functionality not that of their (partially) surviving skeletal remnant?⁸ Realising dials were painted, it becomes obvious that not all hour lines need have been scratched – only enough to guide painting/reinstatement. Similarly, neither encirclement/decorative enhancement, nor hour line annotation, need have been fully, or even partially, scratched. Likewise, original dial size is not necessarily indicated by the scratching. Allowing for the twin possibilities of not all painted detail being scratched and not all scratching surviving, it follows that surviving appearance is at best a partial, and at worst a misleading, guide to a dial's original appearance.

But surviving dial appearance is the only evidence available; there is no alternative to using it. That said, the previous discussion dictates we forego an extensive categorisation based on questionable detailed variations in surviving dials in favour of a smaller one that definitely reflects real differences in their original appearance. Earlier discussion also identified another essential requirement: confronting the categorisation with the data is not an (illustrative or partial) afterthought, but a single combined process – the data must drive determination of the categorisation, and the categorisation must maximise the data used.

Intensive examination of all dials with a recorded image results in the threefold categorisation of Fig. 1.⁹ It is predicated on using the only surviving evidence – scratching and pock marks – to provide the most pragmatic and robust guide possible to the original appearance of mass dials. At the risk of repetition, the practical emphasis is on the identification of major and certain, rather than minor or questionable, differences. Most surprisingly, for diallists, the categorisation eschews the number, and detailed positioning, of hour lines. (Not because it is unimportant, but because the evidence is beyond unambiguous interpretation.) How the categorisation applies can be gauged from Fig. 1's sample of example dials that have been allocated to each type. It is contended that in terms of a dial's original (painted and decorated) appearance, the magnitude and certainty of variation within a dial type is but a fraction of that between

them. It is further contended that differences between the three dial types represent the most visually and generically differentiated categorisation possible.

The categorisation meets the dual methodological requirement. Firstly, definite differences in original appearance – although 'when in use' dial appearance is irretrievable, no one can doubt this categorisation is indicative of three very different types of dial. Secondly, the maximum use of data – only dials in a seriously distressed condition are unrecognisable and beyond allocation within Fig. 1. Any imagined benefit from further (sub)categorisation must be weighed against its costs – reduced certainty that only genuine original differences are being identified, together with fewer dials unambiguously allocated to the categorisation.¹⁰ Both render subsequent statistical analysis/discrimination problematic and less certain. More detailed categorisation is not the handmaiden of more or better information!

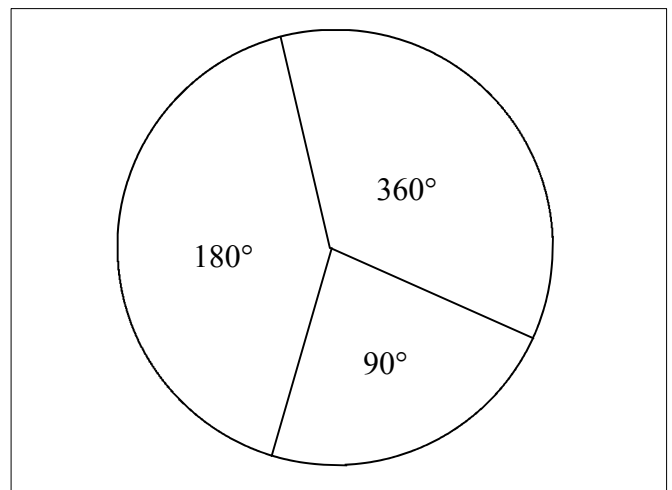


Fig 2. England's surviving dials by type.

Notes

1. Dial types as outlined in Fig 1 and main text.
2. Reconciliation with the English database of 5,500 listed dials (100%) – dials allocated to the categorisation 53%; distressed dials that are uncategorisable 19%; and listed dials without (mainly due to dial loss) a detailed recording 28%.

Pending the results of further investigation, the current purely descriptive nomenclature (360°, 180° and 90° dials) will be retained as a convenient shorthand. Their comparative frequency is shown in Fig. 2. All the underlying data are of course available by county within the database: their detailed statistical analysis to determine the sequencing and age of dial types, as well as any regional variation, will be outlined in subsequent parts of this article.

REFERENCES & NOTES

1. Whilst Saxon dials are beyond the scope of this article it is worth noting that there is an accepted mass dial distinction between Saxon and scratch dials. Although their associated age and quality differences are indisputable, it coincides with an evidential watershed – scratch dials survive by the thousand, Saxon dials by the ten. We need to beware of artificially oversimplifying or dichotomising the pre- and post-Conquest situa-

- tion. For a fuller discussion see Chris H. K. Williams: 'The English Scratch & Mass Dial Era: Origins to c.1250', *Bull BSS*, 22(i), 14-17, (2010).
2. Dom Ethelbert Horne: *Primitive Sun Dials or Scratch Dials*, The Wessex Press, Taunton, (1917). Ch. III.
 3. A. R. Green: *Sundials Incised Dials or Mass-Clocks*, Macmillan, London, (1926). Ch III.
 4. This cannot be circumvented by deeming 'inconvenient' data to be uncategorisable or by the creation of an additional catchall 'miscellaneous' dial category. Each amounts to choosing a biased sample.
 5. Albeit an interesting shift from surviving appearance to original functionality, it has to be admitted that the detailed basis of Cole's categorisation drifted with his interpretation of time-keeping systems, much of which is unsupported by modern scholarship. (Compare T. W. Cole: *Classification of Church Scratch-Dials*, The Hill Bookshop, Wimbledon, (1936) with 'Church Sundials in Medieval England', *Journal of the British Archaeological Association*, (1947)). Furthermore, he never systematically allocated recorded dials to his threefold (including Saxon dials) categorisation.

6. A. Cook: *Mass Dials on Yorkshire Churches*, BSS Monograph No. 3, (2008).
7. More strictly the surviving appearance of dials that have survived (see note 1).
8. The most cursory examination of medieval ecclesiastical art and culture indicates dials would have been painted. Although this was recognised by Horne and Cole, neither considered nor appreciated the consequential implications for interpreting surviving dials. Almost all subsequent students make no mention of painting.
9. To be fair to the earlier literature, Green, *op. cit.*, mentions an equivalent categorisation of wheel, half-wheel, and quarter-wheel dials. But it is merely a single subset of a much larger edifice attracting no particular emphasis or prioritisation.
10. Extending the categorisation results in less dissimilar 'adjacent' dial types: more dials become consistent with more than a single type. Fewer dials can be definitively allocated to the categorisation. Data – information – is being dissipated.

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GNOMON SUPPORTERS

In his article on 'Gnomon Supporters' (*Bulletin* 21(iv), p.40, December 2009), Mike Cowham asked for other examples. Frans Maes has responded with this horizontal dial on the ground of a park in Kleine Huisjes, a hamlet in the very north

Marten described how the schematic yet lifelike figure was obtained: a man knelt in front of a large sheet of paper, illuminated by a slide projector, whereupon his silhouette was traced.



of the Netherlands. It is a 'Monument for Agriculture' and depicts a farm labourer, picking weeds by hand. He holds a hoe that serves as the pole-style. It was designed and constructed in Cor-Ten steel as a community project in 1995. Gnomonic advice was given by Marten Hugenholtz, member of the Dutch Sundial Society.

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THE EVOLUTION OF ENGLISH MASS & SCRATCH DIALS c.1250 – c.1650

Part 2. Age Ranking Dials by Type

CHRIS H.K. WILLIAMS

Part 1 established a methodologically coherent basis for dividing the database into three categories of scratch dial.¹ Here it will be shown that we can statistically discriminate between these dial types – they can be ranked by age and regional variations identified.

The obvious way to discern the past evolution of scratch dials is to analyse, examine and explain the relative frequency of dials by type. Whilst this is an obvious and (apparently) simple statement of intent, its actual execution is much less so. The reasons for this warrant exploration because they determine the precise technical specification, which some might find unexpected or counter-intuitive, of how the analysis must proceed – see Table 1. It can be seen that the weight of argument is overwhelmingly in favour of a cross-sectional approach to relative dial frequency.²

The key to age ranking dial types is the relationship between scratch dial frequency and loss. (Fig. 1) How can the ranking be inferred? The older the dials the greater the loss they will have suffered because of their longer exposure to church rebuilding and weathering. Although the extent of dial loss varies by county, it will still be the oldest dials

which are most responsive to varying conditions. In terms of Fig. 1, the older the dial type the steeper its gradient. The 360° dials, being significantly different from both other types,³ are the oldest surviving scratch dials. The 180° and 90° dials, being statistically indistinguishable, are of similar age.

