GUIDELINES FOR CONTRIBUTORS

1. The editor welcomes contributions to the *Bulletin* on the subject of sundials and gnomonics; and, by extension, of sun calendars, sun compasses and sun cannons. Contributions may be articles, photographs, drawings, designs, poems, stories, comments, notes, reports, reviews. Material which has already been published elsewhere in the English language, or which has been submitted for publication, will not normally be accepted. Articles may vary in length, but text should not usually exceed 4500 words.

2. Format: The preferred format for text is MS Word or text files sent by email to *john.davis51@btopenworld.com*. Material can also be sent on CD or as a single-sided typescript, single- or double-spaced, A4 paper.

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4. Mathematics: symbols used for the common dialling parameters should follow the conventions given in the Symbols section of the *BSS Glossary* (available online on the Society's website). Consult the editor if in doubt or for help in laying out equations.

5. The *Bulletin* does not use footnotes. Where additional information is required, notes should be numbered as a Reference with a superscript number. For very long notes, use an appendix.

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    For books: Author's name; Title of book, in italics; Name of publisher, Place and date of publication.
    For papers and articles: Author's name; Title of article in single quote-marks; Name of journal, in italics (this may be abbreviated); volume number, underlined in Arabic numerals; first and last page numbers; date, in brackets.

    Examples:

    A.E. Waugh: *Sundials, their theory and construction,* Dover, New York (1973).
    D. Colchester: 'A Polarized Light Sundial', *Bull BSS*, **96.2**, 13-15 (1996).
    A.A. Mills: 'Seasonal Hour Sundials', *Antiquarian Horol.* 19, 142-170 (1990).
    W.S. Maddux: 'The Meridian on the Shortest Day', *NASS Compendium,* 4, 23-27 (1997).

    If you simply wish to give a short list of books associated with the subject of the article, this may be given at the end of the article under the heading 'Bibliography', using the convention as given for 'Books' above.

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Front cover: *Close-up of a dial by "Dolland, London" showing the Equation of Time ring. The dial, currently in Wiltshire, dates from the late-18th or early-19th centuries. Our Chairman will be disappointed that there is no provision for Leap Year Day! Note that the EoT minute marks correspond exactly to the day markers: on earlier dials, interpolation to part-days was often seen. Photo: John Davis.*

Back cover: *The horizontal sundial by Samuel Saunders of London at the Royal Palace of La Granja de San Ildefonso near Segovia, Spain. See the article on page 2 for more details. Photos courtesy of Javier Martín-Artajo Gutiérrez.*

CONTENTS

ADDENDUM TO ROBERT STIKFORD'S 'DE UMBRIS VERSIS ET EXTENSIS'

In the article with the above title in the previous *Bulletin*, the date of Robert Stikford's original manuscript describing a method for designing vertical dials showing equal hours was tentatively put as the period from 1396-1401. This dating was on the basis of his name appearing in lists of monks at St Albans for these years in the *Gesta Abbatum*. Since publication of the article, further research has uncovered a contemporary reference to a "Fr. Stikford and John Hedworth, monks of St Albans" being admitted to holy orders in 1367/8.[1] Assuming that this is the same man – as seems highly likely – then the possible date of Stikford's original manuscript is pushed back several decades. Indeed, as most mathematicians and physicists do their most productive and innovative work early on in their careers, before the pressure of administrative duties limits their time for study, it is quite likely that the work for *De Umbris* was performed early in the last third of the fourteenth century. By the end of this period, Stikford was third in command of a large establishment ("*tertius prior*") and probably not able to devote time to sundial theory. This possibility of an earlier dating of *De Umbris* increases the likelihood that Stikford knew of the work then being done at Oxford by Nicholas of Lynn to produce his *Kalendarium* (including shadow-length tables) for John of Gaunt in 1386.

REFERENCE

1. *Registrum Simons de Sudbiria diocesis londoniensis A.D. 1362-1375*, The Canterbury and York Society Series, Volume 38, Catholic Church. Diocese of London. Bishop (1362-1375 : Simon of Sudbury). Part 5, pp.54-5. OUP, (1838). We find (p.54): "Admitted to orders celebrated at London in the chapel of St. Mary in the cathedral church of London by S.[Simon of Sudbury] bishop of London on Saturday in the first week of Lent, viz. 4 Non. March 1367" and listed under "Deacons, Religious, Benificed, and others" we find "Fr. Stikford and John Hedworth, monks of St. Albans". (Aside: Simon of Sudbury was beheaded by the mob during the Peasants' Revolt of 1381 and his mummified head is currently in St Gregory's church, Sudbury, Suffolk.)

John Davis

SAMUEL SAUNDERS
A Study of a London Sundial Maker - Part 1

MACIEJ LOSE

The original intention of this article was to cover the story of two restorations of an early 18th-century London-made horizontal garden sundial by Samuel Saunders. The sundial came into my hands with a broken gnomon but the extent of the damage was hidden behind a very intriguing, early restoration, performed with brass bars bolted to both sides of the gnomon. Due to technical problems that arose during the restoration, its process was prolonged. At some point there was a serious risk that we would fail to restore it properly. Luckily, the obstacles were overcome and the final result turned out satisfactorily making the restoration story and the restored sundial look an interesting topic, worth sharing with *Bulletin* readers. (The dial can be seen below in Figs 3 and 5.)

As part of the article describing the renovation process, I started to collect some basic information on the maker. I found in the Websters' database[1] that there were not one, not two, but three instrument makers named Samuel Saunders, all active in London in the first half of the 18th century!

As various databases gave contradictory attributions of Samuel Saunders' signed gnomonic instruments, the primary task was to find out who made the discussed sundial, and possibly establish correct makers for the other Saunders' instruments. These questions absorbed me and quickly developed into an amateur investigation on preserved works of the three London instrument makers – which I shall discuss in this article instead of original intention of focusing on sundial's restoration which will be the subject of a future article.

The available sources provided some basic biographical records and showed that there was no direct family, guild nor master-apprentice relationhips between the three makers:

Samuel Saunders I
• apprenticed to Jonathan Roberts in the Broderers' Company – 1699,
• turned over to John England in the Stationers' Company – 1703,
• freed by patrimony in the Masons' Company – 1708; died 1743.

Samuel Saunders II[2]
• apprenticed to William Coleman[3] – 1736/7,
• freed in the Goldsmiths' Company – 1759'
• Master Compass Maker to the Admiralty at London's Deptford Dock 1756 – 1782, died 1783.

Samuel Saunders III[2]
• apprenticed to Joseph South in the Clockmakers' Company – 1723,
• freed in the Company – 1730.

Instruments Survey Methodology

In the case of the three non-related instrument makers with identical names – as we have seemingly here – the simple method for attribution of an instrument to a specific maker must be based on comparative analysis of characteristic elements of the signature (summarized later in Fig. 9) and style of engraving, with help from other information, derived from the instrument or historic facts.

Such methods of maker's identification would fail when applied to family generations of instrument makers such as Cole, Adams or Dollond, who visibly passed their craftsman style from one generation to the other, and often signed instruments in a similar manner – making it impossible to distinguish the actual maker.

In the case of Saunders' instruments, the method worked out well and allowed attribution of all the instruments bearing Saunders' signature for which any iconographic material could be found.

I was able to identify total of 13 instruments that bear a signature of S. Saunders. Gnomonic instruments prevail with four horizontal dials, one Butterfield dial, three equinoctial ring dials and a plane table with azimuth dial. Others include: two sets of drawing instruments, a circumferentor, a sector and a compass. Instruments were coded according to the first column of Table 1, which also summarizes the conclusions of the following sections in which individual instruments are discussed in detail and are compared with others.

As the horizontal sundial with broken gnomon (coded as HD2) was the starting point for the survey, it serves as a main reference instrument.

The four horizontal dials covered by the survey represent three sundial types crafted by top London instrument makers; one being a unique overseas, royal commission (HD3), two representing English nobility custom orders characterised by their abundant furniture (HD1, HD4); and the fourth being a standard, though fine and elaborate dial with an EoT scale (HD2).

Erddig Hall Horizontal Dial (HD1)

The Erddig Hall (NT) sundial (HD1, Fig. 1) is the only Saunders dial recorded in the BSS *Register of Fixed Dials*.

				Instruments attributed to Samuel Saunders I	

Instruments attributed to Samuel Saunders I

Instruments most likely made by Samuel Saunders I

Instruments most likely made by Samuel Saunders II

Text Code	Instrument type	Location	Signature type	Signature common features	Notes
HD1	Horizontal garden dial	Erddig Hall, Clwyd, Wales	S. Saunders Fecit	weathered	ca.1725-1732, for lat. 53º 01', repaired plinth, octagonal dim. 36.2cm a.f., 1' time scale, EoT, 8 point compass rose, cities noon ring, gnomon's scrollwork identical to HD2
HD2	Horizontal garden dial	Private collection, Nicholson auction, 2010	Samuell Saunders Londini Fecit	double "ll", "~S~"	octagonal, for lat. 52º, dim. 35,7cm across flats, 1' time scale, EoT, 16 point compass rose, 2x repaired gnomon. **Reference instrument**
HD3	Horizontal garden dial	Courtyard of Royal Palace of La Granja de San Ildefonso, Segovia, Spain	Sam^ll. Saunders LONDINI Fecit	"~S~" double "ll"	ca. 1721-1743, engr. lat. 40º 50', circular, 1' time scale, EoT, 32 point compass rose, engraving style similar to HD2
HD4	Horizontal garden dial	Sotheby's auction, 1998, Dreweatts, 1999	S. Saunders Londini Fecit	?	No pictures. Circular 38cm, 1' time scale, EoT, cities noon ring, 16 pt compass rose, coat of arms, later gnomon - furniture similar to HD1
BD	Butterfield dial	Private collection	S. Saunders Londini Fecit	"~S~"	Oval dial 9.5cm x 7.2cm, mahogany box, style of engraving of some arabic numerals similar to HD2, , *fleur-de-lys* like on: RD1, PT
RD1	Equinoctial ring dial	Nordiska Museum, Stockholm, Sweden	S. Saunders Londini Fecit	"~S~"	Diam. 16cm, bridge for Julian calendar (pre -1752). Inv. No. NM.0151465, style of engraving Arabic numerals identical to HD2, *fleur-de-lys* like on BD,
RD2	Equinoctial ring dial	National Museum of Scotland, Edinburgh	S. Saunders London Fecit	"~S~" ,"t~"	Diam. 12,5cm, bridge for Julian calendar (pre -1752), Inv. No. NMS.T.1875.27.3, style of engraving Arabic similar to BD
RD3	Equinoctial ring dial	Private collection, Christie's London, 1994	S. Saunders Londini Fecit	?	No pictures.Diam. 15.25cm, incomplete: dial lacks bridge
PT	Plane table	Chinese Palace Museum, Beijing	S. Saunders LONDINI Fecit	"~S~" ,"t~"	Dim. 43.2 ×35.5, on tripod stand, style of ngraving arabic numerals identical to HD2, *fleur-de-lys* as BD,
CF	Circumferentor	Private collection, Bonhams auction, 2009	S. Saunders Fecit	"~S~" ,"t~"	Incomplete: base only, style of engraving Arabic numerals identical to HD2, *fleur-de-lys* like on BD,
IS1	Instrument set	Private collection	S. Saunders Londini Fecit, S. Saunders Fecit	"~S~" ,"t~"	Shagreen case,
IS2	Instrument set	Gorringes auction, 2003	S. Saunders Fecit	?	No pictures. Fishskin case
SC	Sector	Dealer offer, 1987	S. Saunders	?	No pictures, Source: Webster's Database
MC	Mariners' Compass	Auction, London, 1960	?	?	No pictures. Source: E.G.R. Taylor, Webster's Database

Table 1. Saunders' signed instruments.

It belongs to the second group – orders from the nobility – and is crucial to the survey as its dating can be established quite precisely. The dial is located in Wales, within Erddig Hall's formal Dutch-style garden. The design of the garden, dated ca. 1725, is attributed to Stephen Switzer and shows the sundial positioned between garden's canal and pond.[4] The commissioner, whose coat of arms is engraved on the dial, was John Meller, a London lawyer who had bought Erddig in 1716. Meller died in 1733 and the residence was inherited by his nephew, Simon Yorke. Until the 1770s, no major changes were made in the garden's structure – which

suggests that the dial was made in short period between 1725–1733.

The dial, besides Meller's arms, bears: the Equation of Time (EoT) in the form of a ring labelled "*Æquation of Natural Days*" and marked "*Watch Faster/ Watch Slower*", an elaborate 8-point compass rose, and a ring with noon times for various geographic locations, in the form characteristic to Broderers' Company masters, i.e. John Rowley and his apprentices. Noon times for the following locations are engraved: Rome, Cairo, Moscow, Ispaham, Surrat, Peking, Mexico, N York, Barbados, Cape Farewell, Tenarif and Dublin.

Fig. 1. Horizontal sundial at Erddig Hall, Clwyd, Wales (HD1). The light-coloured section of the pedestal is a year 2000 restoration after it was vandalised in 1999. John Meller's coat of arms are visible to the left of the right image. Photos: Keith Evans Photography, Wrexham.

Fig. 2. Comparison of John Rowley's Hanover Berggarten sundial (1719) gnomon at the top with the one of Samuel Saunders' from the Royal Palace of La Granja de San Ildefonso, Segovia. They share a common design style and if not the 11.5° latitude difference between dials' locations, the scrollwork designs would likely be similar. Photos: Reinhold Kriegler (top) and Javier Martín-Artajo Gutiérrez (bottom).

The aesthetic attractiveness of the dial is stressed by a floral ornament of a pierced gnomon. This decorative gnomon (Fig. 3) bears similarities to those of other sundials of 1720s, but maybe the most obvious similarity is with pierced gnomon of Thomas Tompion's earlier Kew Gardens sundial, which could had been Saunders' direct inspiration.[5] Although Erddig Hall's gnomon is more robust, it has very similar structure of floral shaped scrollwork contrasted with a characteristic horizontal bar, possibly echoing Dutch mannerism ornament.

The maker's signature "S. Saunders Fecit" is placed beneath the gnomon, in the most weathered area of the dial so unfortunately specific script features of this signature are obliterated by corrosion.

The dating of the sundial, its set of furniture and its engraving style strongly suggests that it was made by Samuel Saunders I, bound with Broderers' Company not only by his first master Jonathan Roberts but also by a trade link with John Rowley, for whom he is believed to have worked between 1702-1715,[6] acquiring some features of his craftsmanship.

Standard Horizontal Dial (HD2)

The first glimpse of the restored gnomon of the standard horizontal dial (HD2, Fig. 5) reveals that it is very close in shape to that of Erddig Hall dial (HD1) – strong evidence that it came from this same workshop. There are minor differences between the profiles of the gnomon foot and the style, as well as in details of the scrollwork decoration, but overall the look is the same.

Both sides of the gnomon have an engraving of soft, curved lines following the main floral theme – the feature that is present Tompion's Kew Gardens dial, but is absent on the Erddig Hall dial.

Fig. 3. Comparison of the Errdig Hall gnomon (HD1, left) and that of the standard horizontal sundial (HD2, bottom) and Tompion's Kew Gardens dial (right, image mirrored), believed to be the model for both. The gnomons of HD1 and HD2 are almost alike, with the Erddig Hall's scrollwork having slightly more simplified appendices and without side engraving. It can be noticed that some of the scrollwork differences along HD1 gnomon's style result from the latitude difference of ca. 1° between two sundials. HD2's scrollwork fits perfectly between the gnomon's style and foot bars, while in HD1 it looks as though the existing pattern had been adjusted with some modifications to the slightly higher lattitude. This supports, text discussed, arguments on the precedence of the HD2 dial. The author encourages readers to enjoy playing 'find differences' game with the two images.
Photos: Keith Evans Photography, Wrexham (top), Maciek Lose (bottom) and Thom Watson (right).

Fig. 4 (below). Horizontal sundial (HD3) from the Royal Palace of La Granja de San Ildefonso near Segovia, Spain. Photos courtesy of Javier Martín-Artajo Gutiérrez.

The dial is of the same octagonal shape and a similar size, with furniture limited to EoT ring, chapter ring with 1 minute intervals and elaborate 16-point compass rose.

The measured latitude from the hour lines gives average value of 52º which matches well with the gnomon angle.

The EoT is labelled "THE INEQUALITY OF NATURAL DAYS" which is a very early 18th-century form, and possibly in most essential way describes the Equation's logic. The form used, together with the inward facing labelling of the compass rose directions – which in case of Rowley characterizes period around 1710 – implies that the HD2 dial should be dated earlier than the Erddig Hall dial.

The engraved EoT maxima and minima values are: 31 January – 14m 48s; 4 May – 4m 13s; 16 July – 5m 46s and 23 October – 16m 0s which match well with values from tables calculated by Flamsteed (1702) and reprinted by Smart (1710),[7] with only 1 second difference in the January maximum and the October minimum.

Within the maker's signature: "Samuell Saunders Londini Fecit" - the double "ll" and "Londini Fecit" spellings should be noted – these are characteristic elements of early 18th-century London makers, and typical for the Broderers' Company circle.

Having direct access to the dial allowed also for a more detailed study of the engraving style – in particular the font of the numerals and the contour of the *fleur-de-lys*. Particular digits should be noted: '8' composed of two flattened ovals; '4' with a distinctive serif at the end of the horizontal stroke; '2' with an inward swirl of the instroke. Compared to other sundials of the period, the numerals, both Roman and Arabic, are of a little larger size, possibly to optimize their legibility.

Segovian Horizontal Dial (HD3)

The third horizontal sundial (Fig. 4) is a true dialling masterpiece and is preserved in perfect condition in its original location, the courtyard of the Royal Palace of La Granja de San Ildefonso, near Segovia, former summer residence of
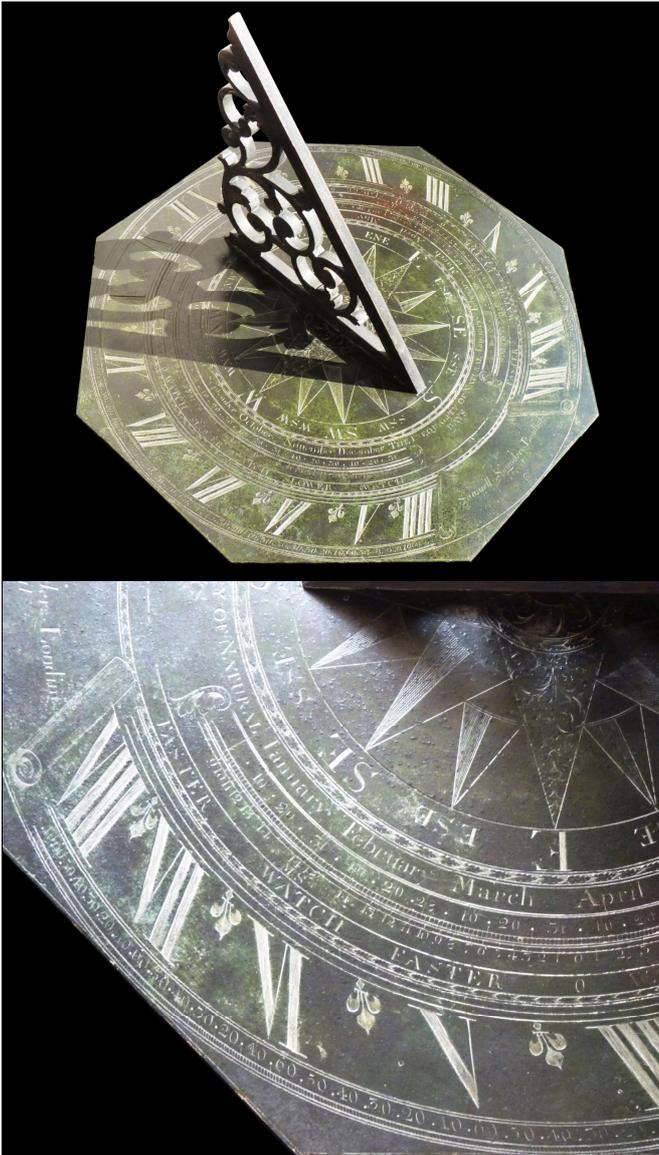
Fig. 5. Standard horizontal sundial (HD2). The Arabic numerals are typical of Saunder's style on all his instruments and larger than on most instruments of the period.

the Kings of Spain. This magnificent palace and gardens complex, commissioned by King Philip V and modelled after Versailles, was built starting from 1721.[8]

The complex was completed before the King's death in 1746 and since no major changes were introduced after his passing, the period 1721–46 marks the most probable date for the dial.

Though the dial's furniture does not include a geographic ring, a feature present on the English nobility dials HD1 and HD4, its abundant floral decoration and precise, excellent engraving entirely compensates for its absence.

The elegant, scrolled gnomon is of a more lightweight design than its Erddig Hall and Standard dial counterparts (HD1 & HD2 respectively). It resembles very closely that of John Rowley's 1719 sundial for Hanover's Berggarten (Fig. 2). In fact, if it were not for the 11.5° latitude difference between the locations, which influences the design of the scrollwork in its upper section, the gnomons would have been identical.

The maker's signature, "Sam[ll]. Saunders LONDINI Fecit", engraved within a cartouche, has a form similar to the Standard horizontal dial (HD2) in respect to the double letters 'll' in the abbreviated form of maker's name and "Londini Fecit" form. Abbreviated names are usual on English dials of the period, with common examples such as 'Tho[s]' for Thomas or 'J[n]' for John.

The 'S' letters include decorative serifs, a feature which is typical for all portable instruments created by Samuel Saunders I.

The overall composition of the signature cartouche is again quite similar to the one used by Rowley in Hanover.

The numeral form and rich palette of various *fleur-de-lys* marks used on the dial match those present on the HD2 standard dial, including: 5-min interval marks in the outer time chapter ring, large classical *fleur-de-lys* marks, oversized numerals and their individual features.

The Equation of Time values are engraved for Gregorian calendar dates, not unusual as the Georgian calendar was adopted in Catholic Spain in 1582, almost two hundred years before England. The maxima and minima values are marked in the same manner as on the HD2 Standard dial, with the values differing by 1 second in May (4m 12s) and February (14m 49s), and the same October/November value of 16m. The July maximum value unfortunately could not be read from the available images of the dial. The three values match EoT values from the 1733 table used by a London clockmaker George Neale,[7] which itself is probably based on revised Flamsteed/Smart calculations.

HD4 Horizontal Sundial

No image documentation of the fourth and last identified Saunder's horizontal dial was found. It is known only from its description found in the Sotheby's (1998) and Dreweatts (1999) auction catalogues. The dial is of a circular shape, 38 cm in diameter, with 1-minute divisions of the time ring and it includes abundant furniture, common with the Erddig Hall dial (HD1) pattern: EoT, 'geographic' noon times ring, 16-point compass rose and coat of arms. The sundial is signed "S. Saunders Londini Fecit".

Based on the above, one can assume with great certainty that the dial was made by Samuel Saunders I.

The catalogue description of the dial notes that the gnomon is of a later provenance. Based on overall similarities to the Erddig Hall dial (HD1) and known details and commonality of the Erdding Hall and Standard dial (HD2) gnomons, one can easily imagine what the lost, original gnomon looked like. If the dial's owner is among the readers, please feel free to make contact and have it reconstructed along Saunders' original ideas!

To be continued

REFERENCES AND NOTES

1. The database of instrument makers compiled by the late Rodney and Margery Webster is now on the Adler Planetarium

website at *historydb.adlerplanetarium.org/signatures/*

2. Samuel Saunders II was ascribed this number to match with the existing entries in Gloria Clifton's *Directory of British Scientific Instrument Makers 1550 – 1851*, Zwemmer, London, (1995) and J. Wilson: *Biographical Index of British Sundial Makers from the Seventh Century to 1920*, 2nd edition. BSS monograph No. 2. (2007). Consequently the Samuel Saunders III of the Clockmaker's Company is given his III number, which is not in chronological order in relation to Saunders II. Clifton's *Directory* and the BSS *Biographical Index* do not include any information on Samuel Saunders III, who in the Websters' database is labelled as Saunders II.

3. According the BSS *Biographical Index*, Samuel Saunders' II master was William Coleman, while Gloria Clifton's *Directory* names William Collier.

4. Design for a formal garden at Erddig, c. 1725, attributed to Stephen Switzer: The National Trust (Yorke Collection), on loan to Clwyd Record Office.

5. The rare Tompion signed sundials, based on their similarity to John Rowley's craftsmanship, are suggested by John Davis to have been subcontracted to Rowley. In light of this, all the gnomons of discussed horizontal dials would be based on Rowley's works. For another view of the replica of the Kew Garden's Tompion sundial see back cover of *Bull. BSS* 23(iii), (2011).