Although dial loss is the primary explanation of dial frequency variability it is not a total one (Fig. 2). It explains most 360° dial variability, but less so others, especially 90° dials. Detailed probing of the data indicates that if a county tends to have more of a dial type it is offset by less of the others – thereby revealing variation between counties in the precise timing of their move away from 360° dials. Probing the data further it is apparent that, unlike other types, 90° dials were never, at a national level, fully or equally adopted.⁴ Finally there is a ‘to be explained’ element. The analysis excludes, given that no comparable data exists, scratch dial displacement by scientific dials and clocks. There can however be no doubting a progressive displacement occurred, culminating in the demise of the scratch dial era; its effects probably account for most of the ‘to be

Assessment Basis		Relative dial frequency defined as (1)	
Criterion	Comment	Serial	Cross-sectional
Objective.	Estimate age by dial type.	Reflects combined effect of age and the duration a dial type remained in use. (Is the least common dial type the oldest or that in use for the shortest time?)	Accepting each dial type was in use for much the same time across the country, this measure primarily reflects the influence of age.
Reliability of estimates.	Dial type data under-represents older dials because only the categorisable recorded subset of the database is included. It per force excludes (the presumed older) uncategorisable or unrecorded dials. (2)	Because inter dial types are compared, there is an unknown element of bias to this measure and the results of its analysis.	Because only intra dial type comparisons are made, no bias is imparted to this measure or the results of its analysis.
Compatibility.	Can previous results be used in this analysis? Can the results of this analysis be combined with previous results? (3)	No. Previous results are incompatible with this analysis and its results.	Yes, all results can be combined. On this measure results are unaffected by representational differences between all listed dials and the categorisable recorded subset.

Table 1. Considerations determining the technical specification of scratch dial frequency by type analysis.

Notes:

1. Two alternatives present themselves when considering the relative frequency of a dial type in a county. The serial, relating the frequency to that of other dial types in the county: And the cross-sectional, relating the frequency to that of the same dial type in the country as a whole. Their crucial differentiating factor is that

the serial is an inter, whilst the cross-sectional is an intra, dial type comparison.

2. For the (subset) composition of the scratch dial database (all listed dials) see main note 1 reference.

3. For previous results (based on all listed dials) relating to dial loss, dial redundancy and 1650 dials/church see main note 6 references.

explained' element – the increase therein for the later dial types is consistent with such a presumption.⁵

Cross-sectional analysis permits an age ranking and sequencing of dial types. If, however, the cross-sectional results are pooled with those of the life cycle model (LCM),⁶ the transition from 360° dials can be dated. It has already been established that the benchmark group of counties (a quarter of the total) have lost two-thirds of their 1650 scratch dials.⁷ It can be seen from Fig. 1 however that 360° dials are about twice as sensitive to loss as other dial types. It can thus be inferred that since 1650 some five out of six of the 360° dials, but only about half of the other types of dial, have been lost. It can be further inferred that the composition of the 2-3 scratch dials per church in 1650 was 60:40 in favour of 360° dials versus the rest. This predominance of 360° dials at the end of the scratch dial era implies that the adoption of alternative types must have been comparatively late: 1500 is the date most consistent with LCM parameters. Some of the implications of these findings merit highlighting via further exploration and elaboration.

Firstly, the 1650 split between 360° and other dials demonstrates how utterly misleading naively taking the surviving 35:65 ratio⁸ at face value is. We can now appreciate this is because differing dial age results in a differential post-1650 loss. If allowance is also made for pre-1650 dial loss, it is clear the vast majority of scratch dials made in the evidential period must have been of the 360° type.

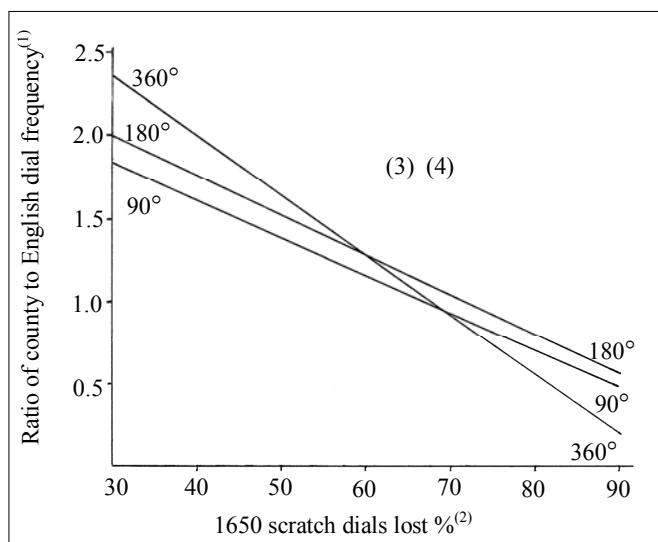


Fig. 1. Relationship between cross-sectional scratch dial frequency and dial loss.

Notes:

1. For each dial type, each county's dials/medieval church is divided by the English average dials/medieval church for that dial type. (See Table 1 for choice of specification).
2. As estimated in main note 7 reference.
3. Each dial type's line estimated by standard least squares regression.
4. As a county's proportion of 1650 scratch dials lost increases, so the incidence of its dials declines – hence the downward sloping lines.

Secondly, some might be surprised by the implication that in 1650 there was (on average) just a single 180° or 90° dial per church: is that credible? The LCM validates it. By about 1650 the progressive displacement of scratch dials by scientific dials and clocks was complete. Those churches where displacement occurred before 1500 would never have had any 180° or 90° dials: whilst for those where displacement occurred after 1500, the subsequent accumulation of such dials (through redundancy) would have been truncated. There would also have been some loss of such dials before 1650. In combination these factors render their apparently low average incidence explicable; it is not inconsistent with multiple 180° and/or 90° dials in the (minority of) churches where scratch dials were yet to be displaced.

Thirdly, how can we be sure 360° dials fell out of use around 1500? This can perhaps be most readily appreciated through the following considerations. The nature of the LCM is such that the data becomes markedly inconsistent with any materially different alternative dating assumption. This arises because whilst the total incidence of scratch dials remains unchanged, the 'presumed' split between 360° and other dials changes sharply as they are 'substituted' one for one.⁹ As a consequence, any radical alternative view on the timing of the cessation of 360° dial use 'requires' an implausible set of large differential revisions to LCM parameter estimates – it is not merely a matter of a slightly variant interpretation of existing results.

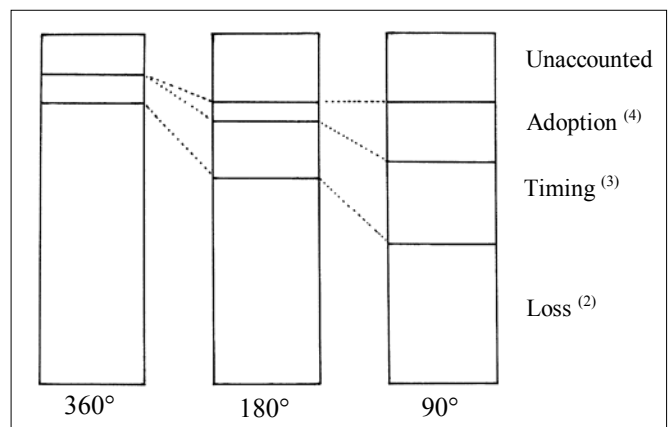


Fig. 2. Accounting for the variability of cross-sectional scratch dial frequency.¹

Notes:

1. The proportion of the sum of the squared deviations accounted for by (variations in) individual factors.
2. The influence of (variations in) loss is measured by the coefficient of determination of Fig. 1 regressions.
3. The influence of variability in the timing of the move away from 360° dials is calculated from the negative correlation structure within the residuals matrices of Fig. 1 regressions.
4. The partial (variable by county) adoption of 90° dials is indicated by the excess of their residuals, compared to 180° dials, in the Fig. 1 regressions. As the two dial types were 'substitutable' (with negative correlation between their residuals) it accounts for variability in both.
5. That proportion of variation not accounted for by elements (2), (3) and (4).

Where does this paper leave us? It has established that, contrary to the profile of surviving dials, most evidential period scratch dials were of the 360° type. Their use ended, in favour of the 180° and 90° types, around 1500. Adoption of the 90° dials varied markedly on a regional basis. This pattern of scratch dial evolution is entirely empirical – echoing the combined collective message of thousands of listed dials – and the first to be derived on a scientific basis. That said, it must also be noted what it is not. It is not the evolution of scratch dials' actual in-use painted and decorated appearance; instead we have a partial, skeletal, monochrome guide thereto. Also, it is only a descriptive contribution to our understanding of scratch dial evolution; it is not an explanation of why. Further elucidation calls for additional alternative lines of investigation.

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- definitional nomenclature developed in Part 1.
2. For the complete avoidance of doubt, for the reasons embedded in Table 1, comparison of the (surviving) frequency of one dial type relative to another, however intuitively appealing, is completely misguided.
3. Standard statistical hypothesis tests at the 5% level of significance.
4. The regional variation in the timing of the cessation of 360° dial use and the extent of 90° dial adoption will be outlined and considered further in subsequent articles.
5. Scratch dial displacement will be considered in a subsequent article.
6. See Chris H.K. Williams: 'The English Scratch & Mass Dial Era: The Evidential Period c.1250 to c.1650', *Bull BSS*, 21(iv), 18-19, (2009) and references therein.
7. See Chris H.K. Williams: 'The Prevalence of English Scratch (Mass) Dials c.1650 – Part 2', *Bull BSS*, 21(iii), 34-35, (2009) for derivation and listing of counties.
8. Ref. 1, Fig. 2.
9. It follows that the regional variations in the timing of the move away from 360° dials referred to earlier are not large.

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NEW DIALS (2)

Highlands School, North Vancouver, Canada

Walk-on sundials do not usually have the analemma '8' shape on the dial itself. It has been recognised that a single analemma shape will yield errors if used directly. This was the cause of the mysterious error in the early Brou dial in France.^{1,2}

It is impossible to provide direct mean time correction over the whole dial using one analemma because the vector correction for the EoT is of opposite signs in the morning and afternoon. It is possible to obtain a direct reading of close to mean time using one analemma for the morning and another for the afternoon. However, perfect values can be obtained for only two selected times in the morning and two in the afternoon. There will be errors at all other times: the problem of determining the least error point can be dealt with analytically^{1,2} or by iteration.³ Helmut Sonderegger's 'Alemma' software⁴ uses Seidelman's method with a minor addition which allows the arbitrary distribution of accuracy over selected portions of the day.

This dial for the Highlands school, North Vancouver was designed using 'Alemma' and built by parent volunteers. It has an average absolute error of 31 seconds and a maximum error of about 3 minutes. These are well inside the reading error. The double analemma design takes only a little more effort than a normal analemmatic dial and, as well as providing mean time directly, the decorative value



adds visual interest and provokes curiosity. The zodiac signs are arranged in approximately the correct positions around the dial.

The dial was set out using vector bars based on the dial centre and the maximum value of the semi-minor axis. Plywood jigs were made for the analemmas. All the setting out equipment was designed to accept a 'Hilti 14' concrete drill with a special tool to drill countersunk holes for bronze survey markers. The survey markers were embossed with the location using an old 20 ton jack and grouted into the asphalt with bitumen grout. The markers provide a permanent reference for future painting. A heavy oil-based paint was used with home-made stencils for each feature.

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4. The Alemma program can be downloaded from <http://web.utanet.at/sondereh>

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ENGLISH SCRATCH (MASS) DIALS: The Ravages of Time Revisited

CHRIS H. K. WILLIAMS

The original article¹ presented the first quantified demonstration of the sheer scale of the twin reapers – rebuilding and weathering. Recognition that the vast majority of dials have already been lost lies at the heart of all our analysis. It is not too much of an exaggeration to say that a true understanding of the mass dial era comes not so much from directly examining survivals *per se*, but from appreciating what has been lost. Whilst we have made enormous progress, the full potential informational content of the original dial loss estimates remains to be extracted. Now that the age structure of surviving dials is coming into focus² we can do so. By integrating dial loss with dial age, previous insights can be restated with both greater precision and in more detail.

The original article derived two estimates of dial loss. First, the total (rebuilding and weathering combined) rate of loss experienced in the twentieth century, as revealed by formerly-listed dials now lost. Secondly, the impact of rebuilding, measured by the number of dials lost to rebuilding relative to those surviving, as revealed by a probabilistic analysis of dials that have obviously been moved – rotated or relocated. Although each is an invaluable probe into the actual dial loss suffered, making full use of the estimates has hitherto been hampered by not knowing either the age of dials or the interaction between age and the rate of loss. Accordingly, it has been necessary to adopt some broad-brush interpretations, inevitably involving the use of ranges, see Fig. 1. Whilst, on the face of it, these might appear disconcertingly large, they are, as evidenced by previous articles, sufficiently precise to illuminate areas previously in complete darkness. In particular, scratch dials were univer-

sal: all churches once had them, with dial redundancy causing most to have multiple dials – the 1650 average being between two and three dials per church.

But we now have, through the analysis of different types of dial, some indication of the age structure of dials (note 2). Pre- and post-1500 dial types is a strong age clue; and differential post-1650 dial loss by type is a strong clue of the relationship between loss and age. These initial indications can, within the context of the life cycle model (LCM),³ be extended to unravel the complete age structure in detail, see Fig. 2. In fact it is possible, by iteration, to simultaneously estimate the dial age and loss structures that best fit the underlying data – some 5,000 listed/recorded dials – Fig. 3.

The revised loss estimates are shown in Fig. 4. There can be no doubting we now have a far superior and precise comprehension compared to that shown in Fig. 1. In turn the 1650 dial prevalence can also be stated more precisely – an average of 2.8 per church. Whilst, compared to the earlier range, this does not revolutionise opinion, it shows clearly where the true balance of evidence points. In the light of Fig. 4 various considerations merit revisiting.

Firstly, we now intimately understand the dynamics of past dial loss. The loss attributable to rebuilding averages 0.14% pa. Was it unchanging over the centuries? Of course not, but it is only possible to estimate as an average. Any cycling around the mean in no way detracts from rebuilding's cumulative impact. Turning to loss attributable to weathering, the inexorable and progressively accumulating impact of dial age is most striking. Shortly after the Great Norman Rebuilding, when all dials were more or less new, loss was

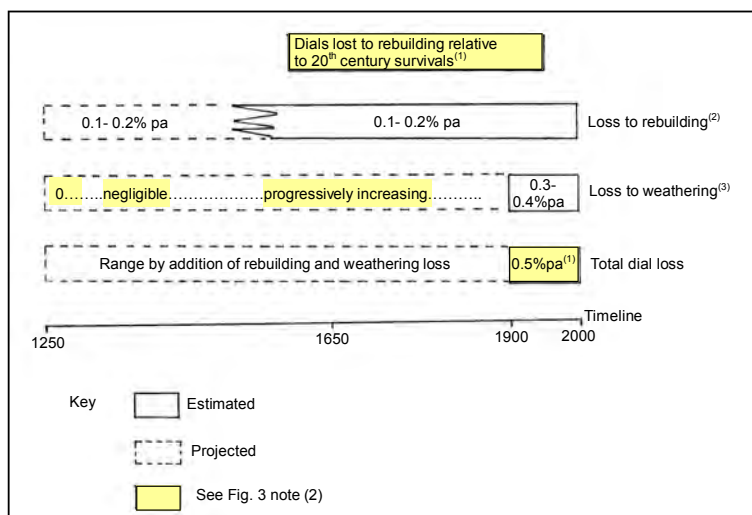
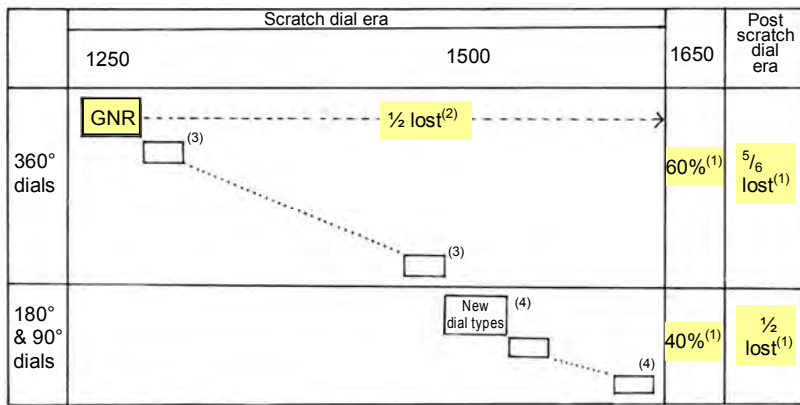


Fig. 1. Interpreting dial loss when dial age was unknown.

Notes:

- (1) Original 'Ravages of Time' estimates. (See main text).
- (2) The % pa range reflects an assumed dial age range sufficiently wide to definitely straddle the (then unknown) actual. The jagged line represents (the former) uncertainty as to the time period to which the estimate pertains. Evidence, visual and documentary, of church rebuilding and repairs does not suggest dial loss would have been lower in the pre-estimate period.
- (3) Twentieth century weathering loss is the actual total loss of (1) less the rebuilding estimate of (2). Earlier weathering is assumed to have been zero at the time of the Great Norman Rebuilding (when virtually every church would have had a new dial), and then to have progressively increased to the twentieth century level.



See Fig. 3 note (2)

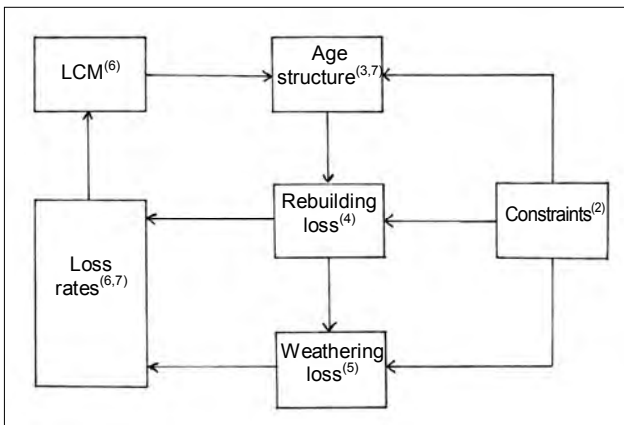


Fig. 3. Logic flow of loss estimates derived by iteration.