6. M. Cowham: 'Dial Dealings 2009', *Bull. BSS* 22(i), 31 (2010).

7. J. Davis: 'The Equation of Time as shown on sundials', *Bull. BSS* 16(iv), 138 (2003).

8. en.wikipedia.org/wiki/ Royal_Palace_of_La_Granja_de_San_Ildefonso

9. A photograph of Saunders' instrument set (IS1), can be viewed at the EAHN exhibition review page: *eahn.org/site/en/ compassandrule.php*

10. E.G.R. Taylor: *The Mathematical Practitioners of Hannovarian England 1714-1840*, 217, CUP (1966).

11. M.A. Crawforth: 'Instrument makers in the London guilds', *Annals of Science*, 44: 4, 319-377 (1987).

12. John England's equinoctial dial in the Oxford MHS collection, Inv. No. 35162, can be viewed at: *mhs.ox.ac.uk/collections/ search/*. For Whipple Museum instruments see: J. Davis: 'Sundials at Trinity College Cambridge, *Bull BSS*, 16(i), p.7 (2004).

Maciek Lose is an architect and astronomy enthusiast. He runs an architectural practice *FORUM Architekci* in Wrocław, Poland, focused on the design of public buildings. He has been interested in gnomonics since the first Polish nationwide survey of sundials in 1995. He can be contacted at *mlose@interia.pl*

NEW DIALS

A new dial by David Harber was unveiled by alumna Nicola Horlick in the quad of Balliol College, Oxford, last December. Balliol was the first of the traditional Oxford colleges to elect a female fellow and tutor (in 1973). A line on the calendar band of the dial for 11 October indicates, by means of a notch on the gnomon, the date in 1979 when the first woman undergraduate was admitted. In view of this, the motto of *About Time* is particularly apt.
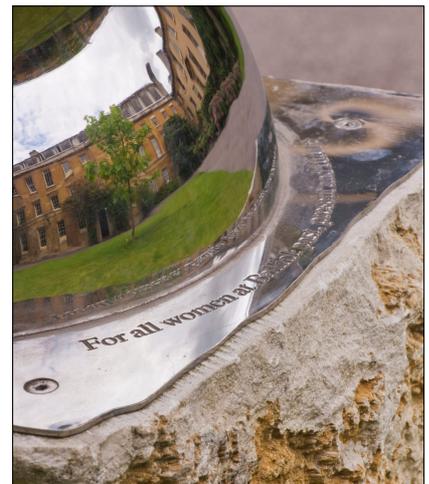
The swinging gnomon also carries the inscription "*Celebrating the Thirtieth Anniversary of the first admission of women undergraduates to Balliol 1979 – 2009*". The base of the 70 cm diameter stainless steel sphere has the words "*For all women at Balliol: past present and future*" and rests on a Purbeck Stone pedestal.

Engraved lines on the sphere indicate the Tropics, the Equator and the Polar circles. In addition, there are scales to allow the device to operate as a moon-dial for three days before and after full moon. Also included are lines at 15° intervals for latitude and longitude (or time).

A time-capsule within the sundial contains the names and signatures of current Balliol women – fellows, graduates, undergraduate and staff. There is also a list and signatures of that first 1979 cohort of women undergraduates.

JD

THE CANTERBURY PENDANT
Part 2: Relationships with the Libellus' rule

MARIO ARNALDI

This second part investigates the graphic of the dial derived from the Libellus de mensura horologii *and identifies it as an ancient source for making portable sundials similar to the Canterbury pendant.*[1]

The layout found by the data furnished in the first text of the *Libellus de mensura horologii*, that we have edited in the first part of this article (hereafter simply *Libellus*),[2] unequivocally reminds us of the layout of the hour lines on a cylindrical portable sundial, that was also known with the name of *horologium viatorum*, and today more commonly known as the 'shepherd's dial'.

In order to investigate if the graphic layout coming out from the instruction given inside the *Libellus*, we must compare the drawing produced from the *Libellus* with the two most important testimonies of the past: the Roman dial from Este (Part 1, Fig. 1) and the Anglo-Saxon dial from Canterbury.

The Cylinder of Este and the Libellus' Horologium

Nothing is written in the *Libellus'* text about the length of the gnomon so we need to hypothesize a value to start our investigation. Of course every length used for testing is arbitrary, nevertheless I must start with some reasonable choice.

The dimensions of the dial given in the *Libellus* are very similar to the proportions of Este's cylinder dial, so I have tried a length for the gnomon of about 20 mm, the length of the summer gnomon of Este,[3] and calculated an hourly lay-out for different meaningful latitudes: 45° N,[4] 48° N,[5] 51° N,[6] and 53° N. None of these four latitudes succeeds in having a correct overlap with the hourly course furnished by the *Libellus*. Changing the length of the gnomon does not solve the dilemma.

The meridian line derived from the *Libellus* appears flatter than a normal meridian line on a common cylinder dial. As we can see in Figure 1, that line is very similar to the one engraved on the cylinder of Este but drawn for a higher latitude, near to 50° N.

It is evident that the problem must be solved by another point of view. An hourly curve so flattened, in effect, can be produced, as far as I know, only in three ways:

1. with a fixed gnomon (e.g., the 'Ham of Ercolano', better known as the 'Ham of Portici'),

2. with a conical body,

3. with the seasonal use of two, three or more gnomons of different lengths.

Both cases 1 and 2 are to be discarded because 1 is not concerned in the text of the *Libellus* and 2 is dubious, because in the *Libellus* this idea is not recorded. Nevertheless, I have tried to test this second aspect without any appreciable success. Therefore only the third suggestion, the use of two or more different gnomons, is feasible.

The 'cylinder of Este' actually has two gnomons: one for the summer period (20 mm long) and one for the winter period (25 mm long).[7] And the calculation has allowed Schaldach and me to confirm the 'acceptable approximation' of these hourly curve to the latitude of Este (Fig. 2).[8]

However, in the graph produced by the calculation (white squares) a significant jump is noticed near the equinoxes; this sudden step of the curve is due to the change of gnomon length.

So the relationship between the *Libellus*' rule and the cylinder of Este is that both consider the use of two gnomons and both prefer smoother (with no equinoctial jump) hour curves.

Fig. 1. Comparison of the noon lines of the cylinder of Este and the Libellus*. We can see that they are very similar. In both cases the curves show a compromise aesthetically smoother (black spots) than the correctly calculated hour curves (white spots).*
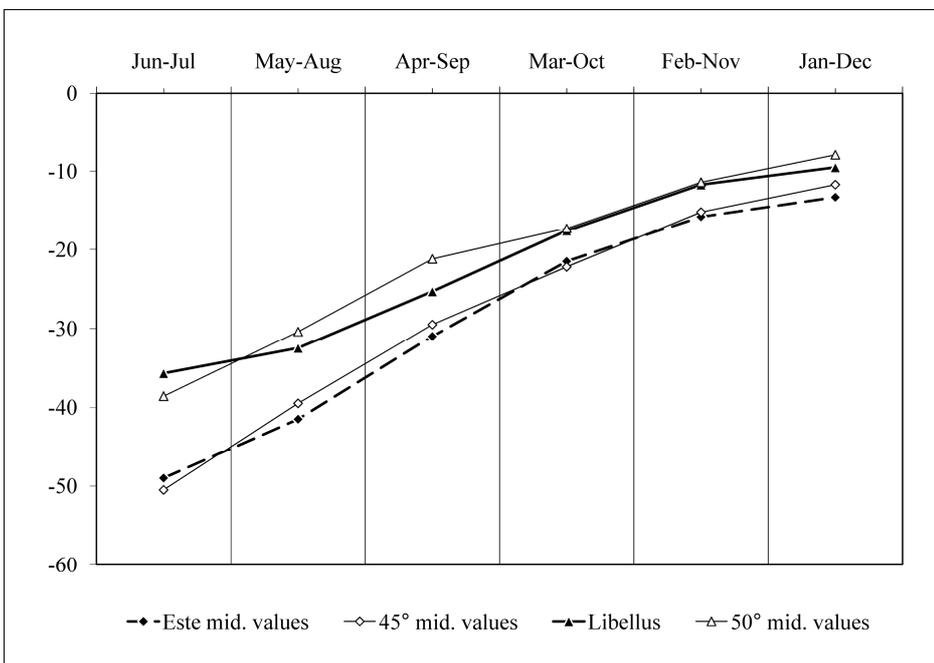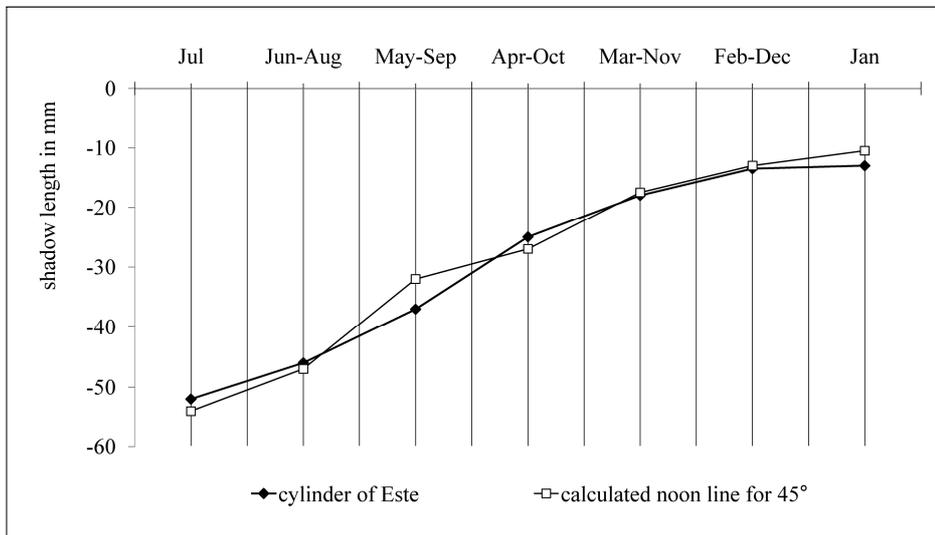
Fig. 2. Comparison of the noon curve of the Este cylinder and the one calculated for latitude 45° N with two gnomons, the shorter one (21 mm) for the Summer months (July, June-August, May-September and April) and the longer one (27 mm) for the Winter months (January, February-December, March-November and October).

The Canterbury Pendant

Besides the portable cylinder of Este, the second most famous testimony of the presence of portable altitude sundials before Hermann's book is the object known today with the name of the 'Canterbury pendant'. The pendant has been dated by researchers to the 10th century (before the Norman Conquest of England in 1066) and therefore still in the Anglo-Saxon epoch.[9] The instrument is basically a rectangular plate with plane surface, 65 mm tall, 19 mm wide and 5 mm thick; we can think of it as a 'flat cylinder'.[10] The gnomon, which is unattached, is decorated at one of its ends with a small dragon's (or snake's) head, with a sphere (perhaps the Sun?) in its jaws and measuring 30 mm in length.[11] Each of the two faces of the dial are divided into three rectangular columns, each related to two of the months as described by the text of the *Libellus*. A hole is provided at the top of each column for the insertion of the gnomon, whose shadow extends vertically downwards to show the hours, reaching some marks on its surface (Fig. 3).[12]

We have just seen (Fig. 1) that the curve of the *Libellus* corresponds to the layout calculated for the latitude of 50° N, a latitude very near that of Canterbury. Is it possible that there is a connection between the pendant of Canterbury and the text of the *Libellus*? I think so and I would like to demonstrate it.

There is a point in common between the graph of the *Libellus* and sundials like the Canterbury one: this is the division of the monthly columns in six equal parts.

Peter I. Drinkwater realized this.[13] Abandoning trigonometric formulas or other sophisticated techniques, as many scholars did before, he suggests a simpler and intuitive construction method for the pendant. He considers the length of the gnomon equivalent to its equinoctial midday shadow, then he divides it in three equal units. For January and December he assigns one unit of the gnomon, for February and November two units, for March and October three units, equal to the whole length of the gnomon, for April and September four units, for May and August five units and for June and July the length of six gnomon units, equal

to twice the length of the gnomon. In this way he gets a rectilinear path of the hours that does not fit perfectly with the hourly points engraved in the pendant of Canterbury, but which is a good approximation.

The same occurs when comparing Drinkwater's method with the *Libellus'* graph. As we can see in Fig. 4, they fit quite well. The method, as far as I know, has not documented foundation, even if it is based on an acceptable medieval-like intuition.[14]

I then wanted to compare the graph of the hours drawn by the *Libellus* with the course of the hourly points on the Can-
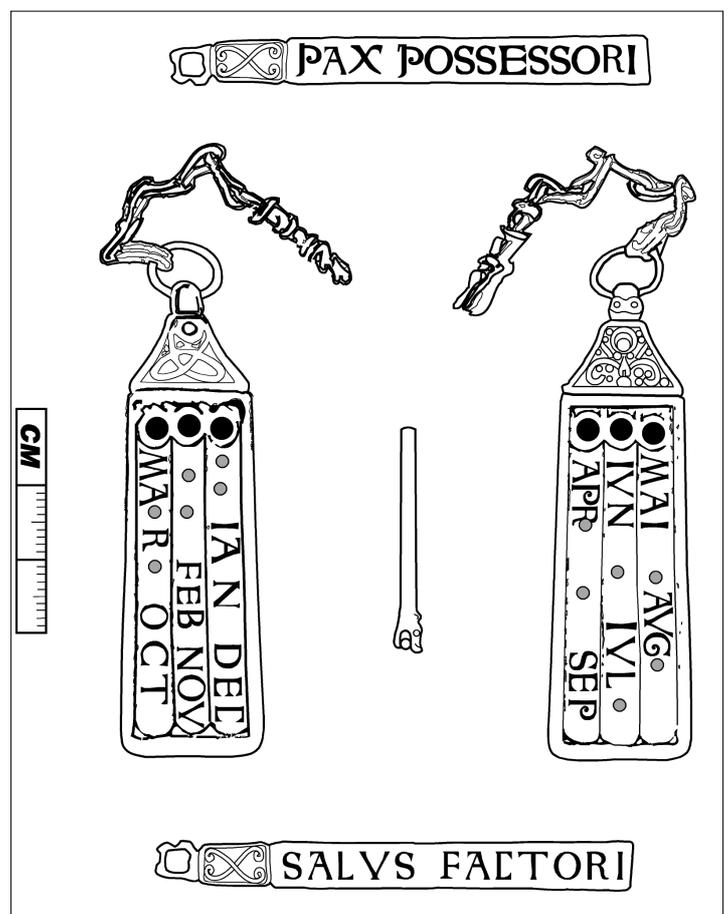

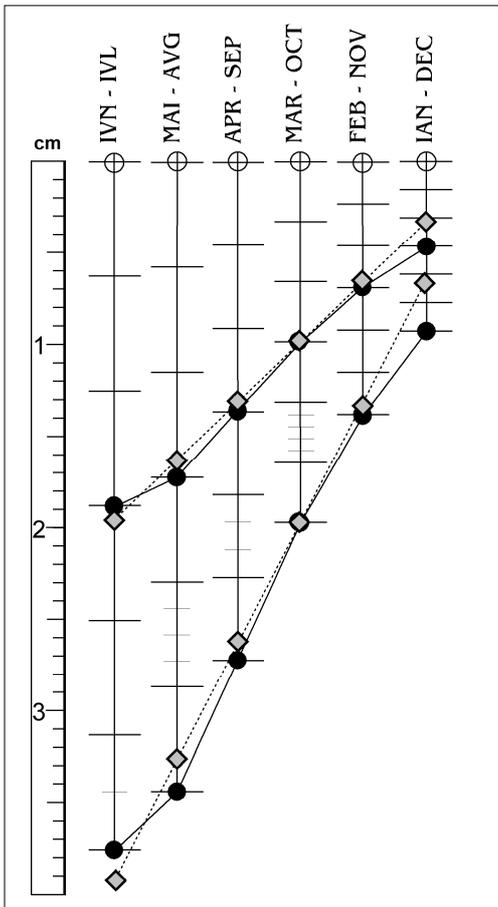*Fig. 3. Drawing, of the portable sundial found at Canterbury in 1938.*

Fig. 4. The diagonal hours (3rd, 6th and 9th) traced with the Drinkwater method and the same hour lines traced with the Libellus' rule.
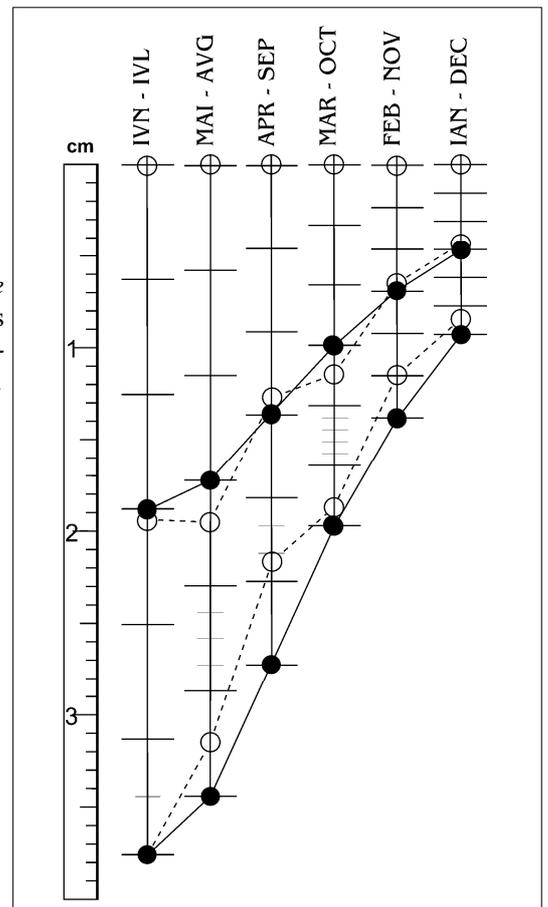
Fig. 5. Comparison of the shadow scale in the Libellus (black spots) with on the Canterbury dial (white spots).

In both graphs, the black spots represent the Libellus scale.

terbury pendant. Following the method described in the manuscripts that we are studying, I have started from the real length of the longest shadow line on the Canterbury pendant (37.7 mm) and, despite the zigzag course of the hourly points on the pendant, the two layouts remain within quite close limits (Fig. 5).

Another connection with the Canterbury pendant is the calendar. As we see, there is a difference between the sun-dial of Canterbury and the ancient Roman cylinder dial. On the cylinder, the hour points are measured along the vertical lines coming down from the borders of the solar months (the days of the sun-passage from one Sign to another).

This makes seven lines with hour points, while the Canterbury dial has six columns, each with one set of hour points. This means that for the cylin-

der (and many other Roman portable sundials) the shadow length is measured at the passage of the Sun into each Zodiac sign, while for the Canterbury pendant and the *Libellus* (and also in many 'shadow schemes') the shadow length is taken in the middle course of the sun month (Fig. 6).

A close relationship to the scheme furnished by the *Libellus* and the hourly points engraved on the Canterbury pendant is therefore more than evident but still not fully satisfactory. As one can see, the horary scheme of the *Libellus* rule is smoother and neater than the straight lines obtained with Drinkwater's method and also compared with the course of the hourly points on the Canterbury pendant.

Fig. 6. The Libellus' calendar and the middle points of the Sun-months, which are the 4th or 5th day of every calendar month.

| JUN. | MAY | APR. | MAR. | FEB. | JAN. |
| JUL. | AUG. | SEP. | OCT. | NOV. | DEC. |

Calculated days
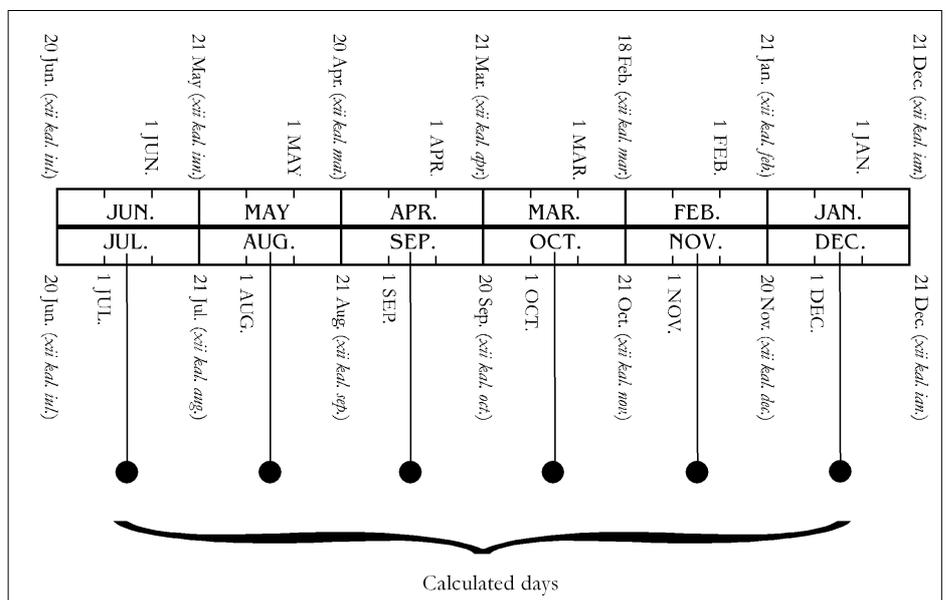
Why in the Canterbury dial do the spots run so zigzagged and not smoothly as we can see in the *Libellus* or in the cylinder of Este?
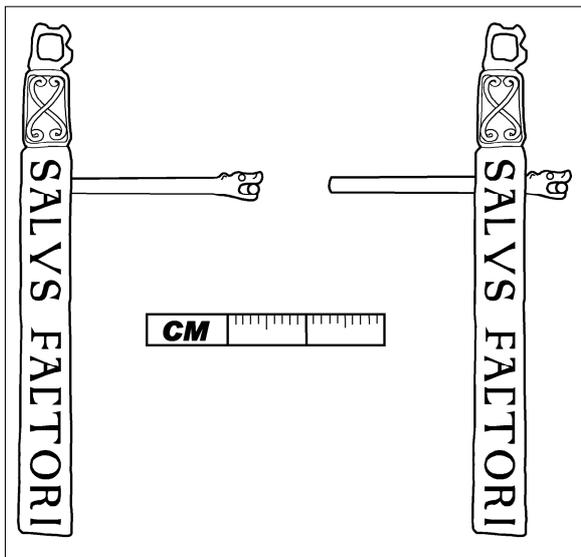

Fig. 7. The double position of the gnomon in the Canterbury pendant. (I have corrected here an error of mine of Fig. 11 in my JHA article, ref. 1.)

Two Gnomons

A study of the Canterbury pendant has been made more than once by different researchers[15] and all have faced the problem of the scheme of the hours when analysing the instrument; each proposing their own more appropriate solution. The conclusion which all have reached, good or bad, is that from such a small object and for the epoch in which was built, one cannot achieve greater precision. The strange zigzag course of the hourly points of the pendant has been considered with the indulgence that is granted to a baby, keeping in mind the approximation to the time that the Canterbury sundial had to have.

On this point it is really that zigzag course, already seen in the calculated layout for the cylinder of Este (Fig. 2), that forces us to reconsider the hourly layout of the Canterbury pendant under a new light: two gnomons.

It can be seen that the Canterbury pendant possesses only one gnomon, which may be assumed by the single storage hole on the bottom of the plate,[16] but the photos shown by Binns[17] and by Mills[18]

Fig. 8. Graphical display of the data in table 1. Comparison of the hour lines 3/9 and 6 on the Canterbury pendant with the same hours calculated for latitude 50° N with two gnomons. The shorter one (20 mm) used for Summer months (Apr–Sept, May–Aug, Jun–Jul) and the longer one (25 mm) for the Winter months (Jan–Dec, Feb–Nov, Mar– Oct).
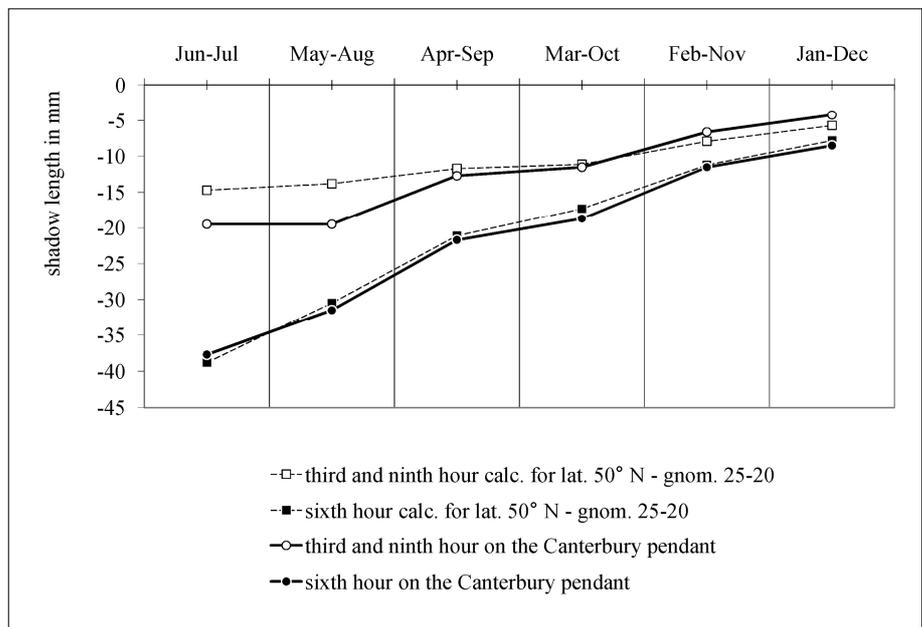
give evidence that the same gnomon could be used in two different ways. Binns uses the gnomon taking the head of the dragon as his vertex, therefore leaving 25 mm of it out of the hole on the dial plate. Mills realizes that the stylus can easily pass through the holes at the top of every monthly column and by pushing it through the plate until the dragon head stops it, the gnomon projects 20 mm on the opposite face of the dial (see Fig. 7).