Notes:

- (1) An iterative solution, one arrived at via successive sequential approximations, is technically possible when there is a permissible mix of sufficient datum points and constraints.
- (2) The constraints, conditions the solution must satisfy, are those elements yellow highlighted in Figs. 1 & 2. They represent key conclusions derived from the database of 5,000 dials and LCM.
- (3) Fig. 2 illustrates the components specifying the age structure of dials. Starting component values are consistent with the dial loss in Fig. 1. The first approximation of the average dial age profile through time is made.
- (4) The twentieth century element of (3) and the original impact of rebuilding estimate (Fig. 1 note 1) permits the first approximation of the % pa rebuilding loss.
- (5) Given (4) the total loss constraints (in Fig. 2) can be apportioned between rebuilding and weathering. The latter permits the first approximation of the % pa weathering loss (against dial age) profile. An exponential relationship best fits the data.
- (6) The first iterative loop has been completed. The % pa loss rates of (4) and (5) are fed back into the LCM, a revised age structure calculated, and a second iteration undertaken.
- (7) Successive iterative loops are made until the age and loss profiles no longer change. (See Fig. 4). Mathematically, the solution is stable and convergent.

overwhelmingly due to rebuilding. It is not until dials are about 250 years old that the annual rates of loss equate. So it is not until well into the post-scratch-dial era that weathering comes to dominate.⁴ By the twentieth century it did so by two to one. There can be no escape; weathering will, inexorably, destroy dials at an increasing rate.

Secondly, we now have a context in which to judge the regional variation in the frequency of surviving dials. Our

Fig. 2. Schematic life cycle model illustration of the age structure of dials.

Notes:

- (1) Elements estimated in the analysis of dial type age ranking and the dating of the use of 360° dials. (See main note 2).
- (2) The Great Norman Rebuilding (GNR) resulted in a new dial at each church. As their age and elapsed time to 1650 is much the same as that for post-1500 dial types to the twentieth century, both must have experienced a similar dial loss – each was equally exposed to the ravages of time.
- (3) Post GNR cohorts of 360° dials determined by loss and redundancy.
- (4) Adoption cohort of 180°/90° dials at churches where scratch dials were not yet displaced; plus post adoption cohorts determined by loss, redundancy and displacement. (Although we have yet to rigorously examine the displacement of scratch dials, given it was completed by 1650 and in large part occurred post-1500, uncertainty as to its exact profile has a damped and muted impact on dial age).

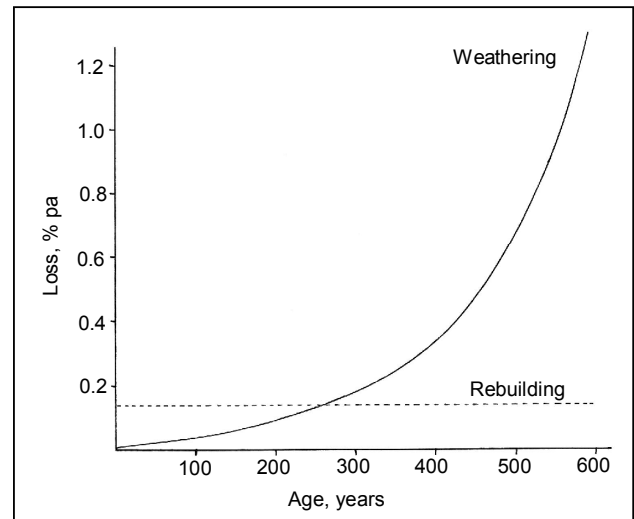


Fig. 4. Dial loss revisited in the light of dial age.

Notes:

- (1) Calculated as outlined in Fig. 3.
- (2) The loss rates are those of the benchmark grouping, a quarter of all counties. For discussion of other counties see main text. For the grouping of counties by scale of post-1650 dial loss see main note 5.

current epoch, in which the average dial age is around 450 years, is exactly when weathering really begins to bite. Were the Fig. 4 weathering curve, (which refers to the benchmark counties), to be delayed or advanced because of the differing characteristics of local building stone and/or the weather, the resulting spread in surviving dial frequency would be wide. This is of course exactly what we see with the regional watershed and concentration of hot and cold clusters in dial listings.⁵ So although we await a systematic scientific technical investigation of regional variability in the ‘susceptibility to weathering’, the variability of dial survival is not of itself, from a purely numerical perspective, surprising. It’s merely a reflection of the nature of the age-weathering relationship and the epoch we now live in:

were the clock to be wound back in time, a progressively narrowing regional variation would be observed.⁶

Thirdly, we now have a firmer and richer basis for determining the true context of surviving evidence; and, just as, if not more importantly, the significance of that we do not have. We have previously (note 2) seen that 360° dials, a minority of the surviving total, constituted the vast majority of those originally made. It is an ironic fact that, although scratch dials are quite correctly and generically viewed as a medieval artefact, most survivals are post medieval. Approaching 600 years of age is well nigh terminal for a scratch dial; by then the annual loss rates of Fig. 4 would have culled them all – any survival would not only be exceptional but have required a ‘sheltered life’ to escape the odds. It follows that surviving 360° dials are primarily fifteenth century rather than earlier;⁷ thereby further compounding the irony in that even the minority of genuinely medieval survivals are in fact rather late examples thereof.⁸ Fig. 4 brings home to us the extent of what has not survived: its limit demonstrates there is a past point in time before which loss is absolute. What then of our natural demand and requirement for ocular evidence? Surely we must recognise there is a point where it is not a question of zero evidence, but that there can be no such evidence! How should we then progress? Any normal reliance on ocular artefactual evidence has but one outcome – silence! Enlightenment can then only be sought through alternative types of evidence and dimensions of context. Such considerations have not intruded upon the deliberations of former mass and scratch dial students.⁹

Finally, it is not only the past that is now laid bare, but also the future. It paints a sad and salutary foretaste of time’s all conquering powers! Fig. 4 heralds weathering will unrelentingly intensify. Dials will be lost at an increasing rate: the proportion of dials in poor condition, now around a third, will progressively increase; and surviving dials will become increasingly regionally concentrated. Around 2200 scratch dials will have all but disappeared; but the last surviving dials will all be in a poor condition well before then!

Should this concern us? In a sense it is no different from what has been happening for centuries! The real difference now is that these will be the last dials. Does that matter? Fortunately, due to the Herculean labours of the Mass Dial Group, our recordings are the envy of the world. Even so, is not something real still being lost? Are a selection of specimens worthy of conservation? Is any such conservation either feasible or practical? We are one of the very last generations of antiquarians that will have the luxury of contemplating such questions! Scratch dials are approaching the bell for their last lap. It will then be too late.

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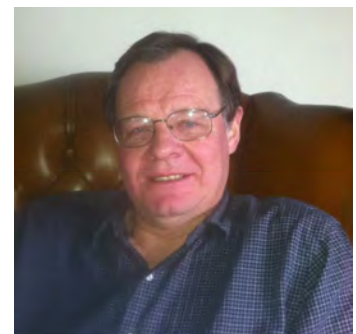
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4. Average dial age increased at a discount relative to elapsed time because of redundancy (creating new dials) and weathering (culling the oldest) – both reduce average age. Typically average dial age increases by around 7 years per elapsed decade.
5. See Chris H. K. Williams: ‘The Prevalence of English Scratch (Mass) Dials c.1650 – Part 2’, *Bull. BSS*, 21(iii), 34-5, (2009).
6. Some of the county spread in dial survival is because of a differential rebuilding impact – for example endemic urban growth (especially in London and Middlesex) and the severity of Victorian restoration – but coherent data beyond the anecdotal is hard to come by. Nevertheless, given the current epoch’s considerable excess of weathering over rebuilding loss, combined with the strong *a priori* expectation large ‘susceptibility to weathering’ differences exist, it is indisputable most dial survival variability can be laid at the weathering door.
7. It should, for the avoidance of doubt, be understood this is a statement grounded in statistical probability. Were we to be presented with a fourteenth and a fifteenth century dial, it would not be possible to distinguish one from the other visually.
8. It is almost an instinctive human trait to presuppose artefacts are either older, or early examples more numerous, than is in fact the case. Contagion is not artefact specific, being also very evident with furniture and houses (see for example S. Pearson: ‘*The Medieval Houses of Kent*’, RCHME & HMSO, (1994)). Serious scholarship almost always exposes conventional dating wisdom to have erred on the ‘too early’ side.
9. For an initial exploration and discussion of such issues see Chris H. K. Williams: ‘The English Scratch & Mass Dial Era: Origins to c. 1250’, *Bull. BSS*, 22(i), 14-17, (2010). (Some may wonder, given the possibility of archaeological finds, how we can be categorical early evidence does not exist. Realistically any yet to be archaeologically retrieved scratch dial evidence is likely to be fragmentary with problematic dating, and definitely rare: It will never, of itself, be sufficient to be incontrovertible).

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research specialises in applying economic, statistical and mathematical techniques to interpreting dialling/horological artefacts and documentary sources. Projects include domestic clock, watch and turret clock markets of the seventeenth/early eighteenth centuries, and Saxon/medieval mass and scratch dials. He is a regular contributor to the *BSS Bulletin* and to *Antiquarian Horology*.



ENGLISH MASS & SCRATCH DIALS c.1250 – c.1650:

Combining Statistical and Religious Evidence

CHRIS H.K. WILLIAMS

Statistical analysis and modelling has revealed the evolution of scratch dials.¹ Further elucidation, particularly their original—as opposed to surviving—appearance, calls for additional alternative lines of investigation. To progress further we must interpret statistical results within scratch dials' original contemporaneous religious and iconographic contexts. This article outlines powerful religious currents and change. Some readers may (initially) find this a little detached from direct, or immediate, dialling significance: but it is absolutely essential to any meaningful appreciation. The consideration of scratch dials has been artificially divorced from their religious roots for far too long. Subsequent articles will explore the iconographic contexts of differing dial types in more detail.

That mass dials and religion be associated can scarcely be considered a novel thought. Yet students have directed surprisingly little attention to the religious context of mass dials. Such consideration as there has been in the literature concentrates on the oldest mass dials – those of the 7th to 13th centuries. Its primary objective has been explaining hour lines in the context of monastic offices.² Important as this traditional focus might be, of England's 5,500 listed mass dials only a few hundred predate 1350.³ An extended and broader focus that includes religion in the 14th to 17th centuries is necessary to match the overwhelming bulk of surviving dials.

When juxtaposing the two streams of evidence, the statistical and the religious, one is immediately struck that each pivots around a common date (Fig. 1). A dramatic change in the appearance of mass dials, the ending of 360° dials, dated by statistical modelling to circa 1500, coincides with the onset of Reformation. The Reformation is one of his-

tory's great misnomers. It was not religious reform but revolution. That in turn begat total revolution – of politics, society, everything. Our closest historical analogue is 20th century Russia. As we shall see, there are seismic grounds for expecting the trauma of Reformation to have noticeably and visibly altered the appearance of dials.

But first, let us consider those aspects of medieval Catholicism that might have a bearing on the use and appearance of mass dials.⁴ Required church attendance embraced matins, mass and evensong on Sunday and feast days. Together these accounted for a quarter of the year. The remaining three quarters was not devotion free. Heaven's waiting room – Purgatory – where the souls of the deceased did time for their earthly sins, drove much devotional activity. Celebrating mass for the dead, and praying for them, was central to easing the pain and duration of purgatory. In a real sense there was a single community embracing both the living and the dead. The pantheon of saints played an intercessionary role, between God and supplicant, both in prayers for deceased souls and personal appeals for help or consolation. Veneration of saints afforded prayer a personal tailored expression of piety. Top of the list was Mary, but any one of hundreds might be appealed to. There were dedicated patron saints for anything and everything, from St Apollonia for toothache to St Zita for domestic servants.

Medieval clergy were a mixed bunch. The holder of a benefice often subcontracted his duties, but not his church income, to a lowly paid priest. Often these were from the labouring classes, with limited education, able to recite rather than *au fait* with Latin, and unburdened with sermons – a later invention. They could not afford to be full time, needing to work to support themselves. Masses for

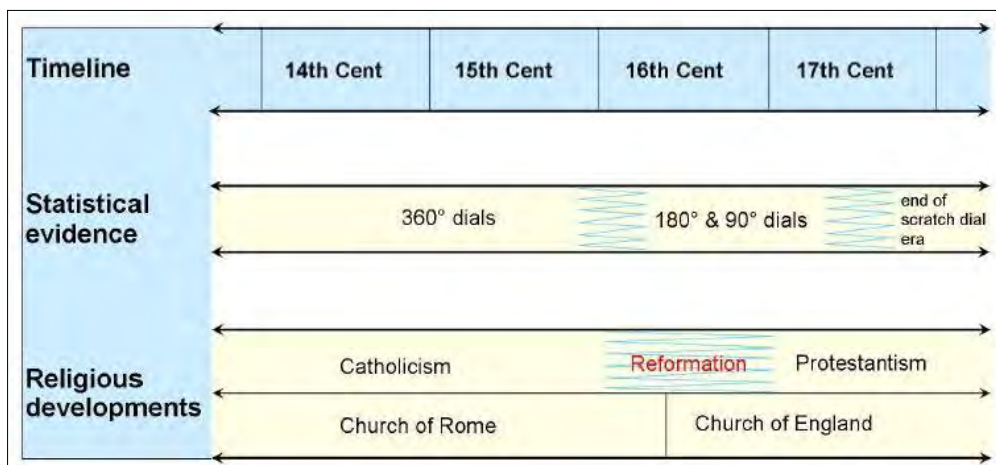


Fig. 1. The statistical and religious contexts of scratch dials. Note: The 360°, 180°, & 90° dial categorisation is illustrated and discussed in Chris H.K. Williams: 'The Evolution of English Mass & Scratch Dials c.1250 – c.1650: Part 1. Dial Categorisation', *Bull. BSS*, 22(iii), 24-26, (2010).



Fig. 2. 15th century Judgement scenes above the rood screen. (left) St. Peter's Church, Wenhamston, Suffolk. Photo: Anne Marshall; (right) Holy Trinity Church, Coventry, Warwickshire. Photo: Rob Orland.

(1) Note where the crucifixion statues once stood in front of the Wenhamston painting. The Coventry painting, in a larger church, was above the statues.

(2) These two examples are indicative of the colour and vibrancy that covered the entirety of all the walls in medieval churches.

the dead were funded by individual mortuary benefactions and guilds for their erstwhile members. Chantry and guild priests were non-beneficed, independently financed, and self-employed. They were a far more significant resource than suggested by surviving chantry chapels or altars, most being itinerant and peripatetic. A parish's ministrations was thus variable and multi sourced.

Guilds played a vital role in fostering devotional activities and, just as importantly, financing the necessary devotional infrastructure. Guilds were far more extensive than the familiar urban trade or craft variety. Every village had them; their number and scope dependent on population. There were general guilds; separate guilds for men, women, boys and girls; as well as guilds dedicated to individual saints. Guilds were the parish, and subsets thereof. As well as being in receipt of bequests and donations, guilds arranged the Parish Ales associated with feast days.

How did medieval Catholicism manifest itself in church furnishings and iconography? It did so in an explosion of colour and imagery! No surface – wood, stone, plaster or glass – was excluded. Most dramatic was the separation of nave and chancel: above the rood screen there were life sized coloured statues of the crucifixion flanked by Mary and St John. Above or behind these was an enormous painting of the Day of Judgement. (Fig. 2). The rood screen itself was carved and decorated, its niches containing statues and paintings. Whilst the rood, crucifixion and judgement ensemble constituted the most dramatic vista, no wall was left bare. Each was covered in a kaleidoscope of colour and paintings; its niches and brackets graced by statues – polychrome statues, often gilded. Lights—burning candles—were maintained before the principle statues.

We are describing a completely lost and unfamiliar world, difficult to imagine. But it is the world from which our oldest surviving scratch dials originate. If we are to meaningfully decipher and interpret them, we must, as diallists, be attuned to the wavelength of medieval Catholicism. This world was swept away by the Reformation.

The Reformation's intellectual roots lay in the Old Testament – “Thou shalt not make unto thee any graven image or likeness of anything that is in heaven above or that is in the earth beneath...”. Reformers saw reverence due to God dissipated on inanimate objects and images. Reformers saw holiness not confined to heaven but dissipated in imagery. Image fuelled devotion, ceremony and ritual was not the route to Salvation. Salvation lay wholly and solely in the bible, with the Word.

The image-infested Catholic Church had to go. It went in successive waves of legislation, regulation, and state sponsored iconoclasm – Henrican, Edwardian, Elizabethan, Cromwellian.⁵ The end result: Catholic colour, decoration, imagery and vibrancy all suppressed and supplanted by whitewashed Protestant minimalism. No rood, crucifixion and judgement ensemble; no altar, just a plain table; no statues and their lights; no colour and art, instead whitewashed walls, their only adornment, the Word; the single innovation, the pulpit, for sermons to preach the Word. Such purging and purification was unrivalled in Europe. It would be extraordinary for dials to have been immune to the Reformation's cataclysmic forces, and our statistical evidence (Fig. 1) shows they were not.

It can now be appreciated that the marked change in the appearance of dials in the 16th century was caused by compelling and profound religious change.⁶ This change is discernable in the surviving appearance of dials. However, it is high time diallists redirected attention away from surviving appearance to that when these dials were originally in use. We can do so by elaborating upon this article's foundations: subsequent articles will develop more detailed assessments of the contemporaneous religious iconographies relevant to medieval Catholic and Reformational/Protestant dials.

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For a photo and CV of the author, see *BSS Bulletin* 23(i).

THE CORONATION DIAL AT PAINSWICK

TONY WOOD

The village of Painswick, out in the Cotswolds, is home to quite a collection of sundials, all quite old, so it is perhaps no surprise to find that the Coronation in question is not that of our present Queen but that of her father, King George the Sixth. The Coronation was in May 1937 and the dial (Fig. 1) has apparently been in its present situation since then. It is a special souvenir Coronation dial and must be one of many¹ produced in 1937 to mark the event and as dials go it is essentially a mass produced popular garden dial of 8 inches diameter in bronze and seems to be marked out reasonably accurately together with a gnomon of 52°.

The inscription round the edge reads: GEORGIUS VI BRITT. OMN. REX. CORONATION 1937.