Using this double position we can get, for the winter months, a gnomon length of 25 mm,[19] and one of 20 mm for the summer months.[20] The calculation shows that, contrary to what has been believed until now, the Canterbury pendant was built correctly for the latitude, or better for the 'climate', of that city and that it worked exactly with two different gnomon lengths. The results (Table 1) are visible in the graph in Figure 8.

Months	Latitude 50° Gnomon length 20 & 25mm		Canterbury pendant data	
	3 & 9	6	3 & 9	6
Jun/Jul	14.7	38.6	19.5	37.7
May/Aug	13.8	30.4	19.5	31.5
Apr/Sep	11.7	21.2	12.7	21.7
Mar/Oct	11.1	17.3	11.5	18.7
Feb/Nov	7.9	11.4	6.6	11.5
Jan/Dec	5.7	7.9	4.2	8.5

Table 1. Comparison of calculated and measured hour-point placings (in mm below the centre of the appropriate gnomon hole).

It may be noticed in Figure 8 that the only line to lie correctly is that of the sixth hour, while the hour-line of the third and ninth hours does not have such a good correspondence with that regularly calculated for that time. The points of the third and ninth hours are all almost half way between the base of the gnomon and the point of the sixth hour. It appears evident that the method of hourly subdivision is almost the same as that proposed by the *Libellus*.
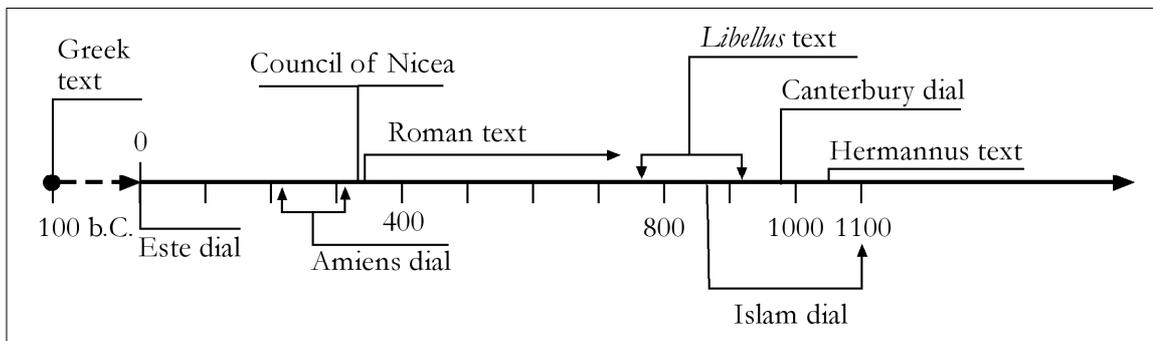
Fig. 9. Time line.

The Libellus' Graph, the Cylinder of Este and the Canterbury Pendant: Conclusive Relationships

Everything discussed so far indicates that the *Libellus* is a late Roman fragment of a folk manual for making altitude dials, but not the one used to make the Canterbury pendant, because its midday curve is arranged in a smooth line, while the maker of the dial from Canterbury chose a correct zigzag layout. Nevertheless, there are relationships between the *Libellus,* the Cylinder of Este and the Canterbury dial. These connections are:

1. Each one considers the use of two gnomons. And the ratio between the two gnomon lengths is around 4 : 5.

2. The course of the hourly points of the third and ninth hours on the Canterbury pendant seems to follow the same subdivision into six equal parts described in the *Libellus*, while the cylinder of Este follows a more correct method.

Figure 9 shows a timeline of the cylinder or cylinder-like altitude sundials. During the course of the publication of the article in the Journal for the History of Astronomy (JHA)[1] the discovery of the sundial at Amiens has been published. So, thanks the results of that work, the timeline here has been improved (also graphically) compared to the one published in the JHA article.

REFERENCES & NOTES

1. For further details see Mario Arnaldi: 'An ancient rule for making portable altitude sundials from an 'unedited' medieval text of the tenth century', *J. Hist. Astron.*, xlii, 141-160 (2011).

2. See Mario Arnaldi: The Canterbury Pendant. Part 1: A New insight from an Ancient Rule for Making Portable Altitude Sundials', *BSS Bull.*, 23(iv), 2-7 (Dec 2011).

3. The 'cylinder of Este' has two gnomons; one for the summer period (the shorter one, ~21 mm) and one for the winter period (~27 mm). My choice for the shorter gnomon is suggested, of course, because the shadow can easily reach the lower hour point at the summer solstice.

4. The latitude of 45° is that one of the 'cylinder of Este'.

5. In the text of the *De Utilitatibus Astrolabii* this latitude is combined with that of the seventh 'climate', which is suitable for Britain. "*Climatis septimi latitudo 48 gradus et 32 minuta ... Initium septimi ab Oceano orientali ... partim Franciam majorem, Britanniam, Scotiam, terram Anglicam ...*"; Hermannus Contractus, *De Utilitatibus Astrolabii libri duo*, P.L. Migne, vol. cxlii, chap. xviii and xix, coll. 402D-404B.

6. This is the latitude of Canterbury.

7. The length of the two gnomons is derived from calculation tests because they are now unmovable due to oxidation. Schaldach and I have hypothesized lengths of 27 mm and 21 mm. Maybe the longer one could be considered between 25 and 27 mm.

8. M. Arnaldi & K. Schaldach: 'A Roman cylinder dial: witness to a forgotten tradition', *J. Hist. Astron.* xxviii, Figs 5 & 6, 113-14 (1997).

9. A.L. Binns, on the base of a passage in the Byrthferth *Manual* and on the tables calculated for the 12th century Iceland by Oddi, prefers to date the object to the first years of the 11th century; see A.L. Binns: 'Sun navigation in the Viking Age, and the Canterbury portable Sundial', *Acta Archaeologica*, 42, 23-34 (1971).

10. I get this expression from Najm al-Dīn. As far as I know, in all Mukḥula's descriptions the body section is rounded, but in the 14th-century manuscript of Najm al-Dīn he uses a curious expression to define this dial: "a flat conical sundial".

11. The measures that we use in this section have been in extracted from the photos of the original instrument published by Allan Mills: 'The Canterbury pendant: a Saxon seasonal-hour altitude dial', *BSS Bull.*, 95.2, 39-44 (June, 1995). D. Jordan furnishes different and more approximate measurements: height 6 cm, width 2.5 cm and the gnomon 2.5 cm (the height could refer to the dial itself without the suspension ring). See D. Jordan & David A. King: *Überlegungen zur Angelsächsichen Sonnenuhr von Canterbury - Reflections on the Canterbury Sundial* (Johann Wolgang Goethe-Universitat, Institut fur Geschichte der Naturwissenschaften, Preprint Series no. 9, 1-16 and 17-28 (1988).

12. The flat shape of the Canterbury pendant is not to be considered *an unicum*; a very similar instrument, a Syrian sundial of the 12th century, correctly calculated, has been described by Casanova (Paul Casanova: 'La montre du Sultan Nour ad Din (554 de l'Hégire – 1159-1160)', *Syria*, 4, 282-99 (1923). A third testimony is given in the words of De Solla Price, *op. cit.* (ref. 38 of part 1), where he wrote that he had seen a sample "of less elegance" very similar to the pendant of Canterbury in 1962, at the British Museum, but I admit that I have never seen it.

13. Peter I. Drinkwater, 'Comment upon the Canterbury pendant', *BSS Bull.,* 95.3, 48, (Oct 1995).

14. See the figure in Drinkwater, op cit. (ref. 13).

15. See Derek J. De Solla Price: 'Portable sundials in antiquity...', *Centaurus*, 14, 242-66 (1969); De Solla Price, *op. cit.* (ref. 38 of part 1); Binns, *op. cit.* (ref. 9); Jordan & King, *op. cit.* (ref. 11); Mills, *op. cit.* (ref. 11); Peter I. Drinkwater: 'Comment upon the Canterbury pendant', *BSS Bull.*, 95.3, 48 (Oct 1995).

16. On the bottom of the plate of the Canterbury pendant there is a hole that penetrates into the body of the instrument. The gnomon is inserted in this when is not used.

17. Binns, *op. cit.* (ref. 9).

18. Mills, *op. cit.* (ref. 11).

19. This position seems underlined by the head of dragon/snake, that in its action of swallowing the Sun in its jaws gives us a classical insight into winter iconography.

20. These measures do not seem casual; they are almost identical to those of the gnomons of the cylinder of Este.

For a CV and a portrait of the author, see Part 1 of this article in *BSS Bull.* 23(iv), Dec 2011.

A.P. HERBERT PUT TO THE TEST

FRANK COE

Two of the articles in the June *Bulletin* triggered memories of an incident I had almost forgotten. Christopher Daniel in his article[1] *Before the BSS* mentions the 1967 book by A.P. Herbert *Sundials Old and New – Fun with the Sun*.[2] I remember borrowing this from the local library at about the same time and being intrigued by the statement that a sundial could be used, as it were, in reverse to navigate across the earth's surface.

At that time I knew nothing about sundials – it was long before the BSS. The June *Bulletin* continued with an article[3] by Malcolm Barnfield about various sun compasses – a version of which the Herbert book had of course been describing. In 1974 I was told I would have to visit Australia for an international conference the following year and I thought the long flight could be an ideal opportunity to use Herbert's gadget and test his statements.

I do not have a copy of Herbert's book, but as I recollect he described a 'sun clock' working in conjunction with a polar dial so I naively decided I could make my own! It took a year! As mentioned above, I knew nothing about sundial construction so I probably did everything the hard way. The result, which I still have, is shown in Fig. 1. The only other requirement was to carry a watch set to GMT and a set of declination tables for the month in question.
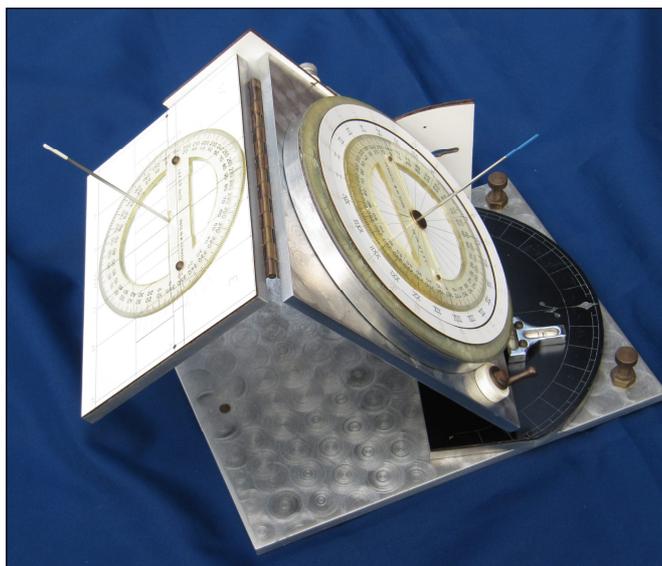

Fig. 1. My version of Herbert's 'sun clock'.

I set off optimistically by Quantas jumbo and from the flight schedule quickly realised my first error. Much of the flight would be in darkness and the possibility of taking readings was severely limited. In addition, it was not always possible to catch the sun through a window onto a flat surface. I was helped by friendly crew members who, once satisfied that I was harmless, arranged for me to use the upstairs lounge tables. If a sighting was possible, it was a simple matter to convert the readings to latitude and longitude for that point. A bonus came in the form of an invitation to show the gadget to the captain on the flight deck. It was soon evident that he knew far more about what I was trying to do than I did myself. He turned out to be a fan of Francis Chichester and his solo flight from Brisbane across the Tasman Sea, with which he was very familiar.

He explained that Chichester had to find Lord Howe Island and then alter course for New Zealand. To do this he took regular sightings by putting his plane into a dive so that he could see a horizon above the cockpit canopy. He then had to quickly make his calculations using a cumbersome cylindrical slide-rule (older BSS members may remember these). If he bungled a calculation and missed the island the next stop after the South Tasman Sea was Antarctica. The captain said he still did not know how Chichester managed this.

Eventually we landed at Sydney and, as we waited for our baggage, the crew came through. "Well where do *you* calculate we are?" asked the captain. "Sydney, plus or minus 100 miles" I said. "Hmm, not bad for medieval technology" said the captain. I never saw him again.

This was not quite the end of the story. When I returned home there was news about the first west to east crossing of the Sahara by Tom Sheppard. One of the stated objectives of this Land Rover exercise was to "try new methods of desert navigation based on sun compass, astro-fixes and dead reckoning with an HP65 programmable calculator". I asked Tom Sheppard what device he had used and his letter confirmed that he used a Cole Mk II with some of his own variations. At that point I decided I had to learn more about sundials and in due course joined the British Sundial Society.

It is nice to be reminded of things half forgotten.

REFERENCES

1. C. Daniel: 'Before the BSS – a sundial chronicle', *Bull. BSS*, 23(ii), 14-19 (June 2011).
2. A.P. Herbert: *Sundials Old and New or, fun with the sun*, Methuen (1967).
3. M. Barnfield: 'The sundial goes to war: Pt 1', *Bull. BSS*, 23(ii), 20-25 (June 2011).

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THE DIALS OF SAINT-HIPPOLYTE-DU-FORT, FRANCE

MIKE COWHAM

Our travels in France for 2011 took us to the south where we visited the small town of Saint-Hippolyte-du-Fort in Gard, about 40 km north of Montpellier.

We had been told about their dials by a Catalan friend who had given us a copy of the walking tour of these dials. Copies of this document may also be had from the local Tourist Information. The town is reputed to have 23 sundials on public view but there are probably somewhat more than this. The ones illustrated in this article are some of the most attractive.
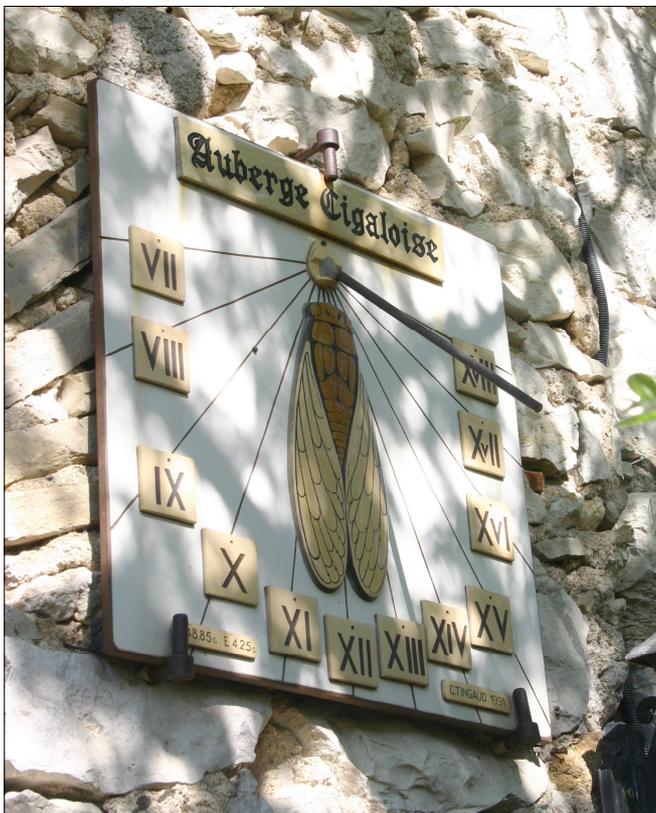

Fig. 1. The rather hidden dial at Auberge Cigaloise.

We booked a room in Auberge Cigaloise, named after the cicada, the noisy southern cricket. The cicada is the town's symbol and can be found in various places. On the wall of the hotel was a fine dial, almost hidden by the tree in front keeping it permanently in the shade (Fig. 1). Note its cicada centrally spaced and similar images will be seen on several of the dials in town, many of which are made wholly or partly from glazed tiles. Other features seen on this and several dials in the town are the use of a 24-hour time system, with numerals in Roman or Arabic form, and several of the mottoes which are in Provençal dialect.

Fig. 2. The town sign advertising their facilities including their "Cadrans Solaires".

We then walked into town, passing the town sign (Fig. 2) which tells travellers about their 'Cadrans Solaires' and then followed the route around. We found most of the dials plus a few more that were not on the list.

The first dial that we found was a rather unusual equatorial dial, standing on a short pillar, with hour lines incised on both faces (Fig. 3). Strangely, its figures for "Latitude N 48,85 G" and "Longitude E 4,30 G" do not make sense for Saint-Hippolyte (actually N 43.966° and E 3.856°). However, the G could stand for the decimal Grad which is one hundredth of a quarter-circle and this would then give the correct results. I also noted that the dial at Auberge Cigalois has similar figures marked on it of "N 48,85 G" and "E 4,25 G" like the equatorial dial.

Fig. 3. Equatorial dial at the east end of Rue Argenterie.

Fig. 4. The dial on the church in Rue Durant.

The dial on the church (Fig. 4) is particularly attractive with its central cicada on the leaf of a plane tree and the motto "A l'ouro de Diéu" (The hour of God).

Several dials may be seen in Rue Argenterie including one of 1993 which is calibrated in both Solar Time and Civil Time (Fig. 5). Its motto is "PROFITEZ DU MOMENT LE TEMPS PASSE SI VITE!" (Seize the moment, time passes so quickly). The initials JC tell us that the dial was probably made by local dialmaker Jean Caisergues.

Fig. 5. Rue Argenterie showing both solar and civil hours.

In the same road is another dial on wood (Fig. 6) now needing a repaint. It has symbols around it, starting top left, for a clockmaker, a florist, an electrician, a baker, a chemist, a patissier, a mechanic and for souvenirs.

A further dial (Fig. 7) at the west end of Rue Argenterie is attractively made with silver scales overhung by grapes. (Argent = Silver.)

The attractive small dial in Rue Sabatier (Fig. 8) is engraved on stone and is boldly dated 1739. It is obviously quite modern so the date may refer to that of the building. Its motto "LOU TEMS PASSO – PASSO LOU BEN" (The

Top to bottom:
Fig. 6. Rue Argenterie displaying the town's trades.
Fig. 7. West end of Rue Argenterie.
Fig. 8. Rue Sabatier.

Fig. 9. Rue Roger Broussous.

Fig. 11. Rue du Galatras.

time passes – Pass it well) was also on one of the dials in Coaraze, 'BEN' really meaning 'bien', but being a play on words by the humorous French artist *Ben*jamin Vautier.

The painted dial on a house in Rue Roger Broussous (Fig. 9) was once most spectacular but is now rather faded. Its motto is "UBI EST DOMUS NOSTRA IBI FELICITATIS NOSTRAE TRANSEUNT HORAE" (Where our house is. There we pass our happy hours).

Fig. 10 shows a dial that represents the town emblem (a fort). Its motto is "BADAU FAÏ TOUN, L'OURO PASSO" (Turning on Your Way, Time Passes). It is located on a house on a short road between Rue André Gaches and Rue Capdeville.

Fig. 11 shows a dial that is north of the old town centre, just across the river Vidourle. It is attractively made from
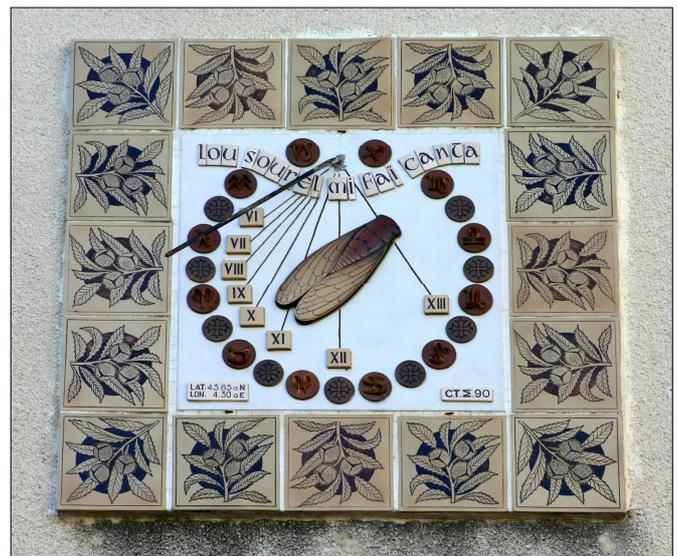

Fig. 12. East declining dial in Rue Capdeville.

tiles with a central cicada and a motto "Au Paradis du bon heur" (The Paradise of the fine hour).

Fig. 12 shows a similar dial at the junction of Rue Capdeville and Rue André Gaches. It is declining east and has the motto "Lou sourel mi faï canta" (The Sun makes me Sing). It has the figures for latitude and longitude plus the maker's details with date – "C. T. Σ. 90".

The dial at Rue de l'Algal (Fig. 13) is attractively cut into stone and has the motto "SEMPER AMICIS HORA" (Always the Hour of Friends).

Fig. 14 is another dial made mostly from ceramic tiles. In its centre is a monogram, probably MJT, and this is surrounded by tiles with the twelve Zodiac signs running anti-clockwise.
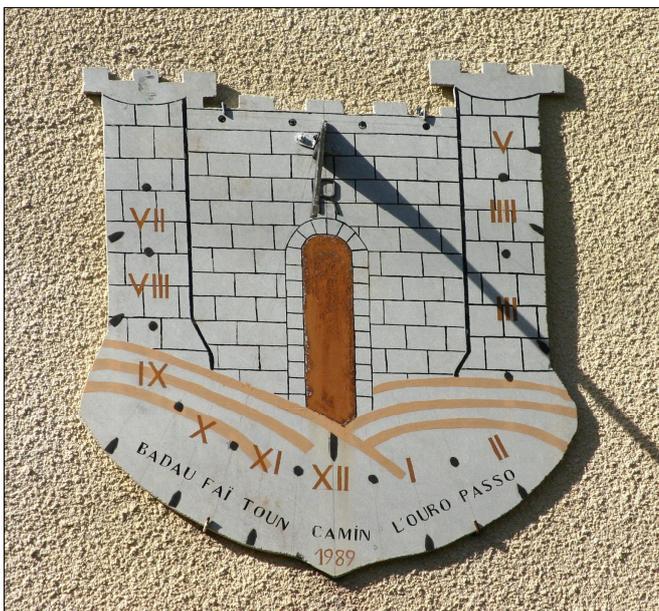

Fig. 10. Dial in the form of the town emblem.

Fig. 13. Rue de l'Algal.

The dials in Figs 1, 4, 11, 12 and 14 are variously signed as sigma, C.T.Σ. and C. TINGAUD. These are the work of a local ceramic artist who has now specialised in making sundials. Note his Roman numerals with a small 'v' in them, such as X^{v}III, to make them more compact so that they fit easily onto his square tiles.

Fig. 14. Rue Jacques Boudon.

If you are ever in the area of Saint-Hippolyte-du-Fort, their fine collection of dials is really worth stopping off to see.

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AN UNRECORDED STAINED GLASS DIAL

This previously unrecorded stained glass dial was purchased by an English collector of stained glass as part of a lot with several other (mainly heraldic) panels. Measuring just 138 × 123 mm and probably dating to the middle of the 17th century, it is unusual in at least two ways.

First, although at first sight it may appear to be a direct West dial, closer inspection reveals that the hour-lines are not quite parallel but would meet some way off the top right hand corner of the panel. 'Reverse engineering' the design indicates that it is a 'great decliner', made for a latitude of around 55.5° N and declining 80° west of due S. The declination is confirmed by the number '80' scratched centre-top on the outside of the panel. This method of marking the declination has been seen on several other 17th-century stained glass dials—see for example 'The Lost Barrington Stained Glass Dial' (*Bull*. 21(ii), June 2009).