The delineation around noon gets a little hazy. The hours scale is divided into half-hours and eighth hours (7½ minutes). A long noon line implies a split noon but the intervals become very irregular. The royal coat of arms appears on the dial plate (Fig. 2) and raises the question of whether many (or indeed any) other dials are so marked. We had a royal monogram granted to us at Ruardean² for the Queen's 50th Jubilee but the Chamberlain's Office did not go so far as the coat of arms. Its survival for 74 years is perhaps surprising as it is located at a pub. The Royal Oak in Painswick has a courtyard and skittle alley out at the back and the dial is mounted on a rough-hewn block of stone with a mysterious row of holes and is barely large enough at the top to hold the dial plate securely.

On a personal note, I seem to have had particular difficulty in taking pictures of this dial (snow and camera problems) and it required at least three visits to the pub with the necessary courtesy of buying a drink (and a meal).

Apart from the challenge of royal coats of arms dials, I suspect we may now have on our lists a sufficient number of pub dials for an enthusiastic member to produce Monograph XXX 'Great Pub Dials of Britain'. In fact a few of us dipped a tentative toe in the water (or beer) with letters to the Editor a few years ago about pubs with dials.³ Any offers?

Fig. 1. The Painswick dial on its pedestal.

Fig. 2. The dial plate.



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MEDIEVAL CATHOLIC ENGLISH MASS DIALS OF THE 14TH & 15TH CENTURIES

CHRIS H.K. WILLIAMS

Hitherto we have analysed the surviving appearance of scratch dials and their broad religious context. Medieval Catholic dials were very different from Reformation/Protestant dials.¹ Although clearly discernable from surviving appearance alone, their original appearance would have differed even more dramatically. This can be confidently inferred from Catholicism's and Protestantism's markedly different religious iconographies – a difference from which dials would not have been immune. This, and the next, article will consider the original appearance of these dials.

The most authentic impression of medieval Catholic iconography can be seen in church wall paintings. Sufficient have survived – preserved under plaster or lime wash – to

reveal how utterly ubiquitous they once were. Unsurprisingly, the pantheon of saints provided endless inspiration, as did messages of a moral nature, both often portrayed in rather secular circumstances.² Fig. 1 indicates the range of paintings to be found in English parish churches.³

How should we interpret such paintings? Their quality is vernacular, rather than fine, art. But that is to apply our modern conventions. Medieval art was not experienced aesthetically, but viscerally. In an illiterate age it was the way to convey messages. Therein lay an endless supply; a supply that not only covered all interior walls, but recovered them – over-painting was endemic. Medieval vernacular art is akin to modern popular print – its content and symbolism was read; and new editions replaced the old!

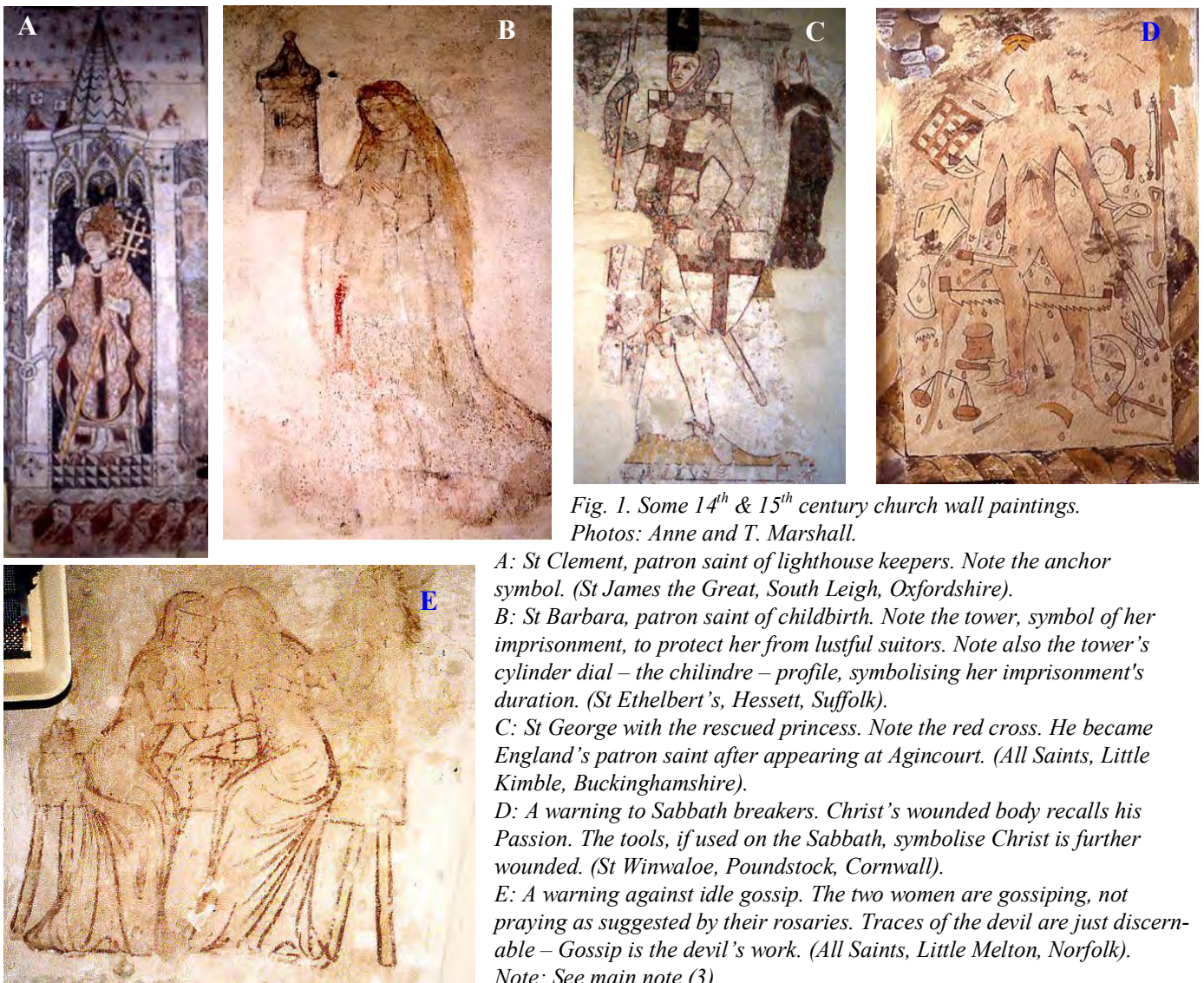


Fig. 1. Some 14th & 15th century church wall paintings.
Photos: Anne and T. Marshall.

- A: St Clement, patron saint of lighthouse keepers. Note the anchor symbol. (St James the Great, South Leigh, Oxfordshire).
- B: St Barbara, patron saint of childbirth. Note the tower, symbol of her imprisonment, to protect her from lustful suitors. Note also the tower's cylinder dial – the *chilindre* – profile, symbolising her imprisonment's duration. (St Ethelbert's, Hessett, Suffolk).
- C: St George with the rescued princess. Note the red cross. He became England's patron saint after appearing at Agincourt. (All Saints, Little Kimble, Buckinghamshire).
- D: A warning to Sabbath breakers. Christ's wounded body recalls his Passion. The tools, if used on the Sabbath, symbolise Christ is further wounded. (St Winwaloe, Poundstock, Cornwall).
- E: A warning against idle gossip. The two women are gossiping, not praying as suggested by their rosaries. Traces of the devil are just discernable – Gossip is the devil's work. (All Saints, Little Melton, Norfolk).
- Note: See main note (3).



Fig. 2. The internal clock dial at Raunds, Northamptonshire. Photo: Anne Marshall.

Notes:

1. Donated by the Catlyn family, it can be dated to c.1425.
2. Note the two flanking angels have wings patterned like peacock tails. Peacocks symbolised immortality; their flesh was supposed never to rot.
3. Although vastly superior – artistically, materially and technologically – to the humble scratch dial, it is easy to imagine the central sunburst motif adorning (some) mass dials.

Colour decoration was not confined to medieval interiors but, for obvious reasons, exterior evidence is very rare. Cathedral fronts, with all their carving and statues, were a riot of colour. Conservators examining the west front of Exeter have analysed hundreds of paint samples, establishing it was repainted eight times before the Reformation.⁴ Were the exteriors of parish churches colour decorated? Given their adoption of interior painting, stained glass, coloured floor tiles, and all manner of other trappings, it would be remarkable if they were not - another example that the absence of evidence cannot be taken as evidence of absence. Perhaps surviving statue niches on some parish churches are the remaining vestigial evidence?

What are the implications of our appreciation of Catholic religion and iconography for the original appearance of mass dials? There are two overriding considerations. Firstly, medieval churches were awash with an explosion of colour. It is inconceivable mass dials were not also colourfully decorated whilst in use. To presume (in the absence of proof positive) they were not flies against the conventions of the time. Secondly, symbolism was rampant. It is inconceivable mass dials did not embody symbolic meaning, thereby validating their upper halves, completely redundant in purely time indicating terms. Again, to presume otherwise flies against the conventions of the time. Medieval 360° dials are only fully explicable in terms of symbolic as well as functional terms.