The latitude puts the design location in the lowlands of Scotland, not a usual place to find stained glass dials. Perhaps a clue to the location is another panel purchased with the dial which features a currently unidentified coat of arms of an unknown diocese, or perhaps abbey, and consisting of two pastoral staves in saltire between a stags head in chief and three tourteaux.

The other unusual feature of the dial is its motto, *Crescere non Sentis, Sentias Crevisse*. This may be loosely translated as 'You do not notice growing older, but you may notice that you have grown old'. Alternative versions based on time passing are also possible. Not only is this motto not in

Mrs Gatty or on any dial in the BSS *Register*, there is nothing even similar to it and it does not seem to come from heraldry either. Thus it could have been penned by the dial's owner.

JD

A PORTABLE HOROLOGIUM

JOHN DAVIS

This article is based on the talk given by the author at the 2011 BSS Newbury meeting.

Medieval portable instruments are rare so, when one is located, there is a significant challenge to interpret how it was intended to be used as the corpus of other material with which it can be compared is a relatively small. An example is the device shown in Fig. 1: it was located in a field near Shotesham (about 10 km south of Norwich) by the metal detectorist Peter Aspinall in March 2003 and reported to the Portable Antiquities Scheme who classified it as a sundial.[1] An attempt was made to sell it at auction but this was unsuccessful, perhaps because there was no precedent for such an item, and it reverted to the ownership of the landowners where it was found.

Fig. 1. Photographs of the Norfolk horologium.

Above: front, shown at approx. 2.5× full size.

Right: back.

Description

The device seen in Fig. 1 is just 36.8 ± 0.2 mm in diameter (approximately 1½″) and 0.9 ± 0.1 mm thick, evidently of a copper-based alloy of some description. It has four very small 'lugs' approximately evenly spaced around the edge. It is not certain whether these lugs have retained their original size or are the remnants of much longer spokes; i.e. the disc may have been the hub of a larger device. One lug, though, can be seen through a microscope to have the engraved radial line through it running right over the tip, suggesting that it has not been truncated. The reverse face is basically blank but has a rectangular block or 'handle' of copper alloy, approx. $14 \times 9 \times 4$ mm, rivetted to the centre of the disc.

The front surface is engraved as shown and has a small hole, nominally 1 mm diameter, in the centre. This hole may have been for inserting a perpendicular pin gnomon or compass needle pivot. It penetrates through the disc and at least 3 mm into the rectangular block. The whole device is in remarkably good condition.

Engraving

The engraving of the device, showing that it could function as a compass and as a horologium, is remarkably fine. The lettering in particular has been cut very deeply by a narrow burin. Viewed with a stereoscopic microscope, it can be seen that it has an included angle of 40° or even less. The circles and longer lines are shallower and appear to have been made with a scribing point but the subdivisions of the scales have probably been cut with the burin.
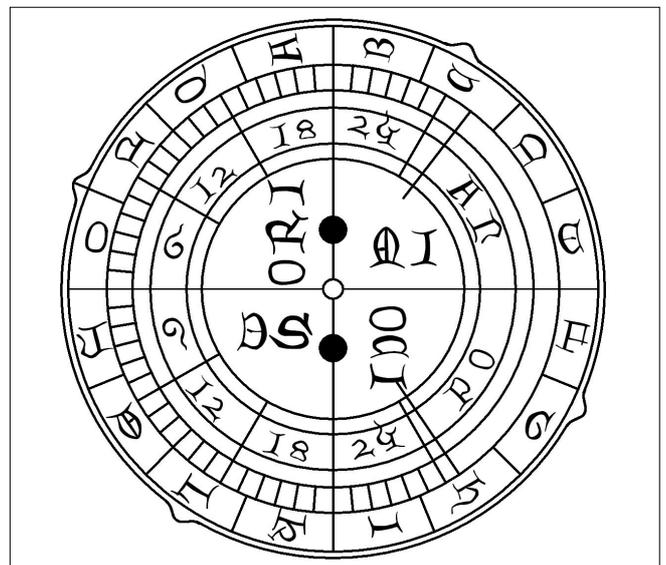

Fig. 2. Drawing of the horologium.

The face is divided in four quadrants by a pair of diameters, one of which is continuous over the tops of the rivet heads. In the centre, the cardinal points of the compass are labelled, in Latin, MI (*meridies*, south), OCI (*occidens*, west), SE (*septentrio*, north) and ORI (*oriens*, east). The engravings are oriented so that the abbreviations stand on the lines to which they refer and, in Fig. 1, East is positioned upwards as was conventional for medieval maps even into the middle of the 15th century.[2]

The compass is further subdivided into 16 directions around the periphery of the disc, being labelled clockwise alphabetically A to Q (omitting J) starting with East (the most important point) at the top and with the letters again standing on the lines to which they refer. The form of the letters may be described as *Early Gothic* or *Lombardic Capitals* and are difficult to date, though they do seem to be of 14th-century or possibly earlier.[3] The use of letters to label directions is quite standard for the Middle Ages (e.g. on the 16-fold divisions of a windrose) and Chaucer even used letters to denote the 24 equal hours around the edge of his astrolabe.[4]

The basic horologium scale is a division into approximate 30° segments, starting at the north ('noon') line and measured symmetrically though the East and West points towards the South. These segments are numbered both ways 6, 12, 18, 25. Note that the final number is not 24 as would be expected by a simple arithmetic sequence: the medieval numeral '4' is a quite different shape looking like a Greek 'alpha' on end and the character engraved here is very clearly the medieval '5' – see Fig. 3. These numbers, although engraved centrally in their segments, refer to the lines to their right, as is standard for medieval instruments.[5] Notice how the numerals in the upper half of the device are oriented inwards but those in the lower half are outwards with the result that the device has clearly been designed to have been read with the orientation shown, with East at the top, rather than symmetrically like a watch.

The time segments are further sub-divided by a number of short radial lines into nominally 5° segments and it is these which are counted by the numerals. Between the North and the East/West lines, there are six divisions per segment but to the south of the East/West line it is clear that there is an extra division with a longer dividing line, as will be discussed below. The actual spacing of these small divisions is somewhat variable and leads to the impression that the division was performed by eye.

To the south (right) of the numerals are the letters AN and PO, again oriented to be read from the 'bottom' of the disc. It might be suggested that these are abbreviations for anti meridian and post meridian but, if so, the positioning is problemmatic.

Function

In what way could this device have acted as a sundial? To modern eyes, a dial delineated with equi-angular spacing immediately suggests an equatorial (or equinoctial) sundial and the Norfolk device could indeed function as such, for the summer half of the year, if it was fitted with a perpendicular pin gnomon in the centre hole, aligned to the north celestial pole and with the plate tipped to the co-latitude of the location. But there is no reliable evidence that such devices, or any dial with a polar-aligned gnomon, existed in Europe until the early 15th century. By the mid-15th century, pocket compendia consisting of a compass, equatorial dial and a primitive nocturnal were available.[6] Evidence of a stone equinoctial dial from the late medieval period has also recently been uncovered in Bristol.[7]

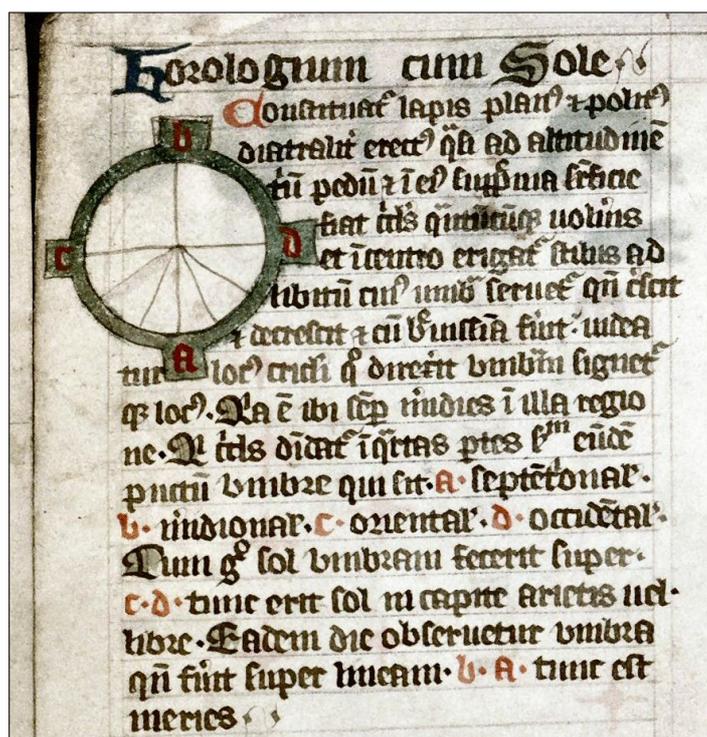However, the presence of the engraved compass directions on the Norfolk horologium strongly suggests that it was

Fig. 4. MS Rawl. D. 939 f.5r. Courtesy the Bodleian Library.

Horologium cum sole	Sun Dial
Constituatur lapis planus et politus	Make a flat and smooth stone
diatraliter erectus quasi ad altitudinem	erected more or less at a height of
trium pedum et in eius suprema superficie	three feet and on it upper face
fiat circulus quantumcumque voliens	trace a circle wide as you like
et in centro erigatur stilus ad	and in the middle put up a style long
libitum cuius umbra servetur quando crescit	as one likes which shadow is used when elongate
et decrescit et cum brevissima fuerit, videa-	and it shorten, and when it will be shortest, one can see
tur locus crideri quo direxerit umbram signetur	the direction shown by the shadow and sign
quae locus. Quia est ibi semper meridies in illa regio-	that place. That it will be always noon in that direction. In some
ne. Qui circulus dividatur in quartas partes secundum eundem	way the circle should be divided in four parts following his
punctum umbre qui sit: A septemtrionalis,	shadows' points that are: A North,
B meridionalis, C orientalis, D occidentalis.	B South, C East, D West.
Cum grado sol umbram fecerit super	When the sun shadow falls over
CD, tunc erit sol in capite arietis vel	CD, then the sun is in the first degree of Aries or
libre. Eadem die observetur umbra	Libre. In that day will be observed the shadow
quando fuerit super lineam BA, tunc est	When it will be on line BA, then is
meridies.	Noon.

Fig. 5. Transcription (with contractions expanded) and translation (courtesy of Mario Arnaldi) of MS Rawl. D. 939 f.5r.

designed to be held horizontally, with a vertical gnomon and hence looks back to an earlier form of timekeeping,

The standard timekeeper in the middle ages was, of course, the mass or scratch dial. This was usually a vertical device with a horizontal gnomon, placed on a south-facing wall. Two recent studies of these devices are by Arnaldi[8] and by Scott & Cowham[9]. Both of these studies also show that horizontal dials, broadly following the principles of the vertical mass dial, did also exist but in much small numbers. A study of five small stone examples of horizontal stone mass dials[10] showed them all to be delineated at 15° intervals over the full circle, rather than just the region where a shadow of a vertical gnomon might fall. Some of these devices, e.g. the one from Nendrum, Co. Down in Ireland, are also discussed by Arnaldi.[11] None of them have sub-divided time scales.

A contemporary manuscript which may be describing a device using the same principles is in the Bodleian Library, MS Rawl. D. 939 f.5r (Fig. 4). The manuscript is described by the library scholars as English, from the second half of the 14th century, and it consists of a six-part set of unbound calendrical and astrological pieces. A transcription and translation is given in Fig. 5. Although the device described in the MS is clearly a large stone dial – a precursor to the stone pedestal sundials of a later era – it has two features which are also seen in the Norfolk horologium. The first is the inscriptions of the cardinal compass points. The second is the division of the northern half of the circle into 30° segments. The text makes it clear that the shadow is to be found on the East/West line only on the equinoxes (Aries and Libra) and that noon corresponds to a shadow on the meridian.

The subdivision of the timescale on the Norfolk device into units of 5° is very unusual for a sundial. The 90° interval between noon (north) and the east/west line may be interpreted as 6 equinoctial hours and since this is divided into 18 subdivisions, each subdivision is equivalent to a third of an hour. This is the unit of time which Geoffrey Chaucer refers to as a 'mileway' (or *mile-wey*) in both his famous *Canterbury Tales* and his less popular, but perhaps more relevant, *A Treatise on the Astrolabe* of c.1391.[12] The derivation is that it is approximately the time that it takes a man to walk a mile and it must refer to an equal hour rather than a seasonal hour – people do not walk twice as fast in winter! There are some references in the literature[13] to use of the term around 1330 and it definitely had Chaucer's meaning by 1370, though its use seems to have died out by the middle of the 15th century. The correlation of time with distance was not uncommon in the Middle Ages.[14]

The sub-division of the hour into thirds has a very long history. King Alfred the Great (r. 877-899) had a candle clock in which each candle, burning for 4 hours, was marked in 12 segments.[15] Later, c.1268, a waterclock described on tablets found at the Cistercian Abbey of Villers-la-Ville in Brabant had a wheel labelled with 24 letters of the alphabet, each calculated to indicate approximately a third of an hour.[16]

The mileway divisions on the Norfolk device continue for a further 7 units to the south of the East/West line, which we take as the sunrise/sunset at the equinoxes. This is one unit beyond the two-hour major spacing of the rest of the scale. The significance of this is probably that the sunrise/sunset times on the summer solstice at Norwich, latitude 52½° N, are 3:42am and 8:18pm LAT, very close to two hours and one mileway before and after, respectively, the equinoctial times. It is most important to remember, however, that the shadow of the vertical gnomon will not fall on these lines at the solstitial sunrise/sunset: the device is not calculated as a horizontal azimuthal dial.

The positions of the final (25th) mileway divisions at the southern ends of the timescale are rather variable. The two lines, approximately to the southeast and southwest, are longer than the other sub-divisions and more similar to the 30° sector lines. The line to the southeast, passing towards the compass point 'C', makes an angle of 52.5° to the meridian line so that the interval between 24 and 25 is significantly larger than the others. Although it is tempting to suggest that this angle has been selected because it is the local latitude, this is probably only coincidental as the corresponding line on the southwest side, passing towards the compass point 'H', makes an angle of 57° to the meridian line which does not appear to have any geographical significance.

The letters AN and PO each stand the wrong side of the meridian line to refer to the morning (**an**ti meridian) and afternoon (**po**st meridian) shadows of a central pin gnomon. They would be correctly positioned if it is to be taken that they refer to the direction <u>to</u> the sun, rather than of its shadow but this is at odds with the fact that the timescale has its gap at the south. They may, of course, stand for something totally different, such as the name of the maker or owner, though it is difficult to get away from the idea that they are related to the function of the device.

Two other physical features of the device invite speculation. One is the block rivetted on the back. This is aligned in the E-W direction and is too small to be comfortably held in the fingers though it does suggest a use as some form of handle or mounting. It could perhaps have been fitted into a larger handle of, for example, wood, with its rectangular shape ensuring correct alignment. Alternatively, it may have held the device into a larger mechanism.

The other feature is the set of four small lugs on the periphery. These are only approximately equi-spaced around the circumference, and are offset from the cardinal directions by between 25° and 30°. They clearly appear to be intentionally made but their purpose can only be guessed at. The possibility that they are the remains of 'spokes' so that the original device would have been a rather larger volvelle was mentioned earlier. Another excavated medieval device which is believed to have been a nocturnal and is currently under study, also shows clear signs of having had a spoked volvelle.[17]

If they are not the remnants of some form of spoke (so that the disc was originally part of a larger diameter circle), they could perhaps have been a form of cam operating a mechanism or indicator revolving around the disc. The fact that the AM and PM numerals are engraved to be read from the west side of the disc indicates that it had a fixed position relative to the use. This position would have needed to have been set to the compass directions.

A simpler and more likely suggestion is that the 'lugs' were used to connect the disc to the end of a short cylinder by interlocking into corresponding cut-outs, thus forming a shallow cylindrical box. This was the method of construc-

tion of the cases of compendia such as that seen in the famous illuminated manuscript[18] of the *Horologium Sapientae* from the mid-15th century. The cases contained a magnetic compass, a relatively new innovation in 14th-century Europe. If this is the case, the central hole in the disc may have been for the pivot of a compass needle rather than for a gnomon and the walls of the cylinder would have precluded its direct use as a sundial. It could still, though, have been part of a compendium which included a sundial.
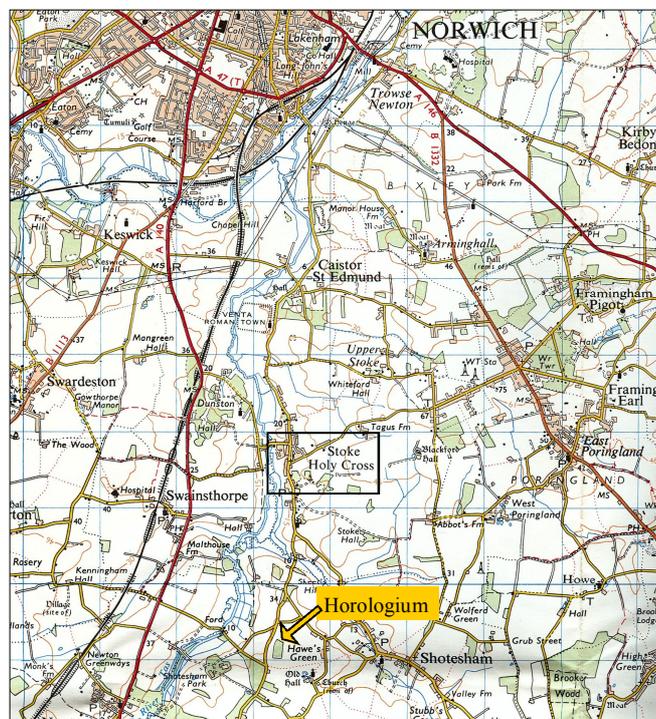
Fig. 6. Map of the region to the south of Norwich.

Discussion

It is perhaps coincidental that this device is the third medieval timepiece found in Norfolk by a metal detectorist in the past decade. The other device, a fragment of a quadrant which has been dubbed the 'Norfolk quadrant'[19] was discovered in a similar rural location, also to the south of Norwich and only about 10 km away from the Shotesham field where the horologium was found. A third instrument fragment from Norfolk, a nocturnal, is also under investigation.[20] Although none of the devices is firmly dated, the balance of the evidence suggests that the horologium could be older than the quadrant by around a century, though this is subject to revision. Given that the author became aware of them because they were reported on a national database and nothing similar is listed for elsewhere in the country, the question which arises is whether this is pure chance, due to the particular diligence of Norfolk's metal detectorists, or to some special place of Norwich in the history of horology.

As was described in the earlier paper on the Norfolk quadrant,[19] the city of Norwich was second in importance only to London in medieval England and its cathedral was one of the very first to have a clock: it was already being repaired by 1291. Over the period 1322-5, a new astronomical clock

of considerable complexity was built at great expense (£52 9s 6d), with the clockmaker Master Roger of Stoke (who later worked with Richard of Wallingford on the celebrated St Albans astronomical clock) being a key figure for a period of over two years.[21,22] Another clockmaker who worked with Roger was a younger man (possibly his son), Laurence of Stoke. Laurence (or someone of the same name) also worked at St Albans, later going on to take orders and become a senior monk: he is described as *horologiarius* when he accompanied a successor of Richard of Wallingford to the papal court in Avignon in 1349. Stoke is a fairly common placename so it is not clear where Roger's and Laurence's origins were. One suggestion made by John North as "plausible" is Stoke Holy Cross, around 6 miles south of Norwich.[22] As can be seen in the map of Fig. 6, this is in fact only about 2 miles from the location where the Norfolk horologium was found. It is also apparent that the find site is only a few hundred yards from the long-ruined medieval St Martin's church. By a curious coincidence(?), the address of the church is Roger's Lane, Shotesham. It is very tempting to put these facts together and invent a scenario where one of the two local clockmakers visits their home church and loses the horologium: although this is pure speculation, the links between Norfolk and horology do seem to be strong.

The connection between officials of the Church and astronomy is demonstrated by the fact that Richard Courtenay, a chancellor of Oxford University and friend and envoy of Henry V, purchased an astrolabe from the great French maker Jean Fusoris in 1414.[23] Courtenay was made Bishop of Norwich in 1413 until his death in 1415. The direct link to astronomical instruments at Norwich Cathedral is, however, rather tenuous as is is believed that Courtenay never actually visited his seat there. Nevertheless...

ACKNOWLEDGEMENTS

REFERENCES

1. The Portable Antiquities Scheme is administered by the British Museum. The 'Norfolk Horologium' is registered as NMS-82C940

2. As late as 1436, Andrea Bianco's *mappa mundi* showed Jerusalem at the centre and Paradise (East) at the top. A reproduction can be seen in L.A. Brown: *The Story of Maps*, Dover, New York (1977), p.126-7.

3. M. Drogin: *Medieval Calligraphy – Its history and technique*, Dover, New York (1980). See particularly p. 56 *et seq*.

4. J.D. North: *Chaucer's Universe*, Clarendon Press, Oxford (1988). see p.62.

5. See, for example, the degree scale in J. Davis: 'A medieval Gunter's quadrant?', *BSS Bull.*, 23(iii), 2-7 (Sept 2011).

6. See (Brussels MS illus, ref 18). Examples also exist in the British Museum (Inv. no. AN440108) and in the Oxford MHS (Inv. no. 46855).

7. C. Mason, Bristol & Region Archaeological Services, private communication, excavation find at St James' Priory, Bristol.

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10. T. Wood & F. O'Carroll: 'A Celtic Quartet', *BSS Bull.*, 20(ii), 84-87 (June 2008).

11. See Arnaldi *op. cit.* ref. 8, p. 287.

12. A transcription of, and commentary on, Chaucer's *The Astrolabe* is given in R.T. Gunther: *Early Science in Oxford – Vol V, Chaucer and Messahalla on the astrolabe*, Oxford (1929). A more modern version by James Morrison is online at http://www.chirurgeon.org/files/Chaucer.pdf. "And, as I have seid, 5 of these degres maken a myle wey, and 3 milewei maken an houre. And every degre ot thys bordure contenith 4 minutes, and every minute 60 secundes."

13. H. Kurath & S. McAllister Kuhn: *Middle English Dictionary*, vol. 13. See p. 469. Univ of Michegan Press, Ann Arbor (1977).

14. J.D. North: *Chaucer's Universe*, Clarendon Press, Oxford (1988). See p.47 for a discussion on time and distance.

15. G. Dohrn-van Rossum: *History of the hour; Clocks and modern temporal orders*, Univ. Chicago Press (1996), pp.57-59, quoting *Asser's Life of King Alfred*, Ed. W.H. Stevenson.

16. Dorn-van Rossum, *op. cit.* (ref 15), pp.66-67.

17. 'Norfolk nocturnal', Portable Antiquities Scheme ref. NMS-D40DC2.

18. An illustrated manuscript c. 1450 (a French translation of Henry Suso's *Horologium Sapientae*, now in the Bibliothéque Royale de Belgique, MS. Bruxelles, B.R.IV, f. 13v) shows a number of instruments including a one-handed clock with a 24-hour dial, a quadrant for unequal hours, a shepherd's dial (*chilindre*) calibrated in Italian and Babylonian hours, and two portable sundials (one horizontal, the other equinoctial) with polar-pointing gnomons.

19. J. Davis: 'A Medieval Gunter's Quadrant?', *BSS Bull.*, 23(iii), 2-7 (Sept 2011).

20. The third device, a nocturnal, is listed in ref. 17.

21. I. Atherton, E. Fernie, C. Harper-Bill & H. Smith: *Norwich Cathedral: Church, City and Diocese, 1096-1996*, Hambledon Continuum, see pp. 441-2 (1996).

22. J.D. North: *God's Clockmaker – Richard of Wallingford and the invention of time*, Hambledon & London (2005). See pp. 141-3 for references to Roger and Laurence of Stoke.

23. J.H. Wylie and W.T. Waugh, *The Reign of Henry the Fifth,* 3 vols, Cambridge University Press, Cambridge, 1, pp.504-507 (1914-29). The story of how Fusoris came to England in an attempt to get full payment for this instrument is told in I. Mortimer: *1415: Henry V's year of glory*, Vintage, London (2010).

24. J. Davis: 'Robert Stikford's 'De Umbris Versis et Extensis'', *BSS Bull.*, 23(iv), 24-28 (Dec 2011).

For a CV and portrait of the author, see *Bulletin* 23(ii), p.13 (June 2011).

LA MERIDIANA

MARK LENNOX-BOYD

In any sundial one can actually see the beauty of the mathematics that made it. In addition, the design is composed of many elements, the materials, the carving or painting, the lettering, the dial furniture, and the overall proportions, but I particularly enjoy the product of the mathematics made into an harmonious image. My main interest comes from the combination of the calculation involved and the design which derives from that calculation. For any particular location, the geometry is invariable, but there is variation in the design of the time lines and curves, and the most important variable arises from the surface onto which the projection is made, plane, circular, conical, or even elliptical, and the angle of the surface in relation to the source of sunlight.

Perhaps I can make my argument clearer by commenting on the drawing in Fig. 1 (overpage). This illustrates *La Meridiana*, Italian for 'The Sundial', which forms the stair tower of the house I have built in Italy. Look at the small area of the east wall above the Latin – time lines every five minutes, date in red, azimuth in green and altitude in blue. This is a vertical plane surface running precisely north to south and facing west. All these lines and curves are determined by the combination of the declination of the sun with its hour angle, and are both mathematically and so visually related. The time lines appear as a gradually increasing staircase of black and occasionally gold steps, which emerge from the point at the bottom right hand corner where the straight equinoctial line starts. On either side are the other date curves, the zodiac curves, splaying out on either side of the equinox in increasing distance from it, in harmony with the increases in distance between the five minute steps of time. Meanwhile, green azimuth lines move leftwards at a slowly growing pace while blue altitude curves ascend from the horizontal bottom line, in curves which increasingly move upwards in harmony with azimuth.

To me this visual harmony is very satisfying, and other harmonious relationships can be seen in the ceiling, and in the north wall, where everything seems to be moving in an upward direction, as it happens towards the words which mean 'Praise be the name of the Lord', LAVDABILE NOMEN DOMINI, chosen from Psalm 112, v.3 not for particular religious reasons (though we are in Italy) but because the sun is seen to rise from the projection of sunlight through the small hole above azimuth 270 degrees, and shines onto the west wall, on which is inscribed 'From the rising of the sun', AB ORTV SOLIS. It sets from the projec-

tion through the hole above 90 degrees onto the east wall, which is inscribed 'Until the setting of the same', USQVE AD OCCASVM.

To visualize the dials you must imagine the three main oblongs of Fig. 1 forming the north, west and east walls on the inside of a box with the ceiling on top and the two little triangles on the south wall of this box. As the sun rises in the east at midsummer dawn, it will emerge and project from the small hole you can just see above azimuth 270 and will strike the south wall on the west side, then move to the west wall, and finally the north wall, before being cut off as the sun moves further towards noon. At this point a small mirror 2 cm in diameter, placed in the centre of the south wall, takes over and the sun's image is projected first onto the west wall by the ceiling, then the ceiling itself, and finally the east wall by the ceiling. This mirror is not shown in Fig. 1 but its support can just be seen as the little semi-cylinder on the upside down part of the roof shown in Fig. 4. In the afternoon and until sunset the cycle continues with the projection of the sun through the small hole above azimuth 90. The dials are designed to work for all times of day at all dates of the year and there is a degree of overlap between the three systems.

In addition to the biblical quotation there is a further one depicted down the centre of the north wall with a line from
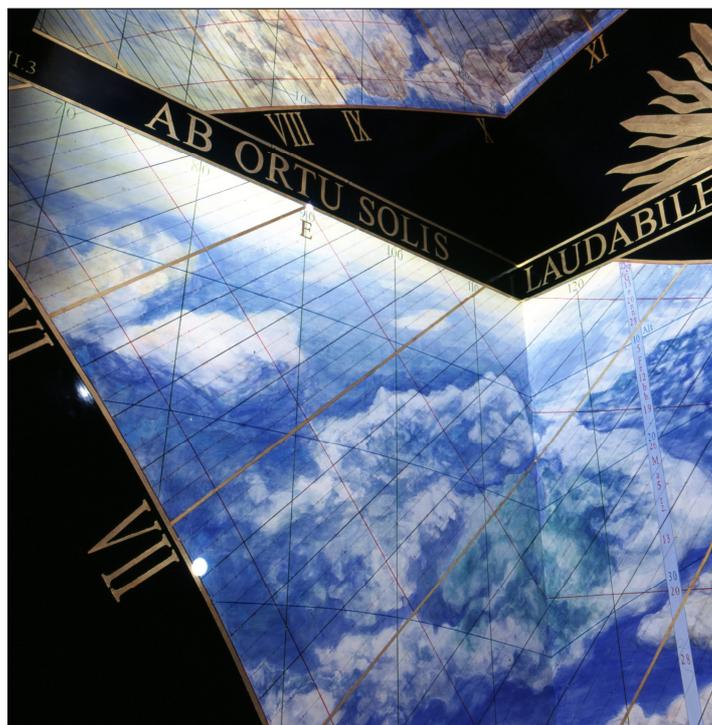

Fig. 2. The finished dial reading 7, 12.5 minutes LST.
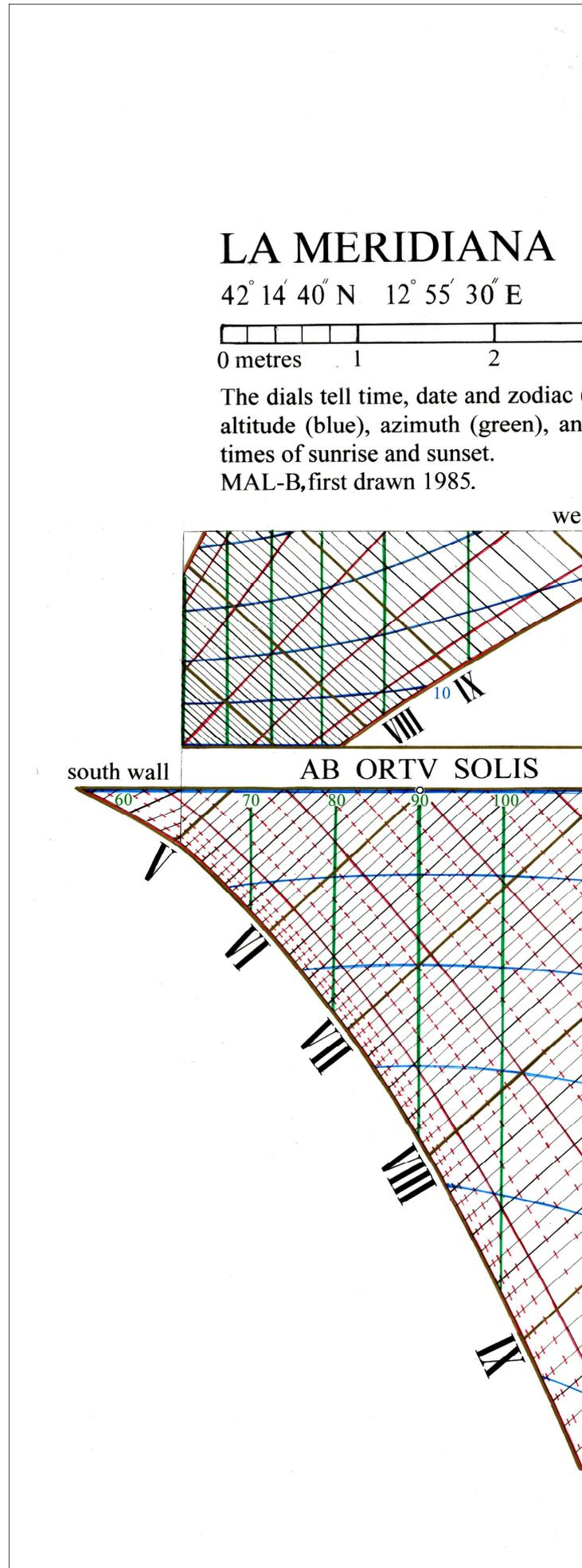
Fig. 1. The design drawing for La Meridiana.

Horace's Odes. It commences with the sundial cliché CARPE DIEM…, in translation 'Seize the day, trusting as little as possible in the future**'.** This line from Odes 1.11 is not what I usually live by, but the ruins of Horace's villa, where he must have thought it, are to be found 15 miles from La Meridiana, as the crow flies, by a beautiful spring in a lovely stretch of countryside.
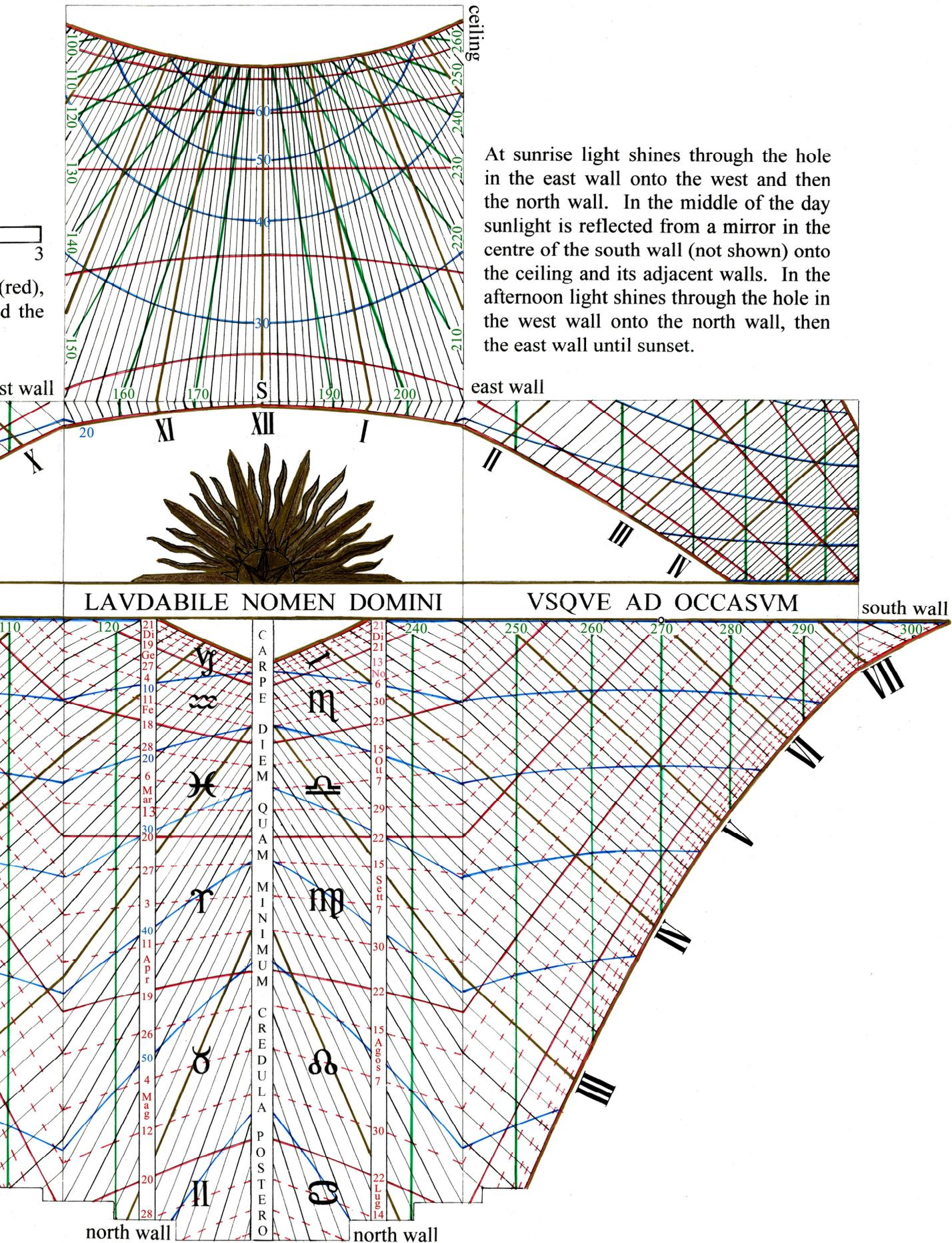
A full technical explanation of the sundial and its making can be found on the internet.[1] So this article is concerned only with a short introductory description. There are many photographs and drawings on the website, and apart from the plan, already referred to, only one photograph of the dial in operation is shown here in Fig. 2. Time by the sun is read from this photograph as about twelve and a half minutes past VII am, very near the summer solstice, azimuth about 83 degrees, altitude about 27 degrees.

The sun's image projected through the two holes, and the reflection from the south mirror, will always form an ellipse for the holes and mirror act like a camera obscura and project a cone of light sliced by the projected surface. Only at the equinox dawn or sunset could the projection theoretically be a circle, but the dial cannot be read at these times, not least because the sun is obscured behind hills or trees. The projected image is therefore a distorted image of the sun itself, and out of focus, and readings are taken from the centre of the image. On the walls, time when corrected for displacement from the Italian time meridian and the equation of time, can be read on the five minute intervals mostly to within 5 seconds, and the date can, by interpolation, be read mostly to within a day. The ceiling is less accurate because of the difficulty of having a precisely horizontal mirror. Date and azimuth on the ceiling have not been calibrated very accurately, and are really there for decorative purposes.

I cannot remember how long ago it was that I first thought of the concept behind *La Meridiana*. It must have been some time in the late 1970s. I had married my Italian wife in 1974 and Arabella's family then owned a nearly derelict tower once used for breeding pigeons in a field called Sorano, opposite their home Palazzo Parisi, in the village of Oliveto, in the Sabine hills, 50 miles from central Rome. This led me to think of the idea of allowing the sun to project onto the inside walls of a tower. I had seen the great noon mark in *Santa Maria degli Angeli* in Rome and thought that if it was practical to project onto the floor it was likewise a reasonable idea to project an image of the sun onto walls. I was aware also of mirror dials, or catoptric dials from the Greek for a mirror, especially the one at the *Lycée Stendahl* in Grenoble. So I reasoned that if one installed projections from the west and east walls, and a mirror reflection from the sill of a south wall, it would be possible to read the dial at all times of the day. It would be an indoor sundial, and large so hopefully reasonably accurate. The inspiration for the staircase was the stair at the National Gallery of Scotland in Edinburgh, and the rising sun image on the north wall with flames and golden swords was derived from a ceiling roundel once used by Clough Williams-Ellis.

The family sold the tower at Sorano, and the idea was born to build a sundial tower as the staircase for a house to be called *La Meridiana.* I was always uncertain that I would be able to build

LA MERIDIANA
42° 14′ 40″ N   12° 55′ 30″ E

0 metres   1   2

The dials tell time, date and zodiac (
altitude (blue), azimuth (green), an
times of sunrise and sunset.
MAL-B, first drawn 1985.

we

south wall   AB ORTV SOLIS

At sunrise light shines through the hole in the east wall onto the west and then the north wall. In the middle of the day sunlight is reflected from a mirror in the centre of the south wall (not shown) onto the ceiling and its adjacent walls. In the afternoon light shines through the hole in the west wall onto the north wall, then the east wall until sunset.

ceiling

(red),
d the

st wall

east wall

S

XI   XII   I

X

II

III

IV

LAVDABILE NOMEN DOMINI   VSQVE AD OCCASVM

south wall

CARPE DIEM QUAM MINIMUM CREDULA POSTERO

VII

VI

V

IV

III

north wall   north wall

Figs. 3 & 4. The second model – sycamore, mahogany, box, pearwood, paper, pastel, ink and paint. The lower flight and one side flight of the elliptical staircase can be seen. The removed top section shows the false ellipse ceiling which was not built, and the cut out figure is the author.

the house, but read an article in the Italian art magazine FMR which described how a lesser Renaissance architect (I forget his name and the details) who had entered a competition to extend or embellish St Peter's in Rome but knew in his heart that he would never win the commission and so decided to build a model of his concept for the cathedral. His model survives and has thus secured his name in posterity. I have seen it at an exhibition in Venice, some 20 years ago. It is magnificent and gigantic, if I remember correctly, more than 10 metres long, and must rank as one of the greatest architectural models ever constructed.

So I decided to design the dial and build a model, if nothing else. I was very busy at the time with other activities, but the first model, for there are two, was completed in 1985. Although I continued to think of building the dial, I felt it best to give the concept a rest for several years and come back to it with my mind refreshed to see if my original idea and layout was confirmed after a period of time. It happened that I had become even more busy, and I am glad to say that when I started to rethink the concept I could not improve on the original idea. When I was less busy in the mid-nineties I decided to construct the second model. The model, complete with its staircase, was finished in 1995, built by Malcolm Cobb, a neighbour in Lancashire. I coloured the inside.

Figures 3 & 4 show the second model. I had originally hoped that the dial would have an elliptically curved ceiling, and I laboriously mastered the technique of elliptical integration in order to write a computer program to plot and design it. This was successfully designed, but I then decided that no country builder would be willing even to

try to build accurately an elliptically curved ceiling that was also precisely orientated on a north-south axis. So I settled on a false ellipse (my term) for the model. In the model, the cross section of the ceiling is two quadrants joined by a narrow plane strip on either side of the noon line. This gives the illusion of an elliptical curve, but after further thought I concluded that even this simplification would result in such complexity of construction that it was not worth attempting. So, the sundial has a horizontal plane ceiling, but I would certainly like one day to make an elliptical ceiling on some other project.

In about 1995 I designed the house with the assistance of Architetto Dr Bolko Hans Von Schweinichen, and building work started in September 1999. Some calibration started in November 2000 and it was concluded in 2008. I myself calculated and depicted all the lines and curves. For reasons explained in the web article, most of the five minute lines were not put in by calculation, but empirically, by marking the sun's position on the walls against a stopwatch set for LST. Time lines were then drawn for every five minutes from at least three observations of the sun on different dates, and the time lines thus drawn from the marked points of known declination were used as an armature onto which were calculated, by computer, points to form the date curves. First, I had to measure, by means of the sun, the declinations of the walls. In the drawing of Fig. 1 the west and east walls run precisely north south, but as built are slightly off, and I measured them, I am fairly certain, to within about one hundredth of a degree. With this, and again my stop watch, and my knowledge of the dates and declination of the at least three observations stated above, and the usual formulae developed into programs in Basic, and my computer, I could calculate the distance in cm and

mm from the observed points on the time lines to the points for the required date curves. (I am sorry if this most brief explanation appears convoluted. If you are interested please see more on the web.)

I had initially imagined that calibrating the dials would require about 300 hours work, but my notes indicate that I spent 1150 hours calibrating them over the seven years during about 50 visits, each of a few days or weeks length. I probably spent much longer than 1150 hours, and anyway this does not include time spent in the UK making programs, nor of course thinking about the project and designing the tower and tools and designing and colouring the models. Nor indeed is the time painting the walls included. In addition there is of course the time spent by the builder's men constructing the tower. I believe that a conservative estimate for the project would be more than 3000 man hours. Of course much time was inefficiently spent by me, but such time was also part of my learning. I can say with some confidence that no one has ever spent so long building a sundial. My enthusiasm sometimes lagged, but I was always urged onwards by the recognition that once commenced the project had to be finished.

In June 2004 there was a BSS group visit to *La Meridiana*, during its construction, and so many members have seen it.[2] Figure 1 is truncated at the bottom, for part of the dial is projected onto horizontal treads and vertical risers, in fact 14 small dials are depicted on these in addition to the ten in the illustration – so 24 projections in all. The skyscape was painted by my stepdaughter Dominique Lacloche in casein

tempera, fiendish to use but with a finish which resembles fresco.

I sometimes asked myself why I had embarked on this project, but it is now finished and of course I look on it with pride. What I have just written is not quite true – it is not completely finished. The 'U's in the Latin must be changed to 'V's, the signs of the zodiac must be painted, the quotation from Horace added, and the dials now need some restoration.

There is an earlier description of the model in the *Bulletin*[3] and a short description and further photographs of the tower appear in my book 'SUNDIALS, History, Art, People, Science'.[4]

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POSTCARD POTPOURRI 21
Lewes, East Sussex
Peter Ransom

This (undated, presumed c.1930) postcard features a spherical dial at Lewes Castle. In *The Book of Sun-Dials* (1900) by Eden & Lloyd, it mentions "In the courtyard of Lewes Castle there is a stone ball on a pedestal which shows signs of having been covered with dial lines, and has some holes where gnomons were once fixed. It has been broken and mended with mortar, and was presented about fifty years ago to the Sussex Archæological Society. Its history is not known."

Since I cannot find this dial in the current Register I wonder whether it still exists.

pransom@btinternet.com

APPARENT LONGITUDE PROBLEMS WITH SOME SCOTTISH SUNDIALS

DENNIS COWAN

I first realised that there may be a problem with the longitude marked on some Scottish sundials after I entered the Sundial Trail competition in 2010 sponsored jointly by 'Sundials on the Internet' and the BSS, with my entry entitled "Sundial Trails to the Home of Golf". This trail was actually three trails in one – one trail to St Andrews (East Neuk) and another from St Andrews (North Fife), as well as a trail in St Andrews itself.

Fig. 1. The dial on University Hall, St Andrews.

Within the St Andrews trail, I included the vertical sundial on the old wing of University Hall (Fig. 1). On the roof of the building there is a weathervane inscribed with 1911, presumed also to be the date of the sundial. Inscribed above the dial is "LAT 56 20.7 N and LONG 11 12 W". It should be noted that the superscript units are hidden by the shadow of the surround, so it is unclear of the designer's actual intent. It was quite rightly pointed out by one of the judges that although "the latitude (56° 20.7′ N) appears correct, the marked longitude (11′ 12″ W) would place it in the middle of the sea! It should be about 2° 48′ W. This deserves further investigation".

It irked me that I had missed this error and I decided that at some point in the future I would investigate further as suggested by the judge.

Later on in 2011, I visited Greywalls, a hotel in East Lothian next to the famous and exclusive Muirfield Golf Club. So exclusive is Muirfield that you will find no direction signs to it at all.

Greywalls was designed in 1901 by Sir Edwin Lutyens who, in his lifetime, was said to be regarded as Britain's greatest architect since Sir Christopher Wren, if not indeed his superior. He collaborated with the landscape architect Gertrude Jekyll on the design of Greywalls and its grounds as well as on many other projects. Apart from many significant houses and other buildings, he was responsible for the
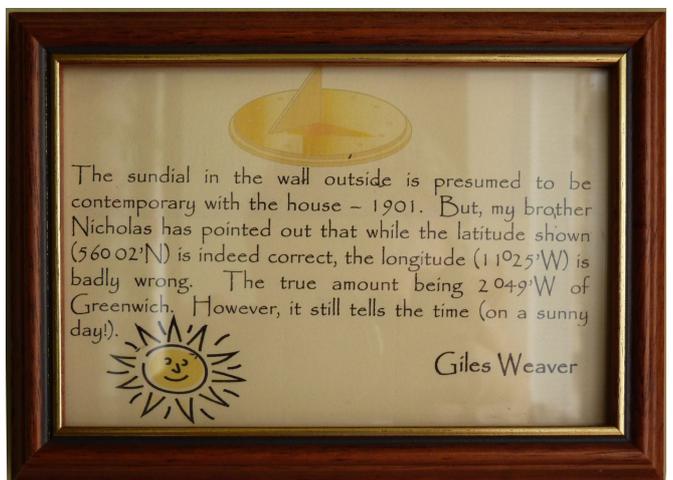

Fig. 2 (top). The dial on Greywalls hotel.
Fig. 3 (bottom). The notice indoors.

Cenotaph in Whitehall and the Memorial to the Missing of the Somme at Thiepval in France. When he died in 1944, his ashes were interned in St Paul's Cathedral. This sets the scene therefore for my visit to Greywalls.

I had been led to believe that there was a vertical sundial on the wall of the hotel and it was for this reason that I visited Greywalls. The staff were very accommodating and readily took me into the garden to show me the sundial (Fig. 2). A notice (Fig. 3) at the door to the garden was proudly pointed out to me saying that the sundial was inaccurate.

This notice rang a bell – the very same comments as the judge in the sundial trail competition about the sundial at St. Andrews. However, given Lutyens' pedigree, it was inconceivable that he had allowed such an error as to get the longitude so badly wrong.

At this point something kindled in my brain – were there others too? I looked through my collection of photographs and indeed there were other similar examples.

Some years ago I had photographed two other sundials with apparent anomalies in the longitude inscribed upon them, but had not picked up on it.

Fig. 4. The Hill of Tarvit Mansionhouse dial.

The first was at the National Trust for Scotland house near Cupar in Fife (Fig. 4). The Hill of Tarvit Mansionhouse was designed in 1906 by Sir Robert Lorimer for the Sharp family who had made their money from the jute industry, and it included a rather magnificent huge vertical sundial on the south face of the house. This dial showed a latitude of 56° 18′ and a longitude of 12^{min} West. Lorimar was also a

Fig. 5. The dial in Peebles High Street.

famous architect and would he too have made such an error? There had to be an explanation.