Given the ravages of time on dials' scratched remnants, any trace of original painted decoration has long been lost. Any 'entombed' archaeological example preserving original decoration would be miraculous. No such evidence has yet been found. Perhaps the best to be hoped for, and again yet to be seen by diallists, is a manuscript illumination of a mass dial. The only contemporaneous analogue we can

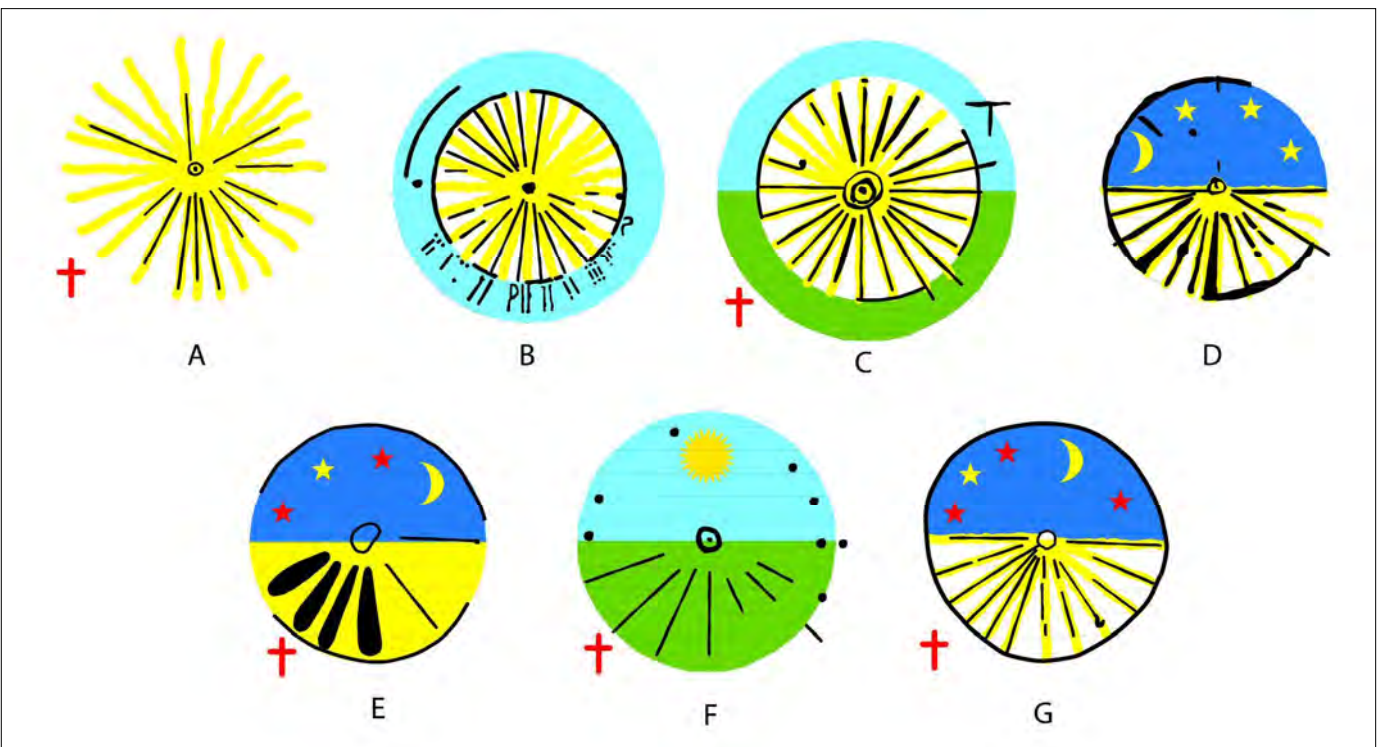


Fig. 3. Stylised illustrative Catholic mass dials.

Artwork: Tony Moss.

Notes:

1. Decoration has been superimposed on examples of 360° dials surviving scratchings (shown in black). The horizontal central gnomon is not shown.
2. Dials A, B & C use sun based symbolism; with dial B sur-

rounded by heaven, and dial C showing heaven above and earth below.

3. Dials D, E & G use day-night symbolism.
4. Dials C & F use heaven above and earth below symbolism.
5. Annotation has been limited to marking, with a red cross, mass at the hour of terce.
6. See main text for discussion of symbolic meaning and further consideration of possible annotation.

currently deploy are mechanical clock dials (Fig. 2). Sun (burst or ray) clock dials also occur in illuminated manuscripts.⁵ We can only speculate on the sun motif's derivation. Surely the inspiration for such clock dials is far more likely to be secondary, flowing from an established earlier sundial decorative tradition, than primary and original to mechanical clocks themselves?

The sun is the most obvious decorative motif for a sundial. As well as representing the ultimate and most intimate physical association with a sundial, the sun is also deeply endowed with rich religious symbolism. Such symbolism is multi-layered. Firstly, the sun symbolises the light of the world – God's eternal light. Secondly, it symbolises creation and life – especially the Creation. Thirdly, its daily rise symbolises Resurrection. Although this listing is by no means complete, it is sufficient to appreciate that there is no better single symbol of God's omniscience and omnipresence than the sun!

Another interpretation of 360° dials is that they represent day and night. Again the symbolism is rich and multi-layered: life versus death, living and departed souls, heaven versus earth and by implication the twilight zone - Purgatory. Each, and all, of these would have resonated with medieval Christians in ways virtually unimaginable to us today. In a very real sense medieval Catholicism was a single community embracing both the living and the dead. Life was but preparation for one's own death, the next world and the day of judgement; one assisted, through prayer and masses, departed souls in the agony of purgatory; and, one lived and died in the firm expectation one's own purgatorial agonies would be alleviated by the prayers of the earthly living.

In the absence of extant evidence, and the virtual certainty that no material evidence will come to light in the future, we can only conjecture as to mass dials' original in-use appearance. Figure 3 is an attempt to do so: it is intended to be indicative not definitive. Almost infinite variation in execution can, as with any artistic endeavour, be imagined. Undoubtedly there were different styles – some ornate, others less so – and an evolution therein. Despite all that texture being beyond retrieval, Fig. 3, for all its stylised limitations, forces us to confront and recognise a stark reality – surviving mass dials are, of themselves, but a ghostly and glaringly inadequate guide to both their original appearance and meaning.

That dials were painted and decorated cautions against over-interpreting a dial's scratchings. Not all of a dial's detail need originally have been scratched – only sufficient to aid reinstatement. It cannot be assumed all hour or event lines were scratched – as opposed to only painted. It is improbable all, or any, of their inscribed annotation was scratched. Inscription need not have been limited to indicating times or services. Some dials' annotation might have been personalised to the priest who used it or, given the importance of masses for the dead, the departed souls for whom masses were being offered. It is conceivable a dial's decoration and annotation changed whilst it was in use.

Symbolism has been considered from a purely visual perspective. Although the most directly relevant iconographic context, there was also a long literary tradition, which can

be traced back to the 5th century, utilising the horologium – sundials and clocks – and time itself as a religious or theological metaphor.⁶ Whilst a full intellectual appreciation was confined to a small educated literate elite, the literary tradition would have influenced, again in ways no longer obvious or meaningful to us today, both the original perception and appearance of mass dials. For example: general perception would have been affected by the common use of 'Horologium' in the title of theological works; and, the frequent use of twenty-four chapters therein may have helped inspire mass dials with lines dividing day and night into twenty-four hours.

Hopefully all are persuaded that the traditional approach of former mass dial students, by focussing on dials' surviving appearance independent of their iconographic context, was unduly conservative and restrictive. We have a deep and detailed appreciation of their iconographic context. By reuniting mass dials with their contemporaneous Catholic iconography, their remains can be reinvigorated. Although the exact original details of an individual dial are beyond retrieval, mass dials can be collectively repatriated with their generic character. (Fig. 3). The time has come for diallists to look beyond skeletal monochrome remains. Catholic mass dials were colourful, with an extensive symbolic oeuvre. Appearance wise, symbolism trumped time indicating functionality. It is even probable symbolic message was more important than time indication. This visual rehabilitation is of course additional to our previously established understanding of their true original numerical incidence.⁷ All churches once had mass dials: most several. It is likely, given itinerant chantry priests and the importance of masses for the dead, that more than the one dial was in concurrent use. Hopefully all are also persuaded Catholic mass dials deserve and warrant far greater appreciation and recognition amongst diallists.

REFERENCES & NOTES

1. Chris H.K. Williams: 'English Mass & Scratch Dials c.1250 – c.1650: Combining Statistical and Religious Evidence', *Bull. BSS*, 23(iii), 20-22 (2011).
2. We have, in addition, already considered crucifixion and judgement paintings. *Ibid*.
3. Readers wishing to explore the full glory of church wall paintings should consult Anne Marshall's website: <http://www.paintedchurch.org/index.htm>
4. See Andrew Graham-Dixon: *A History of British Art*, BBC Books, (1996).
5. Two c.1450 examples of such illuminations: Sapientia surrounded by clocks and other time related instruments in a copy of Henricus Suso's *Horologium aeternae sapientiae*, Bibliothèque Royale, Brussels, MS IV, iii, f.13v; and Temperantia adjusting a clock in a copy of Christine de Pisan's *L'Épître d'Othéa*, Bodleian Library, Oxford, MS Laud misc. 570, fol. 28.
6. See Otto Mayr: *Authority, Liberty, and Automatic Machinery in Early Modern Europe*, The John Hopkins University Press, Baltimore & London, (1986).
7. See Chris H.K. Williams: 'English Scratch (Mass) Dials: The Ravages of Time Revisited' & 'The English Scratch & Mass Dial Era: The Evidential Period c.1250 to c.1650', *Bull. BSS*, 23(i) & 21(iv), 36-8 & 18-9, (2011) & (2009).