The second was on a building in the High Street in Peebles in the Scottish Borders (Fig. 5). This time, the huge sundial dated 1877, quoted Lat 55° 39′ and Time 12.85^m West. It was this sundial that gave the clue in that it quoted the word "Time" rather than "Longitude".

Looking at these four dials together, it was obvious that the longitude quoted on all four dials was not the longitude, but was instead the time difference from Greenwich. When the time quoted on the sundials was converted to actual longitude in degrees and minutes they were all virtually spot on with their locations. It actually makes more sense for longitude to be shown in this way as it makes it much easier for the user to tell the time.

This quite nicely answers the judge's query from the sundial trail competition.

I subsequently advised the owner of Greywalls that his notice about the error in longitude was itself an error, but he replied that he would rather leave the notice as it was as it provided a talking point! I'm not sure that Lutyens would have approved.

There appears to be a further error in the notice as it presumes that the sundial is contemporary with the house (1901). John Foad's article[1] on Lutyens' Vertical Sundials identifies that the sundial was added some time later, as a photo of Greywalls from 1913 does not show it to be in place.

The sundials were all from the period 1877 to around 1913. Was this a Scottish peculiarity or are there any other sundials from this period marked in a similar fashion in other parts of the UK?

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For a CV of the author, see *Bulletin* 23(iv), December 2011.

GILLOT AND FRAGONARD: TWO EIGHTEENTH CENTURY FRENCH ARTISTS' CONCEPTIONS OF BALL SUNDIALS

MALCOLM BISHOP

Charles Aked, a previous Editor of the *Bulletin*, was not much impressed by the representations of sundials made by artists. The opening sentence of his 1994 article 'Sundials in Illustrations'[1] was as follows: "The average artist, when depicting a sundial, usually demonstrates a complete lack of understanding of the elementary principles of dialing."

This article discusses two illustrations of French eighteenth century ball sundials (one of which, the Gillot, Aked noted) which, though clearly unrealistic and confirming Aked's statement about artists and their dials, have a genuine purpose in their context, and show what they need to show very clearly and satisfactorily.

The first is Claude Gillot's (1673-1722) etching (Fig. 1) for Houdar de La Motte's[2] (1672-1731) Fable *La Montre et le Quadran*[3] *Solaire* (1719)[4] and it is both described and used here to provide inspiration for a fresh interpretation of the second.

The second dial described (see Fig. 3, below) is the pillar and ball sundial which occupies such a prominent position in Jean-Honoré Fragonard's (1732-1806) painting *Rêverie* (or *L'Abandonnée,* painted 1790-1).

Claude Gillot's Dial of 1719

Gillot was responsible for some seventy of the one hundred prints which illustrate La Motte's *Fables Nouvelles Dediées au Roi,* the King in question being the nine-year-old Louis XV (1710-1774), who had acceded to the French Throne in 1715.

La Motte first shows the value he put on Gillot's illustrations in his secondary dedication of the collection to the Duc D'Orleans, who was Regent. This dedication takes the form of a preamble to Fable I, where he says that the hundred Fables will be much enhanced by a hundred '*Estampes*' and, as they are for the young Louis, they should be beautiful. The cost he puts at two thousand écus.[5]

More personally, and emphasising the importance of the illustrations as being more than merely decorative, La Motte dedicated Fable XVIII, Book IV (*Les Animaux Comediens*) to Gillot, his 'brother in Apollo'. He 'paints to the ears', Gillot 'paints to the mind'.

Elsewhere he acknowledges the anthropomorphism of the animals in the stories, and here he admits that the fables are anti-Cartesian (*Contre l'orgueil Cartesien*) asking "do you

Fig. 1. Claude Gillot; La Montre et le Quadran Solaire, 1719. Etching on paper; 3″ × 3¾″ (89 mm × 107 mm to plate edges) British Museum 161.a.41. ©The Trustees of the British Museum. All rights reserved.

think I'm an automaton?" For the 'Fable of the Watch and the Sundial' La Motte extends human voices and human emotions further, to metal and stone, as he describes a watch mocking a sundial, which at the start of the account is in shadow.

The watch boasts that it runs for eight days at a winding and shows the time whether or not the sun is shining. It has a passing strike, which rings to say that the time is four o'clock, and in Gillot's illustration the young lady is seen listening intently, fore-finger raised.

Then the sun breaks through (*"Phoebus de ses ardents regards, Chassant nüages & broüillards ...."*). The artist shows its rays as broad bands and the gnomon shadow falling, as seen by the reader but unobserved by the couple, at a non-realistic but precisely drawn, not four o'clock, but four forty-five (Fig. 2) to accord with the fable.

At this stage in the development of the watch as a time-keeper Hilaire Belloc (himself born French[6]) could not have made his well known 'botch' epigram, for it is the dial that is accurate, not the watch.[7]

The sundial (which has been in place for some while, as the damage to the weather side indicates) replies with La Motte's own moral *"je te conseillerois de suivre mon usage. Si je ne vois bien clair, je dis: je n'en sçais rien. Je parle peu, mais je dis bien. C'est le caractere du Sage".*
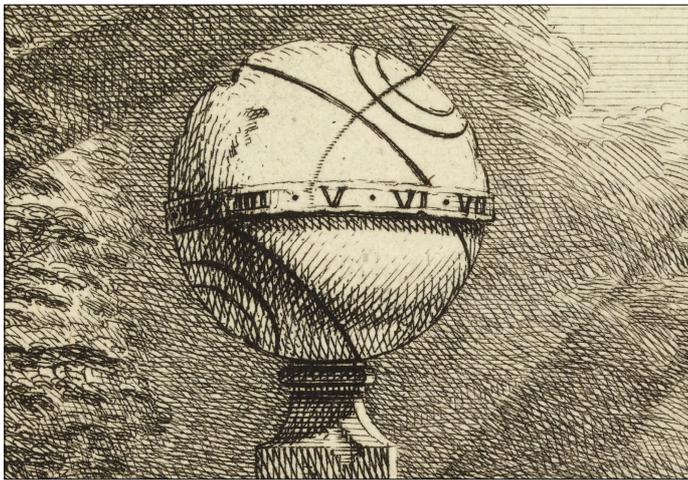
Fig. 2. Detail from Fig.1: the gnomon shadow at precisely 4:45pm and the damage to the weather side of the dial. ©The Trustees of the British Museum. All rights reserved.

'Be like me. If I can't see clearly, I say I don't know. I may not say so much, but what I do say is accurate. That is wisdom.'

Today, the motto from this particular fable has some currency in France, and the illustrations are valued not least because Gillot was the tutor of Watteau and Lancret.

There are obvious flaws in the sundial, which cannot be considered as in any way realistic: the circular lines seem to have no meaning apart from the decorative. Most notably, the dial is reversed, with the afternoon sun still apparently in the East. (The sun is too high in the sky for the time to be 4:45am.) If this were a realistic sundial, the numeral shown in this approximate gnomon shadow position would be not V but X or XI.

It is no help to say that Gillot's original drawing may have been the correct way round (reversal in the process leading to the printing of the plate was usual) for if that was the case the numerals would still have had to be exchanged, since it is imperative for the narrative that the shadow fall exactly at 4:45 so that the sundial can correct the watch. By showing this, the illustration performs its function admirably, and adds more with its human interest in the two young people who explain the presence of the watch.

There may be more meaning here than immediately meets the eye. A point which is likely to escape English viewers is that *Le Cadran Soleil* is masculine and *La montre* is feminine. So in both the La Motte and Fragonard images there are resonances for the French viewer (however subliminal) that are not apparent to the Anglo-Saxon.

Jean-Honoré Fragonard's Dial of 1790-1

As for the Fragonard, shown in Fig. 3, and his last major work[8], an account of a sundial which is capable of telling the time for a few weeks at most may not seem immediately appropriate to this *Bulletin*. However, as the Fable of La Motte makes clear, the point of a sundial is its precision, and this accuracy can be interpreted as being as essential to the narrative of Fragonard's painting as it was to Gillot.

His ball dial may be of little use in general terms, but its essential function is the same as that of the Gillot, to show for the purpose of the narrative of the painting precisely the time of day. All extraneous dial markings (date arcs and hour lines, for example) which would make the dial in any way usable in real life have been omitted.

In place of a gnomon or style there is a cupid. Although at the Frick Collection the painting stands alone, in the original setting at the Villa Maubert the cupid is the central one of three, the over-doors to either side and at the same level showing him very much alive and turned towards the dial.[9]

The paint tones are little different from those used for him as a sculpture, and the effect, clearly intended by Fragonard, is very much that he has settled briefly on the dial with the sole purpose of casting his shadow.[10] His expression is curiously sulky.

The nodus shadow of his finger falls on the second I of XII, just past noon (see Fig. 4) where we know it will linger for just a few more minutes. In addition, the sun is high in the

Fig. 3. Jean-Honoré Fragonard 'Rêverie' (or 'L'Abandonnée') 1790-1. Oil on canvas; 125⅛" × 77⅝" (317.8 × 197.2 cm). Henry Clay Frick Bequest. Accession number: A 1915.1.49. Copyright The Frick Collection.

Fig. 4. Detail from Fig. 3; Cupid and dial, showing shadow on the second I of XII. Copyright The Frick Collection.

sky, from where its summer light casts a fugitive shadow onto the numerals, and where it will remain for only a few days even if Cupid keeps his position.

Without the cupid and the dial, the young lady, seen in a 'Tivoliesque' setting[11] and pictured in a posture for which the alternative title 'Abandoned' suggests either of the two previously accepted interpretations of the painting (given below), is just what she seems, and attracts no particular sympathy from the viewer.

Once accepting the fact that the dial (like the Gillot one) is a nonsense as a real instrument, but an important component of the painting rather than just background, it is reasonable to surmise that the artist wants the viewer to engage in a time-related dialogue, for the shadow position is very precise.

The clearest implication is that the young person is thinking of being past the noon-tide of her life as far as love is concerned. This may seem ridiculous to us in an age where life expectancy is so different, but average life expectancy in France in the late 18th century was about 27[12] and, as late as the first half of the 20th century, novels could describe a thirty-year-old as middle aged.

If the reference to mid-summer as well as mid-day was also intentional, the possibility of an autumn to be endured alone is a further reinforcement by Fragonard of the story of the painting. Here the elegiac first section in the Belloc poem *For a Sundial* is entirely apt.[13]

The History of the Painting

The history of the Fragonard painting is complex. In 1771-2 Madame du Barry (1743-1793), mistress of Louis XV (to whom as a child-king La Motte had dedicated his Fables), commissioned four large paintings[14] for her new Pavilion at Louveciennes[15] on the Seine near Paris.

However, after they were completed and installed, she changed her mind, for reasons much debated since, and gave the commission instead to Joseph-Marie Vien (1716-1809), a painter in the then fresh neo-classical style.

The rejected Fragonard series, depicting various agreeably enigmatic scenes, is generally collectively known as the *Progrès de l'Amour,* and these first four may have offended by reflecting too nearly biographical details from his Patronesses life. Each one includes a cupid as part of a sculpture, but these are clearly stony and lifeless.

After their removal, and having been for seventeen or eighteen years in store at his studio in the Louvre, the canvases were taken by the artist in January 1790 to the house of his second cousin Alexandre Maubert in Grasse (now the Musée-Villa Fragonard).

Alexandre's father Honoré commissioned two more paintings, and it is appropriate that in *Rêverie* the young lady is surrounded by roses, the tools of Maubert senior's trade as a wealthy Grasse *Parfumier*.[16]

In the meantime much had changed for France and Madame du Barry. Fragonard survived the French revolution, being appointed in 1793 as a curator at the Louvre, where with some irony, the Vien series now hangs.[17] *L'abandonnée* well described the condition of Mme du Barry after the death of Louis in 1774. She perished during the Terror.

Precedents and Interpretations for the Young Woman and the Dial

Colin Bailey, in his definitive monograph *Fragonard's Progress of Love at the Frick Collection*, published last year, notes the two existing interpretations of the posture of the young woman – the former romantic 'abandoned' du Barry reading, now discarded, and the current reading which favours André Molitui's 2001 conclusion that the girl is a version of an erotic painting by Pierre-Antoine Baudouin (1723-1769).[18]
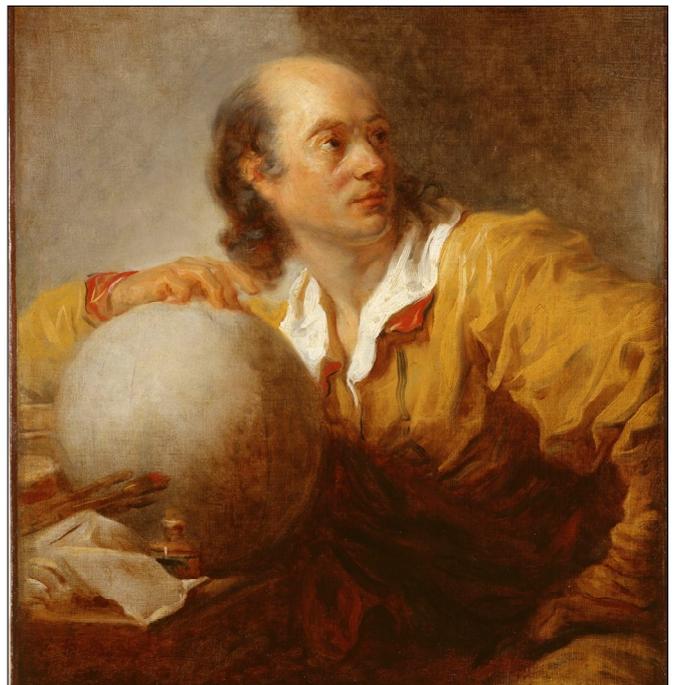

Fig. 5. Jean Honoré Fragonard (1732-1806) 'Portrait of Joseph-Jérôme Lefrançois de Lalande (1732-1807)'. Oil on canvas. c.1769. Musée des Beaux-Arts de la Ville de Paris, Petit Palais. © Petit Palais / Roger-Viollet.

Whatever the elder Maubert's motives and requirements in commissioning such a subject from the artist might have been, it would seem that Fragonard's sympathetic handling of the theme and his addition of the sundial has resulted in a much more thought-provoking work of art.

As for the concept of a sundial involving the viewer of the painting in a dialogue, the La Motte fable furnishes a reasonable precedent. An English translation was available from 1721, although it was not illustrated.[19] Fragonard himself may or may not have seen the Gillot etching, but it is probable that at least some who viewed the painting would have done so and be in a position to draw their own parallels with the earlier work.

For the origin of the inventive design of the cupid and ball, there exists another potential, and possibly more certain, source in one of Fragonard's own previous works, his c.1769 portrait of the astronomer Lalande, shown in Fig. 5. Like Cupid's, and as fleetingly, the shadow of the astronomer's extended forefinger falls on a globe, in this case most probably his famous twelve inch celestial one (1765[20]-1775) with its charming constellations,[21] and which he is shown in the process of illustrating.[22]

The Problems Inherent in Ball Dials

The problems inherent in ball dials were comprehensively addressed by Mike Cowham in his article in the *Bulletin* in 2003.[23] Spherical dials may be crepuscular but, as he says and as the etching and painting illustrate well, the definition of the shadow is poor for any exact indication of the time.

Where they have a gnomon, it may be vertical like that on Nicolaus Kratzer's 16th century ball dial which surmounted his Corpus Christi Oxford lectern dial, or inclined like the gnomon of the Gillet dial. All are poor at shadow casting, but none as poor as Fragonard's, were it to be considered as a real dial.

Real life ball sundials are not common. Andrew Somerville photographed two at the 18th century Brechin Castle,[24] and Dennis Cowan illustrates a few more Scottish examples.[25] Kratzer's has long gone from Oxford, although it was fortunately well documented by Robert Hegge,[26,27] and it is now reflected in David Brown's dial of 1999.[28]

An eighteenth century English pillar and ball dial stands at the centre of the turf labyrinth at Hilton. A photograph taken in about 1922 appears to show a gnomon crudely similar to that on the Gillot dial.[29] This 1760 dial was fully described, together with others (including Kratzer's) of spherical form by Cowham.

Conclusion

In conclusion, both of the dial pictures show one characteristic of the sundial put to good artistic use. In the case of the Gillot illustration, La Motte's narrative dictates the presence of the sundial and demands its accuracy in just one particular point, even though the dial as a whole is unrealistic.

By taking the lead from La Motte and Gillot, and regarding Fragonard's painting too as being a dialogue, in this case between the sundial and the young woman, *Rêverie* is transformed. Each previous interpretation can be accepted into this fresh reading. Still melancholy, but no longer sordid, the painting becomes a narrative debate which draws in and engages the viewer.

'Je parle peu, mais je dis bien.'

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3. M-A. Dupuy-Vachey: *Fragonard,* sm'ART Terrail. Paris; (2006)
4. C.B. Bailey: *Fragonard's Progress of Love at the Frick Collection.* The Frick Collection, New York, D.Giles Ltd., London (2011).
5. P. Pattenden: *Sundials at an Oxford College,* Deddington, Roman Books. (1979).

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1. C.K. Aked: 'Sundials in Illustrations', *Bull.BSS.,* **94.**1, 9-16 (Feb 1994).
2. Antoine Houdar de La Motte (1672-1731).
3. Spelt Cadran in the Index, but not the text, in an un-illustrated third edition of 1719.
4. A.H. de La Motte: *Fables Nouvelles, Dediées au Roi.* Livre III, Fable II. Paris, Dupuis, 142-3 (1719). The British Library has three copies: 85.g.4 was re-bound for 'The King's Library' the Library of George III (1738-1820), now at the core of the British Library. 831.i.20 has a bookplate for Marie Anne Electrice de Bav[e]. (Bavière, (1728-1797))
5. Very approximately £45,000 in today's money.
6. Joseph Hilaire Pierre René Belloc (1870 –1953) born in La Celle-Saint-Cloud, naturalised in 1902.
7. J.H.P.R. Belloc: *For a Sundial.* Lines 17 & 18. The Belloc Estate has refused permission for quotation outside the whole poem, which may be found at *Sundials on the Internet www.sundials.co.uk/mottoes.htm.* Undated.
8. There is a companion '*The Triumph of Love'* which is somewhat sketchy.
9. Lest there be any doubt that he is a cupid, rather than just a putto, the companion to his left hand side carries the iconic dart or arrow and a quiver lies on the ground below.
10. This is seen very clearly in Fig. 12 of Colin Bailey's book, and the transience of Cupid's stay is reinforced by the final *Triumph of Love* panel, which, were he not already a god, would be an apotheosis.
11. S.D. Borys: *Fragonard and the Garden Setting: the* Progress of Love *at Louveciennes*). Montréal. PhD Thesis. Dept. Of Art History, McGill University. (1994)
12. Institut National d'êtudes Démographiques; *www.ined.fr/en/ everything_about_population/graph_month/life_expectancy_france/,*

accessed Oct 2011. Note: This figure is skewed by the inclusion of infant mortality numbers, and should not be taken at face value. It does give a guide.

13. J.H.P.R. Belloc *For a Sundial.* Especially lines 1 & 2, 8 & 9. (Undated).
14. *L'abandonnée* matches the earlier four and is over ten feet tall and more than six feet in width.
15. 1771, architect Claude-Nicolas Ledoux (1736-1806).
16. The painting and its companions remained at Grasse until 1898, when they were acquired by the English dealer Charles Wertheimer from Maubert's grandson, being replaced in the villa by copies painted by the Lyonnais artist Auguste de La Brély. J.P. Morgan bought them, and then finally in 1915 Joseph Duveen acquired all the works for Henry Clay Frick, and they are now to be seen, together with over-doors and other works by Fragonard which had furnished their original setting, at the Frick Collection in New York. The full story is recorded in Colin Bailey's book (details in Bibliography above).
17. M-A. Dupuy-Vachey, *Fragonard,* sm'ART Terrail. Paris; (2006) is a good light illustrated biography of Fragonard available in an English translation.
18. C.B. Bailey *Fragonard's Progress of Love at the Frick Collection.* The Frick Collection, New York, D. Giles Ltd., London. 32-3 (2011).
19. A.H. de La Motte: English translation by Robert Samber (1682-1745) *One Hundred New Court Fables, Written for the Instruction of Princes etc....* (Not illustrated) London, Curll & Jauncy, 223-4 (1721).
20. For a full description of the 1765 (9″) celestial globe; *www.artfact.com/auction-lot/a-fine-and-rare-delalande-lattre-celestial-glob-1-c-72ozzj4ve5.*
21. For an illustration of a constellation from the 1775 (12″) celestial globe; *www.lessing-photo.com/dispimg.asp?i=32010168+&cr=125&cl=1*
22. In real life Lalande was famously ugly and anyone less like a Cupid in appearance would be hard to imagine.
23. M. Cowham: 'The Discovery of a Spherical Sundial in Cambridgeshire', *BSS Bull.*, **15**.3, 116-119 (2003).
24. *www.scotlandsplaces.gov.uk/search_item/index.php?service=RCAHMS&id=303085*
25. *www.sundialsofscotland.co.uk/index_files/sundialregisterbyarea.pdf*
26. Corpus Christi College MS CCC 40, 152,430.
27. P. Pattenden: *Sundials at an Oxford College,* Deddington, Roman Books, 22-24. (1979).
28. *Bulletins* various, and *www.davidbrownsundials.com/cc.html* Accessed Oct 2011.
29. For a c.1922 illustration with gnomon in place; *http://www.sacred-texts.com/etc/ml/ml14.htm.*

For a CV of the author, see *Bulletin* 23(ii), (June 2011).

BOOK REVIEWS

The Bagnold Sun-Compass: History and Utilization

by Kuno Gross**.** Pub. by Books on Demand GmbH, Norderstedt/ Deutschland.
ISBN 9783842337022. (2011**)**
68pp. 220 mm × 170 mm.
Available from *www.desertstories.org/* or through bookshops. €11.00 plus p&p.
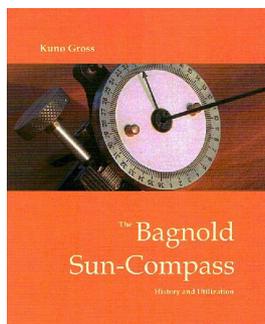
Shortly after the 'Sundial Goes to War' article appeared in the *Bulletin*, I was contacted by Kuno Gross of Switzerland who had just published a small booklet on the Bagnold sun compass. A few days later my endorsed copy arrived and what a delight it is.

This is an exhaustive examination of the origins, development, usage, history, preservation and modern reproduction of the tiny yet highly effective instrument. The research is thorough and the author even managed to find and interview surviving soldiers from the WWII Long Range Desert Group and that evidence of real usage is recorded, almost 70 years later. Many previously unknown photographs of the compass in use, along with the users, are included in this well-illustrated book.

The author gives working examples of plotting a course using the azimuth tables and a map actually from the period. Then he goes on to test a replica instrument in the North African desert and records the results. He offers to email interested readers printable copies of a test instrument customisable for their latitude. The bibliography and reference section is comprehensive and the index good. There were a few typographical errors in my copy but these have been fixed in later editions. For a German speaker writing in English this is a fine work.

If there is to be a cardinal reference point relating to the Bagnold Sun Compass, this is it.

Malcolm Barnfield

Essex Sundials by Peter Meadows.
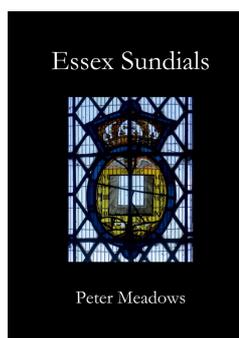
A5, softcovers, 44pp, full colour. ISBN 978-0-9570789-0-1, Self-published, *www.petermeadows.com/essexsundials,* £12.00 plus p&p. Also available from BSS Sales.

This small (A5) booklet offers the user a welcome introduction to an interesting selection of sundials to be found in the county of Essex. Written in a relaxed and non-technical style, the descriptions of the sundials are suitable for the most casual reader.

The introduction provides location details of the county and with a simple map showing Chelmsford, the county town roughly at the centre, indicates the general location of the sundials presented in the booklet.

The sundials featured are spread across the county and all have public access, the majority being located on churches. However, access may need to be obtained to view two of the sundials that are located within churches.

A good range of the usual types of sundials to be found are included, from the early mass or scratch dials to horizontal, vertical, human analemmatic and armillary sphere dials. Also included in the selection are two of the less frequently found, stained-glass type sundial. The sundials range from almost three hundred and fifty years of age to some made in more recent years, as well as the rather older mass dials. Helpfully, a list of sundial terms is also given.

Sundials at nineteen places are described and fully illustrated with colour photographs. At some of the locations further details about the church, other buildings, locally associated people or other items of interest are also included.

A detailed bibliography is provided at the end of the booklet, noting particular publications referred to, as well as the internet addresses associated with the additional items noted at those locations. Although not essential, the inclusion of the OS National Grid References would perhaps have been useful to enable the sundials to be more precisely located. Several minor typographical errors were noted, but they do not detract from the understanding of the narrative and it is believed that these will be corrected in the next printing.

For those contemplating a visit to Essex, this well presented and conveniently pocket-sized booklet offers an informative and useful guide to some of the varied and publicly accessible sundials to be found in the county.

Ian Butson

A Dial in your Poke: A Book of Portable Sundials
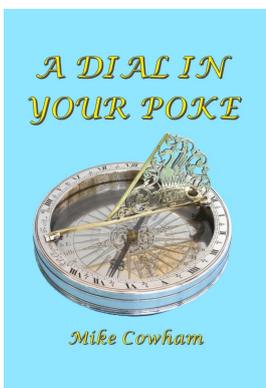
by Mike Cowham. A4 hardback, 208pp, full colour. Self-published, ISBN 978-0-9551155-2-3, Price £49.50 or £39.50 from BSS Sales.

Published by the author in 2011, this is the second edition, greatly revised and extended with 208 pages to provide 28 chapters and 7 appendices with superb colour illustrations on every page. Unlike its predecessor, the second edition is a hardback in the more conventional portrait format which has enabled larger presentation of the original illustrations. There are also many new illustrations available since the first edition as access to additional fine dials in auction houses and private collections has been obtained by the author.

There is a helpful introduction with definition of terms for those less familiar with the subject. The author emphasises the various characteristics and limitations that these instruments have because they are portable. The history and evolution of portable dials is covered in the first five chapters where several general categories are considered in detail. Chapter 2 on 'Altitude Dials' has been considerably revised to include some of the author's research in 2008 for his BSS monograph on the same subject. Pillar dials, vertical disc and plate dials, the navicula and quadrants are all described. These are followed in chapter 3 by simple ring dials, sometimes known as 'poke dials' after a couplet by Shakespeare ('poke' is short for pocket and when pronounced must rhyme with 'clock'). In chapter 4 we see the rather more mechanically sophisticated equinoctial ring dial with its very finely engraved bridge.

Quadrants are discussed in chapter 5 although they are instruments not primarily designed to tell the time. Perhaps this topic could have been moved nearer the end where other portable primarily astronomical instruments are discussed and illustrated. Ivory diptych dials and French ivory dials follow with many excellent illustrations and text describing their different characteristics. A high point of science and engravers art is reached with the French and Butterfield type dials described in the next three chapters. The author is to be complemented on the wealth and quality of over 600 illustrations in this book, particularly the illustrations of these dials.

The survey continues in the following chapters through all the well known and less common types of portable sundials and other time-telling portable instruments. The accompanying text provides a comprehensive history of the development of portable dials, the science, the ingenuity of the mechanical design and the skills of the engravers both functional and aesthetic. There is a clear discussion on 'Precision' and an excellent illustrated and informative history on 'Perpetual Calendars'. Compass dials, inclining dials, scaphe dials, and analemmatic dials are all described and illustrated to the same high standard. The important topic of caring for a collection is covered in a later chapter: it provides general advice also applicable to other types of small instruments. The final chapter concludes the study with many close-ups of the fine detail on these dials that you would be hard-pressed to see in a museum display.

The seven appendices provide a wealth of supplementary information: Appendix 1 explains the numerals, letters and zodiac symbols (sigils) to be found as furniture on portable dials. Appendix 2 provides a list of the Saints' days on calendars both for English and German use. There is an extensive bibliography and the variation of magnetic declination over 300 years in different locations is shown. In use many of these portable dials were oriented on the meridian by use of a magnetic compass, some of which were marked with the current magnetic deviation. The author lists 33 museums world-wide where collections of portable dials are kept. The final pages provide a catalogue of photographs of signatures by over 70 dial makers beautifully presented with sympathetic colour variation.

In this short review I have not exposed every topic covered by the author. My only observation is that this book deserves a more worthy main title. This is a really comprehensive 'Reference Book of Portable Sundials'. It will be an asset in any diallist's collection, both for the abundant illustrations and the depth of historical information it provides.

Graham Aldred

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

CHRIS H. K. WILLIAMS

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 functionality 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]
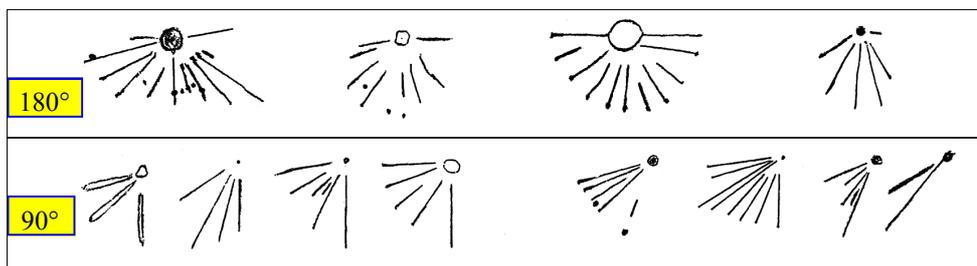

Fig. 1. *Reformation and Protestant scratch dials in England.*
Note:
B&W line drawings of surviving dials are a reasonable visual approximation of their original in use appearance – in complete contrast to Catholic mass dials, (see Fig. 3 in Ref. (1)).

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

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

		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.

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.
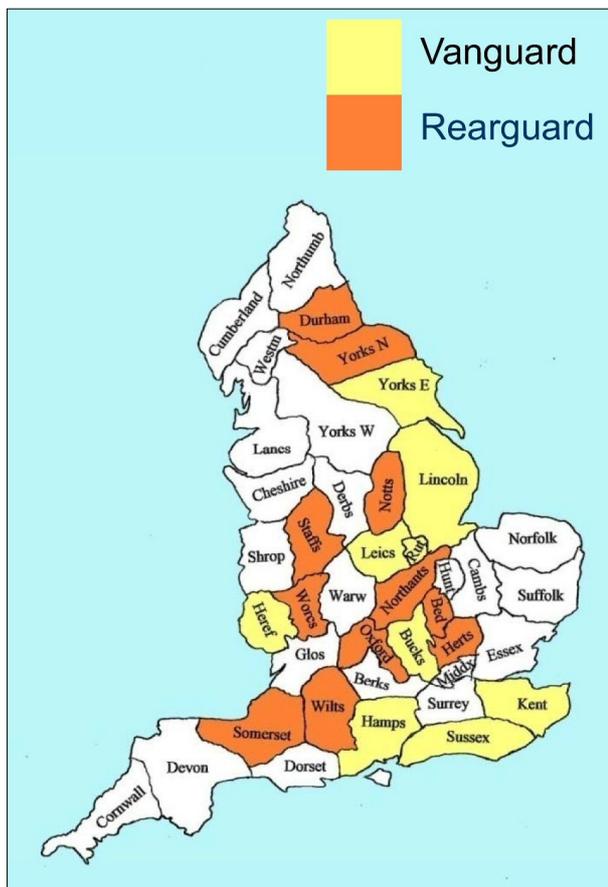
Fig. 4. The march of Protestantism – the message of over five thousand scratch dials.

Notes:
1. See Fig. 3 and main text.
2. Counties in the fringing cluster (see Chris H. K. Williams: 'The Geographic Distribution of Surviving English Scratch (Mass) Dials', *Bull. BSS,* 20(ii), 75-76, (2008)) have insufficient surviving dials to meaningfully test differences between actual and expected dial incidences. It is thus possible some of Cornwall, Devon, Shropshire, Cheshire, Lancashire, Cumberland and Northumberland might be in the Protestant vanguard or Catholic rearguard.

English Reformations: Religion, Politics, and Society under the Tudors, Clarendon Press, Oxford, (1993); P. Collinson & J. Craig (Eds.): *The Reformation in English Towns, 1500-1640,* Macmillan Press, London, (1998).

9. Firstly, historians do not agree on primary data's meaning, for example: is the wording of wills – a common/classic indicator of religious change – reflective of religious affiliation, scribal convention, or political correctness? Are documented Protestants indicative of known (administratively or legally pursued) hotheads or genuine popular Protestant ardour? Secondly, there is the way historians use data. At the risk of generalising, when handling data, historians tend, from an analytical viewpoint, to gravitate to the anecdotal rather than the technical statistical end of the spectrum. For example, considerations of survival bias, selection bias, or normalisation rarely intrude.
10. This begs the next question: How do 90° dials reflect Protestant zeal? The suggestive clue, embedded in the very appearance of 90° dials themselves, lies in aspects of zealous Protestant religious practice that, in contrast to traditional Catholic practice – and possibly also reluctant Protestant conformism – are confined solely to the morning. To date the author's research to authoritatively authenticate such an hypothesis have proved inconclusive – it remains work in progress.
11. On the other hand most scratch dials ever made were (Catholic) mass dials; but the overwhelming majority have already succumbed to loss (weathering or rebuilding) – see Chris H.K. Williams: 'English Scratch (Mass) Dials: The ravages of time revisited', *Bull. BSS,* 23(i), 36-38, (2011). Justification perhaps, should any such be required, for the continued use of the Society's Mass Dial Group's name!

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

the distinction has not hitherto been appreciated by diallists. The time has come for the distinction to be recognised in our standard terminology. Traditionally diallists have used the terms 'mass dial' and 'scratch dial' synominously. They are most definitely not one and the same! A Protestant mass dial is a contradiction in terms! The generic term is scratch dial. Apart from incised Saxon dials, all mass dials are scratch dials. The reverse is not true. As a matter of fact, most surviving scratch dials, being Protestant rather than Catholic, are not mass dials. [11]

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1. Chris H.K. Williams: 'Medieval Catholic English Mass Dials of the 14th & 15th Centuries', *Bull. BSS,* 23(iv), 29-31, (2011).
2. Chris H.K. Williams: 'English Mass & Scratch Dials c.1250 – c.1650: Combining Statistical and Religious Evidence', *Bull. BSS,* 23(iii), 20-22, (2011).
3. *Ibid.* (ref 2), especially Fig. 1 and references therein. This article also continues with the dial categorisation developed earlier.
4. *Ibid.* (ref 2) for a fuller discussion.
5. It is worth reminding ourselves we are discussing scratch dials on churches. As such we are confining consideration to primitive and ecclesiastical dials. The appearance of scientific or secular dials can be expected to have been influenced by a differing balance of considerations.
6. A.G. Dickens: *The English Reformation,* Batsford Ltd., London, (2nd Ed., 1989).
7. E. Duffy: *The Stripping of the Altars: Traditional Religion in England c.1400-c.1580,* Yale University Press, New Haven & London, (1992 & 2005).
8. The literature is vast. See for example (and the bibliographies therein) D. MacCulloch: *The Later Reformation in England 1547-1603,* Macmillan Press, London, (1990); C. Haigh:

Midnight Nodus

A reveller celebrating the arrival of 2012 attempts to scale the gnomon of the Silverlink Park sundial gets a fine view of the firework displays over Newcastle and North Tyneside.

A dozen or so people climbed the artificial hill to view the sundial in what is becoming a small tradition in the area.

Tony Moss

DIAL DEALINGS 2011

MIKE COWHAM

Although the market has been depressed for a few years there are still people with money who want to buy something good with it. They have lost confidence in banks, so are going for more tangible items than cash or bonds. Therefore some of the better dials are selling strongly, but the cheap and common types are still struggling somewhat.

Prices shown include Buyer's Premium but not VAT.

Christies South Kensington, 6 April 2011 (Travel, Science and Natural History)

This interesting stone polyhedral dial was sold for £16,250. As this dial has already been featured in the *Bulletin*, please refer to the article for further details (June and September 2011). A larger version of this picture is on the cover of the June *Bulletin*.

Fig. 1. Scottish stone polyhedral dial.

Bonhams, Knightsbridge, 19 April 2011

A small garden dial by the famous maker Thomas Heath was sold for £660. Its main plate was only 6½" square and
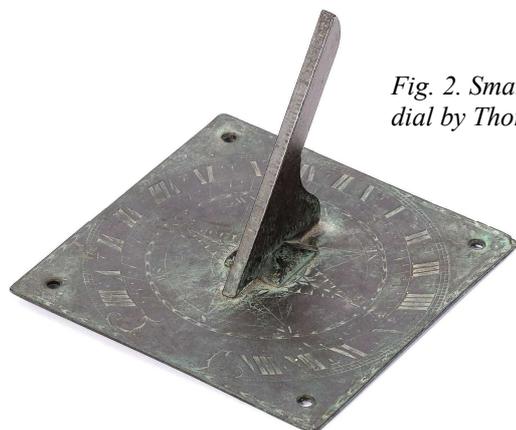
Fig. 2. Small horizontal dial by Thomas Heath.

it was signed in an unusual place – on the sloping edge of its gnomon. Its latitude was reported as being around 56°.

Christies Paris, 21 June 2011 (Collection d'un Amateur)

In this interesting sale were several portable dials. I have chosen two that were particularly interesting.

The first is an ivory diptych dial signed *C Bloud A Dieppe*. It has that rare speckled finish, probably produced by acid with a wax resist for the white spots. It is a magnetic azimuth dial – and Charles Bloud was famous for making these. However, this dial is different. Instead of having a moving chapter ring in the compass bowl, this dial simply has curved hour lines that are read from the point where the
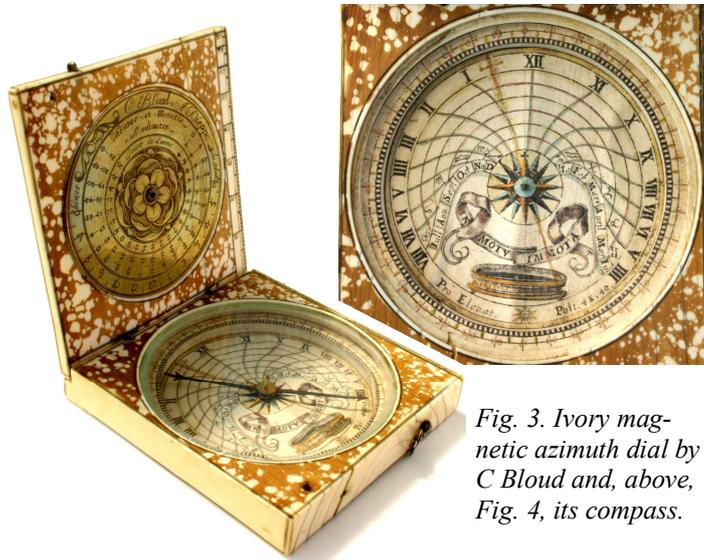
Fig. 3. Ivory magnetic azimuth dial by C Bloud and, above, Fig. 4, its compass.

compass needle crosses the concentric circles of the date lines. On checking the magnetic declination shown on the paper compass card, it suggests a date of about 1650, so perhaps it is the earliest known of Bloud's dials. This was obviously noticed by the bidders and the dial made a healthy €3750, over twice its estimate of €1000 - €1500. The compass card is particularly interesting being hand coloured. It also has a later magnetic declination line, but the original due North line may be seen finely dotted just to the left of the XII line.

Also in the sale was a fine silver universal equinoctial ring dial by Pierre Sevin, 8.6 cm diameter. Bidding was also fierce for this dial and it sold for €20,625, again more than twice its estimate of €7,000 - €10,000.

Fig. 5. Silver ring dial by Pierre Sevin.

Fig. 6. Diptych dial with ebony case. Maker unknown.

Figs. 8 & 9. Gunter quadrant by John Checkley, 1691.
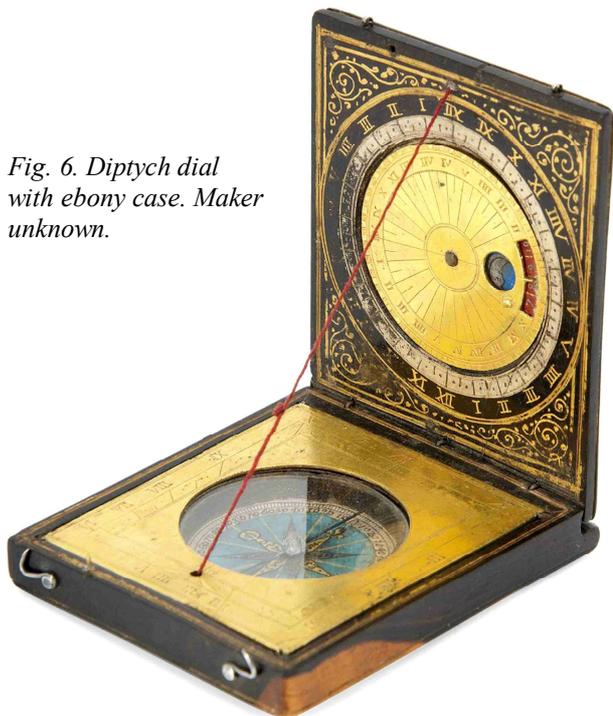
Christies, South Kensington, 29 September 2011

In this sale were also two unusual dials. The first was a diptych dial of the type usually made from ivory. However, this one used a dark ebony type of wood. Of particular interest is the maker of this dial which is unsigned. Over the years I have seen about ten dials from this workshop, which was probably in Paris. All have been unsigned, but two have had the initials RF stamped on their undersides. There is only one dial of this type that I know that is signed. It is by Pierre Dujardin of Paris and is in the collection at Château d'Ecouen, north of Paris. However, the Dujardin dial is considerably more complex, so the present dial (and the others that I have seen) is probably from a follower of his. It sold for £10,625.

The other dial of interest was a particularly small equatorial dial in silver signed '*Fait par Nourry ALion*'. French equatorial dials are quite rare and to find this one so small, just 2" long, and of a fairly early date, c.1675, helped it to make a healthy £5,250, about twice its mid-estimate.

Charles Miller, 26 October 2011

Sales by this relatively new auction house are beginning to attract the public's attention. Here two interesting dials were sold. The first was a Gunter quadrant of a fairly standard pattern on its front but with the addition of a table of planetary rulers on its right side. However, its reverse was much more interesting, having perpetual calendar information with Easter dates from 1691 to 1730. It also had a lunar conversion table. The quadrant is signed Iohn Checkley and is dated 1691. Interestingly it is inscribed "Living in Everdon * Thomas * Burton * 1691* ". The village of

Fig. 7. Small equatorial dial by Jean Nourry of Lyon.
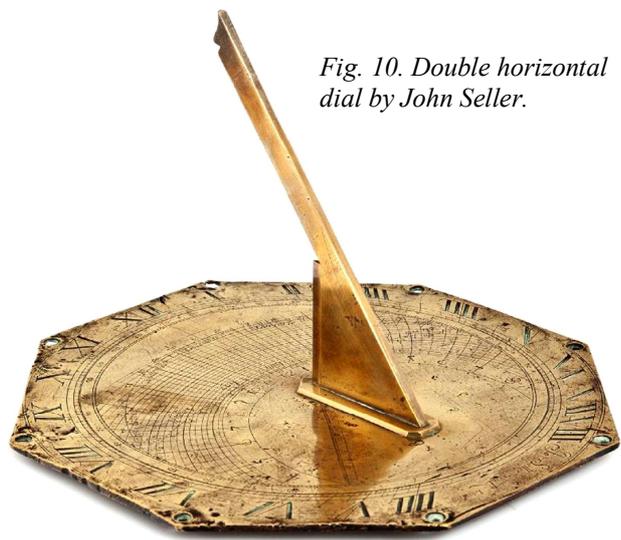
Fig. 10. Double horizontal dial by John Seller.

Everdon is just south of Daventry in Northamptonshire. This attractive quadrant was sold for £4,680.

Also in this sale was a fine double horizontal dial signed *Joⁿ Seller*, but his signature is engraved over traces of the name of Elias Allen. This dial was estimated at £2000 - £3000 but it made a fantastic £9,000. It is the dial that was described in detail by Davis & Daniel at the 2009 BSS Conference.

Christies, South Kensington, 6 December 2011

An interesting 10" diameter horizontal dial with a low angle gnomon was offered by Christies. It is inscribed "W Watkins, Bristol" and "J Coley, Somerset". It was probably made for export to the West Indies on a ship from Bristol. However, on checking its latitude by stretching the picture vertically it has been found that the dial plate is delineated for about 51° 30'. The gnomon looked to be original. It is therefore possible that Watkins was not an accomplished dial maker and did not realise that the hour lines as well as the gnomon angles need to change with latitude. Perhaps it was because of these problems that this dial failed to sell.

Fig. 11. (above) Dial by for low latitudes and (left) the photograph stretched in the vertical direction to facilitate measurement of its hour line angles.

Bonhams, New Bond Street, 13 December 2011

(Fine Clocks, Barometers and Scientific Instruments)
In this sale were two further quadrants. The first was by *John Ismay*, a clockmaker known to have been working at Oulton near Wigan around 1700. The front of his quadrant has a fairly standard Gunter projection, although it was made for a latitude of 54° 48', being on a line between Carlisle and Sunderland. It is its reverse that is particularly interesting as it has dialling scales. On the lower part of the
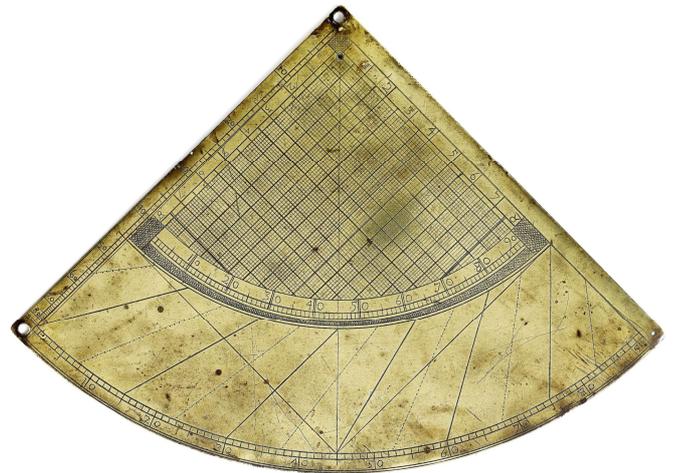
Figs. 12 & 13. Quadrant by John Ismay for latitude 54° 48'.

quadrant is a projection of diagonal lines. This is a projection that is detailed in the book by Thomas Stirrup, *Horometria or the Compleat Diallist* of 1652.

Above this is what looks like graph paper, set within a smaller sinecal quadrant. This is a simple way of allowing the user to solve right angled triangles without having to resort to trigonometrical tables. It is a matrix of eight large squares, each sub-divided into ten smaller ones, as they would have worked in fractions rather than decimals as we do now. Islamic quadrants have similar scales, but with twelve squares each sub-divided into five smaller ones. This quadrant sold for £4,750.

Fig. 14. Medieval quadrant dated 1396.

Fig. 15. Reverse of the medieval quadrant.

Also in this sale was a very special quadrant dated 1396. It is similar to one in the British Museum that was made for King Richard II in 1399. It is certainly by the same maker.[1] Again, it is its reverse that is more interesting. Here every day of the year is represented and a number between 14 and 62 is placed every few days. This is the altitude of the Sun at noon, so it can be used to set the bead on the 12 noon line on the front side. Without this scale it would be impossible to use this quadrant. The Richard II quadrant, however, does have zodiac settings on the front side. In the apex is a circular scale *Tabula bisexti* of dominical letters for working out the day for the start of each year, and consequently other months too, over a 28 year cycle, with two letters for each leap year. This very rare quadrant failed to sell at the auction, but it had been estimated at £150,000 - £200,000. I understand that it was likely to be sold afterwards for an undisclosed sum.

REFERENCE
1. Catherine Eagleton: 'A King, Two Lords and Three Quadrants', *Early Science and Medicine,* **16.3**, 200-217 (May 2011).

READERS' LETTERS

Dial Transmission
Anthony Turner's letter (Dec 2011) is perceptive. I would like to make the following observations.

1) The answer to the "thorny problem of transmission" has to lie with the church: insular practices or neglects did develop, but reforms from the centre (i.e. Rome) eventually came.

2) In my comments on the water clock I was thinking of the primitive 'clay pot' water clock – not the elaborate machines which came later – as equating more readily with the 'primitive' scratch dial; as I believed that this was what Chris Williams was thinking of. We are both aware of the elaborate devices described by Vitruvius.

3) On the Hever Castle spherical dial, I have heard of this and seen a reproduction. I formed the view, rightly or wrongly, that this was more likely to be an artifact made for some 16th century princeling than a survivor from antiquity.

Has anyone investigated the use of the scratch dial within Islam? I have recently acquired a copy of a photo of a scratch dial on the main minaret of the Umayyad mosque in Damascus, Syria. This is a full circle dial with 8 grand divisions, each having 3 smaller divisions between them to give 24 hours. The hours lie, not on the lines but between them. Sunrise, midmorning, noon, midafternoon and sunset all lying between the two short lines dividing the divisions into 3. The appearance is very like a cross pattée within a circle.