For a CV and portrait of the author, see *Bulletin* 23(i).

ENGLISH REFORMATION AND PROTESTANT SCRATCH DIALS OF THE 16TH & 17TH CENTURIES

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In the previous article we considered medieval Catholic mass dials.¹ Earlier we examined the devastating impact of the Reformation and Protestantism on traditional Catholic iconography – its colour, imagery and symbolism.² It would be unbelievably extraordinary were scratch dials to have been immune to the Reformation's cataclysmic forces, and our statistical evidence shows they were not. This article discusses two questions. Firstly, how did church dials' appearance change? Secondly, what does the varying incidence of Catholic and Protestant dials reveal about the pattern and pace of religious change within England?

The surviving appearance of Reformation and Protestant (180° and 90°) dials look and feel completely different to their medieval Catholic forebears.³ Scratching is confined to the functional day period: the night is devoid of scratching. This is very strong evidence that their original decorated in-use appearance was also markedly different. Traditional Catholic symbolism (both portrayed on and dependent upon, 360° dials) had obviously been shed – so too one presumes their associated colour. The new Protestant iconography removed or defaced and whitewashed Catholic imagery and decoration; the only permitted decoration was that of the (biblical) Word itself.⁴

As no decorated dial is known to have survived we can only conjecture as to their original in-use appearance. There is no reason to suppose dials were not subject to exactly the same influences as all other ecclesiastical/religious artefacts. The dial vision most resonant with the new iconography is one of black painted hour lines and annotation on whitewash (see Fig. 1). Such a new symbolism would represent the black and white of the printed Word.

Dials evolved within the prevailing iconographic conventions of their time.⁵ Catholic dials were colourful, loaded with symbolic meaning; Protestant dials lacked colour. Symbolism trumped time-indicating functionality in the appearance of Catholic dials: on Protestant dials functional-

ity seems to dominate, symbolism being embedded in (a minimalistic) functional appearance – the black and white of the (printed) Word. Catholic dials had individuality: Protestant dials lacked artistic and symbolic individuality.

That said, some (limited) artistic expression may have (temporarily) lingered, as suggested by the wall painting in Fig. 2. Its focus on the Word, in this case the Commandments, using the wording of *The Second Book of Common Prayer* (1552), makes it indisputably Reformational – yet it contains an image. Undoubtedly this is a testing, or taunting, of the new boundaries. By showing Moses – smasher of idols, biblical authority for iconoclasm, and moral justification for iconoclasts' unimaginable havoc – it would have presented an intriguing challenge to the next Visitation. Their dilemma – order the whitewashing of the Reformation's biblical intellectual roots versus setting precedent by accepting some images are permissible.

The example of the previous paragraph illustrates a wider reality. No revolution advances smoothly, still less marches in lock step. From above, the political pace of reformation witnessed several accelerations and decelerations, as well as outright Marian reversal. Whilst from below, conformity and enthusiasm varied within communities and across the land, with dangerous rebellions in 1536, 1549, 1554, and 1569. Tracing the strength and spread of Protestantism has long fascinated historians.

Dickens, former doyen of Reformation studies, saw an early powerful Protestant spearhead in the coastal south east; a less strong early Protestant element in the Thames valley; and the rest of England, with Protestant hotspots isolated to a few urban centres, and the north west and south west being particularly conservative.⁶ Over the last twenty years, several revisionist historians, Duffy being the most influential,⁷ extrapolating from the burgeoning stock of detailed local studies, envisage a less clearly and dramatically segregated picture, with reformation and Protestantism advancing on a broader front throughout the realm.⁸

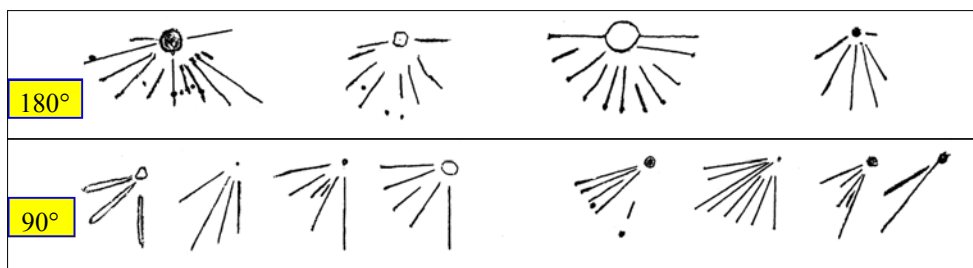


Fig. 1. Reformation and Protestant scratch dials in England.

Note: B&W line drawings of surviving dials are a reasonable visual approximation of their original in use appearance – in complete contrast to Catholic mass dials, (see Fig. 3 in Ref. (1)).



Fig. 2. Moses with the Ten Commandments. Wall painting, St John the Baptist, Stokesay, Shropshire. Photo: T. Marshall.

Why is there not a more definitive historical consensus? Perusing the extensive Reformation literature, the unavoidable conclusion is that historians are afflicted by, and burdened with, data problems – conceptual and technical.⁹ If the Holy Grail is coherent unambiguous data, might our mass and scratch dial database assist? What better indication of Protestantism’s progress and spread than the relative adoption of Reformation, at the expense of traditional Catholic, dials?

The comparative spread of Reformation dials is shown in Fig. 3. The most populated cell is the middle one, indicating that the greater part of England embraced Protestantism at much the same going rate. The top row lists those counties with a significant shortfall of medieval Catholic, and a

		90° dial adoption		
		High	Average	Low
Cessation of 360° dials	Early and/or rapid	Buckinghamshire Herefordshire Kent Rutland Yorks. East Riding	Dorset	-
	Average	Hampshire Lincolnshire	REST OF ENGLAND	Bedfordshire Durham Somersetshire Staffordshire Wiltshire Worcestershire
	Slow and/or late	Leicestershire Sussex	Hertfordshire Oxfordshire Northamptonshire Nottinghamshire	Yorks. North Riding

Fig. 3. Comparative incidence of Catholic versus Protestant dials on churches within England.

Notes:

1. Each county’s statistically expected dial incidence (by type) derives from the estimated relationships shown in Fig. 1 of Chris H. K. Williams: ‘The Evolution of English Mass & Scratch Dials c.1250-c.1650. Part 2. Age Ranking Dials by Type’, *Bull. BSS*, 22 (iv), 42-44, (2010). Note that expected dial incidence takes account of a county’s (estimated) level of dial loss.
2. Each county’s actual dial incidence is compared with its expected incidence (note 1) – standard statistical hypothesis test at the 5% level.

corresponding excess of Reformation, dials. Clearly these counties were part of the Protestant vanguard. Further insight depends on the interpretation of 90° dials.

If all Reformation dials are considered to be of equivalent meaning, little more can be said. However, as the 90° dials are so different in appearance to the 180° type, and – unlike the broad national spread of 180° dials – are geographically concentrated, both in their incidence and absence, the strong presumption must be that these differences reflect real meaning. What? As their incidence clusters in, and their (comparative) absence avoids, the Protestant vanguard, the data of itself suggests the presence of 90° dials reveals Protestant enthusiasm and zeal – as opposed to acceptance.¹⁰ Recognising that 90° dials indicate Protestant ardour permits the extraction of further insight from Fig. 3. Might the abundance of 90° dials in those counties not at the forefront of giving up 360° Catholic dials identify a somewhat delayed acquisition of Protestant zeal? Might the conservative tail of lingering Catholicism, where Reformation is (reluctantly) conformed to rather than embraced, be identified by the three cells in the lower right of Fig. 3?

How do our findings, seen in Fig. 4, on the comparative incidence of Catholic and Protestant dial types inform the historical debate on the Reformation’s progress? They decisively support the revisionist historians. The greater part of the realm surrendered Catholic practice and adopted Protestantism at much the same rate. Remaining counties, be they part of the Protestant vanguard or the Catholic rearguard, are widely dispersed and not regionally concentrated. There are some major reversals of conventional wisdom.

East Anglia has always been viewed as a Protestant bastion, yet Essex, Norfolk and Suffolk are all counties of the norm. Oxfordshire, widely believed to have been part of the Protestant vanguard, emerges as part of the Catholic rearguard. No historian appears to have judged Herefordshire, East Yorkshire, or Leicestershire and Rutland to have been in the Protestant vanguard.

We have seen that Catholic and Protestant dials constitute two completely distinct species! So distinct that within our scratch dial database there are the echoes of the Reformation’s spread. We can, as diallists, inform historians. The gravity of

3. If actual and expected incidences (note 2) cannot be statistically differentiated the county conforms to ‘average’: If they can, the county deviates from the norm. (See also Fig. 4 note (2)).
4. Brevity precludes including 180° dial results. The most economical and informative exposition has been chosen. Nothing is hidden – in a three horse race the positioning of two suffices: (as 360° dials predate the contemporaneous 180° and 90° types) the timing of the cessation of 360° dials is relative to the 180° and 90° types, whilst 90° dial adoption is relative to the 180° type.