I am reminded of an idiosyncratic scratch dial, of Anglo-Norman date, above the doorway of the church of Tidming-ton (near Shipston) which takes exactly this form. With noon lying on the centre of the lower arm of the cross, and the hours of tierce and nones between its intercices. The 'gnomon hole' is too slender and too deep to be convincing as a mere ornamental feature.

Peter Drinkwater, Shipston-on-Stour

Early Dials
In response to John Ingram's request for the oldest sundial still in position, I would like to offer SRN 4778 at St Mary's Church in Great Washbourne in Gloucestershire. It is a direct East dial and low down, following the mass dial tradition. Any dial later than 1550 would have been sited higher up. It may have been carved as a simpler alternative to a direct south dial. The church itself is Early Norman but the East end was rebuilt in 1642. I imagine the dial survived as part of the window.

It now appears, following the article by John Davis on Robert Stikford's 'De Umbris' in the preceding *Bulletin*, that there may have been three lines of progress towards a 'scientific' sundial:

1) The equatorial, following the recent discovery of such a dial in the ruins of a priory at Bristol and tentatively dated mid-15th century.

2) The delineation of declination lines using the shadow from a point nodus. The article mentioned above describes a manuscript work 'De Umbris' of c.1400 in which a full description of the construction is given.

THE SCAPHE SUNDIAL AT HEVER CASTLE, KENT

DAVID BROWN

This sundial continues to be enigmatical. I offer this account of my involvement with it, with some observations, and have included measurements that might be of use to BSS members and others who may thereby be able to shed more light on it. The questions still remain – is it a genuine Graeco-Roman sundial, and the only known one to show equal hours, or is it a failed attempt of a much more recent age to produce a sundial that looks like an ancient one?

Historical Background

Hever Castle, near Edenbridge in Kent, dates back to 1270 when the massive Gatehouse, the outer walls and the moat were first constructed.[1] Two hundred years later, the Boleyn family added a comfortable Tudor dwelling-house inside the walls. Hever Castle was the childhood home of Anne Boleyn, second wife of Henry VIII and mother of Queen Elizabeth I. In 1903 William Waldorf Astor acquired the estate and invested time, money and imagination in restoring the Castle, building the 'Tudor Village' and creating the gardens and lake. He had been USA's Minister to Italy from 1882 to 1885 and while in Rome developed a life-long passion for art and sculpture.[2] He

Fig. 1. Noel Ta'Bois examining the dial in the1980s.

emigrated to Britain in 1892[3] and was created 1st Viscount Astor in 1917. He brought sculptures and statuary dating from Roman to Renaissance times to Hever. He was succeeded by his son, John Jacob Astor V who became 1st Baron of Hever in 1956.

It is not known exactly when the several sundials[4] in the Gardens at Hever were first taken there, or where they had originated. John Jacob Astor's son Gavin, later 2nd Baron, speculated in 1969 that the scaphe dial, often referred to as the 'Roman' sundial, together with many of the other pieces in the Rose Garden were brought to Hever in 1920 or 1922 when his grandfather's villa in Sorrento was sold.[5]

In March 1969, Hon Gavin Astor read an article in *Country Life* in which it had been recorded that the polyhedral sundial[6] had been restored by Dr Frank Ward of the Science Museum, South Kensington, London. Hon Gavin wondered if Dr Ward would consider visiting Hever and giving his advice on the polyhedral dial there (No. 37). The visit was duly made, followed by several others over the following months, during which period Ward became particularly fascinated, as others were, with the scaphe dial (Fig.1). Astor arranged for a glass-fibre cast to be made of it and it was subsequently delivered to the Science Museum in January 1970.[7] Ward came to the conclusion by 1979, after he had retired, that the scaphe dial is "… a rare example of a Roman sundial (indicating <u>equal</u> or 'modern' hours, whereas classical Greek and Roman sundials usually show the 'unequal' hours which were in general use during this era…. It appears therefore that Hever no. 38 is not merely unusual but unique and deserves further study, and I should be glad if I may pursue this in collaboration with my successor at the Science Museum, Dr. D. Vaughan".[8] He went on to ask: "Is it possible that this sundial dates, not from the classical period but from the 15th, 16th, or 17th century? I should be glad to know if your records shed any light on this". The answer was that there was no further information.

Ward and Vaughan went on to revisit Hever and together wrote an article in the autumn 1980 edition of the *Journal of Antiquarian Horology*.[9] They described all of the dials at Hever in some detail, and re-iterated their conclusion with regard to the scaphe dial that: "its special feature is that it shows 'equal' hours, the present-day type, whereas all other surviving Greek and Roman sundials, numbering over 250 in all, indicate the 'unequal' hours".

Ward & Vaughan had been able to refer to the then recently published book by Gibbs[10] which contains details of all the

256 stone sundials known to her which are thought to date from Greek and Roman antiquity to the fourth century AD. All show only seasonal (unequal) hours. Only about 85 of the preserved Greek and Roman dials are spherical. Bonnin reports that in his database of 563 dials, nothing else like the Hever scaphe exists.[11]

The Dial at First Hand

My own involvement with the Hever 'Roman' dial came about because I was asked in June 2009 by Graham Aldred (BSS Restoration Advisor) if I would be interested in advising Hever Castle on what restoration work might be done on it, Hever having approached BSS earlier about possible restoration grants. Although I knew of the dial I was not intimately acquainted with it. I made arrangements through the Head Steward, Jane Apps, for a site visit on 4 July – a day when I was also doing some sundial work at nearby Penshurst Place. Hever's Chief Executive, Mr Duncan Leslie, took me to where the dial was stored in an outbuilding amongst other statuary. It had been put there in its deteriorating condition for better protection. I was told that the funerary altar on which the dial had stood, but is in no way related to the dial, was still in its original position in the Rose Garden, but was also in need of restoration.

Having carried the dial between us to a nearby grassy area, I was left to make whatever measurements and photographs I could that would enable me to write a report and make the necessary recommendations. Meanwhile I was able, by correspondence, to enlighten Jane Apps on various aspects of sundials, and in particular on the difference between equal and unequal hour divisions.

Fig. 2. The dial taken from store in 2009.

On first appearance, the dial has a very attractive classical appearance (Fig. 2) – the scaphe, the lions claws, the stepped support, the rosettes in the upper corners all tie in with known, authenticated dials. The weathering of the stone surface and consequent loss of detail, such as in the rosettes and lion's claws, suggest a considerable age for the dial, but without personal knowledge of the way in which
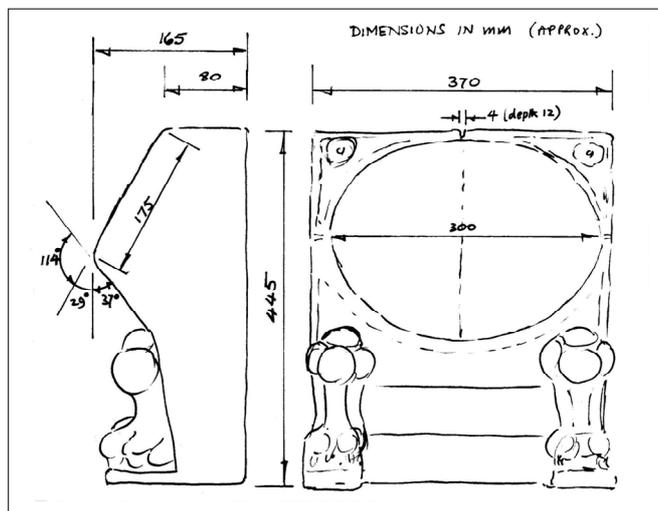
Fig. 3. Dimensions of the dial.

marble ages, I cannot speculate as to the age that this weathering implies. It certainly looks ancient.

The upper sloping surface is different from any other known dial, as reported later by Bonnin (see Ref. 11). The dimensions of the dial are given in Fig. 3. The radius of the dial surface is 153 mm between the cusps, but varies slightly from 160 mm at the upper point on the meridian line and 155 mm at the lowest.

I completed the report in Sept 2009 and sent copies to Graham Aldred and to Hever. Further copies were later sent, on request, to Jérôme Bonnin and Nicola Severino. My principal recommendations were:

(a) The surface should be cleaned[12] by professional restorers, amongst whom are Cliveden Conservation,[13] being particularly aware of there being what seems to be a repaired crack running from top to bottom of the dial, as well as other impact damages.

(b) Consult further with the sundial fraternity as to the supposed uniqueness of this sundial and compare it with the Science Museum glass-fibre casting to see what deterioration has taken place over the last 40 years.

(c) There would be little advantage in trying to attach a gnomon to the dial in order that it could be made to 'work' because the dial was not made for the latitude of Hever. Even if the divisions were for equal hours, as suggested by Ward and Vaughan, the dial would have to be tilted forward some 16° to compensate for the difference in latitude between Hever and its designed latitude. It would be much better to keep the dial as it is, cleaned up, and if it was thought that a working sundial would be appropriate, and also for educational purposes, have another dial made of similar design but made for Hever's latitude. I would be interested in undertaking this work.

I realised during the writing of the report that there were other measurements that I needed to take in order to obtain a full picture of the arrangement of markings on the dial surface. There is no record, as far as I have been able to establish, of the detailed measurements made by Ward and Vaughan, so I arranged a further visit on 25 September

Fig. 4. Testing the sphericity of the surface.
Fig. 5. Testing separation of the seasonal lines.

2009 to do this and to test the sphericity of the dial surface. A sheet plastic semicircular gauge of diameter 30 cm has two protruding arms coincident with a diameter (Fig. 4). The arms form an axis and are rested on the east-west cusps of the dial and the gauge rotated about that axis. It was found that with some small irregularities, the dial surface is indeed close to being spherical, as noted above. A second quadrant was also used to test the positions of the seasonal curves on the meridian line (Fig. 5). This confirmed that the separations of the seasonal curves were consistent with the geometric centre of the dial. This seemed to be the likely position of the absent gnomon/nodus.

Further close inspection of the dial surface showed that there is a cross marked on the winter solstice on the fourth hour line to east and west on each side of the meridian, just visible in Figs. 2 and 11. Ward and Vaughan state that these represent the approximate times of sunrise (8am) and sunset (4pm) at the winter solstice.[14] That is true for a latitude close to 51°, but for a latitude of 37°, the times are nearer to 7am and 5pm respectively.

Separations of the seasonal curves and of the hour lines were measured and these are presented in Fig. 6. In addition, the distances of the seasonal hour curves measured down the meridian from the top of the dial rim are 170, 256

Fig. 6. Measurements of the delineations.
Fig. 7. Markings on the upper surface.

and 299 mm respectively for the points W, E and S shown later in Fig. 9.

There are two further markings on the uppermost horizontal surface of the dial, each of diameter about 7 cm, which may be nothing more than decorative (Fig. 7).

Comments on the Delineations

The seasonal curves should be parallel. They are reasonably so near to the meridian, but definitely not at their extremities (Fig. 6).

The separation of the seasonal curves is consistent with a concave surface of these dimensions. For a radius 155 mm, the distance s between equinoctial and each solsticial line is given by $s/\varepsilon = 2\pi r/360$ from which $s = \pi r \varepsilon/180$. For $r = 154$ mm, $s = 63.2$ mm compared to a measured value of 62 for SE and 63 for WE. The separation of the hour lines on the equinoctial should be $\pi r/12$, giving 40.3 mm compared to an average of 39.1 mm (range from 35 to 47).

The equinoctial curve should coincide with the 6am and 6pm hour lines in a horizontal line through the nodus. The nodus is not present and if it were, it would have to be well displaced from the geometric centre of the dial to satisfy this requirement. The 6am hour line is not well marked, and the 6pm line cannot be seen.

If the dial had been delineated for unequal hours, the hour lines for 6 am and 6pm would be horizontal. From what little can be seen of them, they are not.

The hour lines marked between the seasonal curves have been extended towards the northern rim of the dial (Figs. 2 & 11). The shadow of the time-indicating nodus (wherever it may be) would never fall outside these curves, so the hour line extensions are meaningless. However, it is postulated later that there might be some use for these lines – if they had been correctly marked.

There is no evidence for there ever having been a gnomon on the dial, although there is a slot in the uppermost surface which suggests that the maker had intended to use it for holding the gnomon.

The usual form of Graeco-Roman scaphe sundial shows the lower face of the block structure below the scaphe as being parallel to the equinoctial plane (Fig. 8). Gibbs discusses this in more detail and shows how it provides a means of determining the latitude for which an ancient dial has been made. This is how Ward and Vaughan could have determined the supposed latitude of the Hever scaphe, because the lower face is inclined at 37° to the vertical. If we apply Gibbs' reasoning, then the position of the nodus for the Hever dial cannot be at the geometric centre of the recessed surface. Ward and Vaughan place it at P (Fig. 9), but this has the consequence that the meridian distances ES and EW become unequal (EW < ES) whereas measurement on the dial shows that they are very nearly equal (Fig. 6).

If the nodus was intended to be at the geometric centre of the scaphe, in line with the majority of these ancient dials,[15] then various dilemmas arise:

(i) It would mean that the equinoctial would make an angle of 37 + 23.4 to the vertical, taking the dial to 60.4° N – a most unlikely outcome – although it would also mean that the upper sloping face of the dial would be parallel with the polar axis; a rod slotted into the groove on the top of the dial and bent down so as to give a nodus at the geometrical centre of the dial would in effect form a polar gnomon. Could the hour lines be compatible with such a gnomon?

(ii) On a correctly delineated scaphe dial, the 6am and 6pm hour points on the equinoctial and the nodus should all form a straight horizontal line. This is true whether the delineations are for equal or for unequal hours.[16] On the Hever dial, the 6am and 6pm points on the equinoctial are well displaced horizontally and vertically from the line joining the two cusps so the nodus could not have been at the centre of the dial surface.

From the end elevation of the dial (Fig. 3) the angle between the upper and lower sloping faces is 114°. Could

there be some significance in this? The upper face could be at any angle, after all. Could a gnomon, bent down to be parallel with the upper sloping face to carry a nodus at its lower end also act as a polar gnomon to cast a long shadow on the dial surface, and give a reason for having the extended hour lines? To be useful, the position of the nodus would have to be such as to form a horizontal line with the 6am and 6pm points of intersection with the equinoctial curve.

It is unlikely that this is what was intended, because that would require the dial to have been made for a latitude of around 61° (Fig. 10). Furthermore, a nodus at Q would place points W and E at very different positions from those on the dial. The extended hour lines would need to be great circles of the dial surface, and look like lines of longitude on a globe. Fig. 11 shows that they do not. So a polar gnomon is ruled out.

Conclusions

Gibbs reports that the evidence is that Greek and Roman diallists preferred conical to spherical dial surfaces,[17] always marked the twelve seasonal hours of daylight between sunrise and sunset, used the shadow of the tip of the gnomon, not its edge, and fixed the gnomon, shaped like an elongated pyramid, in a lead-filled hole on the dial face somewhere along the meridian line.

Bonnin says: "The lion's feet are of roman style, no doubt. The two rosettes are also Roman, but the base is unique, for it is a mix between what I call a 'scaled type base' and a 'lion's feet base'. This is the only dial of that sort."[18] He goes on to explain that the way in which the upper part of the dial is cut is unique and doesn't fit with a roman spherical sundial where the upper part is horizontal, not sloping. He goes on to explain that judging by the cut recess, the gnomon would have been flat, in iron or bronze, not a prismatic one, which would have been expected on a Roman dial. In addition, a sloping gnomon would be unknown for antique dials.
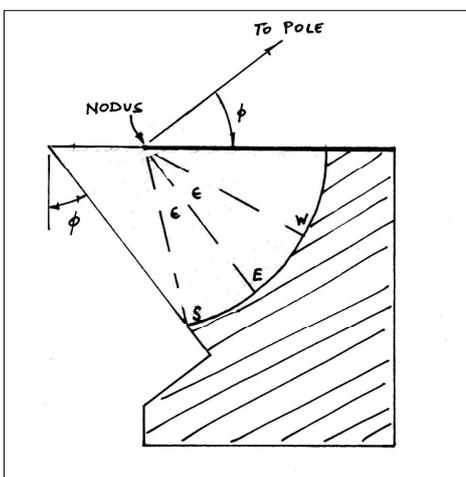

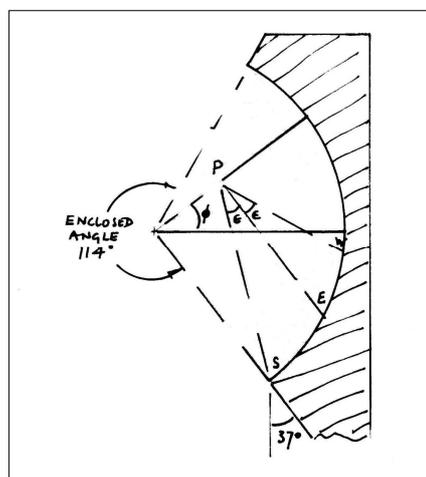*Fig. 8. Diagrammatic analysis of scaphe dials (after Gibbs[10]).*
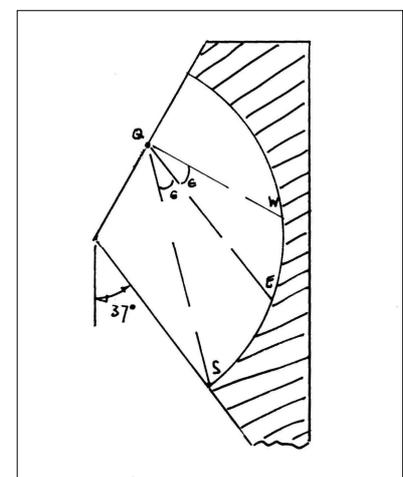
Fig. 9. Ward's position for the nodus.

Fig. 10. Nodus on the polar axis.

Fig. 11. Markings on the western side.

Severino notices the similarity of the lion's claw feet to several shown in Gibbs and to dials he has seen in Pompeii, Ercolano and Rome.

Gibbs describes how it is possible to work out the designed latitude for a dial from the lines on it.[19] Ward and Vaughan provide a simplified version,[20] reproduced in Fig. 9. The conclusion by Ward in 1970[21] had been that the dial was designed for "a latitude of 35°, which corresponds to Tunisia. It could have been used to the north without serious error in Sicily or in the area of Alexandria to the south". Ward and Vaughan state more emphatically in 1980 that it was made for a latitude of 37°, that of Sicily.[22] Ward conjectured that the dial might date not from the classical period but from the 15th, 16th or 17th centuries. "I have never seen an illustration of a Roman sundial of this type from the late medieval or renaissance periods."[23] This is echoed by Bonnin: "if it were an 18th century creation, it maybe would not be the first time we face a 'false sundial' ". Gibbs states that "It is difficult to determine the exact date of origin for most examples of Greek and Roman dials. Few were found in their original location… Most lack datable inscriptions or ornamentation."[24] The Hever scaphe is no exception.

Sadly, I come down on the side of the Hever dial being an unworkable dial, in spite of its visual appeal. Whether it is Roman or from some much later period is still open to question. It is my intention to make a dial of this kind, with all the classical 'trimmings' to produce a dial that would work. Watch this space!

Tailpiece

The dial and funerary urn base were restored by Cliveden Conservation and now stand back in their original place in the Rose Garden at Hever Castle (Fig. 12).

ACKNOWLEDGEMENTS

I am grateful to many people who have been generous with their time and expertise during the course of my work on this sundial, *viz.* (*inter al.*): Jane Apps, Head Steward, Hever Castle; Tony Wood, BSS; Jérôme Bonnin, Lille; Nicola Severino, Roccasecca, Italy.

Fig. 12. The restored dial in 2011.

REFERENCES & NOTES

1. I am obliged to Hever Castle's publicity flyer and web site for this concise summary. TN8 7NG. Map ref: TQ 478452 Lat: 51.18691° N; Long: 0.11351° E.
2. From Wickipedia.
3. Cambridge Biographical Encyclopedia 1998.
4. Some of these are recorded in the BSS Register as SRNs 2906 (Mult. facet head, stone), 1961 (scaphe, marble), 2178 (equatorial, metal). These are recorded in Hever's (1969) Catalogue of Statuary and Sculpture as numbers 38, 37 & 25 respectively. There are in fact other sundials at Hever – an octagonal horizontal dial (32) in the rose garden near to numbers 37 and 38, and a scratch dial on the right-hand side of the moat bridge entrance to the Castle. There are further references in the correspondence of Ref. 5 below to a further dial, possibly a cross dial, now lost. A small version of the well-known 'bow-string' dial (28), a copy of which is now outside the Adler Planetarium, Chicago, by Henry Moore used to be in the Castle courtyard, but is assumed to have been sold off in the early 1980s. There is no reference in Eden & Lloyd 'Book of Sun-dials' (Mrs Gatty) of course, whose publication pre-dates the likely arrival date of these sundials to Hever.
5. Correspondence between Hon Gavin Astor and Dr F.A.B Ward – held by The Science Museum (Nominal File 4119) and by Hever Castle Archives.
6. There are in fact two polyhedrals at Penshurst (SRNO 0669 and 0628). The originals have been removed recently for safe-keeping and replaced with identical cast stone versions of one of them.
7. I understand from Rory Cook of The Documentation Centre, Science Museum, London SW7 2DD, that the dial (Inventory number 1970-101) is now stored in the Museum's Small to Medium Object Store, Blythe House, 23 Blythe Road, West Kensington, London. Contact: *graham.wheeldon@nmsi.ac.uk*
8. See Ref. 5.
9. F.A.B. Ward & D. Vaughan: 'Sundials at Hever Castle', *J. Antiq. Horol.,* 12/3, 307-12 (1980).
10. Sharon L Gibbs: *Greek and Roman Sundials*, Yale University Press, New Haven & London (1976).

11. Jérôme Bonnin; private correspondence dated 1 Aug 2011.
12. It was related to me by Mr Leslie that Lord Astor had in the past enlisted the help of local WI ladies to clean the garden statuary from time to time with caustic soda to maintain its pristine whiteness!
13. Cliveden Conservation, by appointment sculpture conservators to the National Trust, The Tennis Courts, Cliveden Estate, Taplow, Nr. Maidenhead, Berks, SL6 0JA.
14. See Ref. 9 p.308.
15. See Ref. 10 and Nicola Severino's CD *De Monumentis Gnomonicis apud Graecos et Romanos* (2005) from *www.nicolaseverino.it*
16. P. Drinkwater: *Oronce Finé's First Book of Solar Horology*, Shipston-on-Stour, p.22 (1990).
17. See Ref. 10, p.4
18. See Ref. 11.
19. See Ref. 10, p.12 *et seq*.
20. See Ref. 9 p.309.
21. See Ref. 5, 28 Jan.
22. See Ref. 9, p.307
23. See Ref. 5, May 1979.
24. See Ref. 10 p.5.

David Brown, formerly a physics teacher, has been making sundials for about 20 years. He specialises in particular in multi-faceted polyhedral sundials depicting the recipient's interests and family events. Recently he has been responsible for the design and supply of a 6-metre diameter 'silver' stainless steel analemmatic sundial in the Olympic Park, London. He juggles the joys of hands-on days in the workshop with his responsibilities as Master of the Somerset Guild of Craftsmen and occasionally finds time to enjoy the company of family and friends and do a spot of gardening. He can be contacted at *david@davidbrownsundials.com*

READERS' LETTERS

3) Possibly the last to appear – the shadow cast by a sloping gnomon onto an array of radial lines in either the horizontal or vertical plane.

For various reasons it seems that the third option has been the most widely adopted. Mass dials themselves seem to have been bypassed and only one or two 'transitional' dials show any influence from the scientific endeavour and progress.

Tony Wood, Gloucs.

Suburban Reflections

This picture below was taken from my front garden at about 11am in early December. Ignoring for the moment the strange diagonal reflections, it can be seen that here we have a potential, if rather hit-and-miss reflecting sundial.

A black spot painted on the middle of one of the lower windows could act as a nodus, though around the time of the photo it would be briefly eclipsed by the passing of that chimney shadow. Even worse, at slightly lower sun altitudes the whole window area will be in the shade. When the sun is higher in the sky, the roof shadow not only clears the windows, which is good, but it retreats southwards across the road, making it impossible to discern reflections cast onto a bright sunlit surface. These problems could be quite small compared with that of obtaining authority to paint hour lines that extend onto a public pavement and road. Maybe I won't get out my paint brush just yet.

As for the weird crosses, I guess they are due to multiple refractions and reflections in the double glazing. It seems that the light is being concentrated into preferred directions. Strangely, in the photo the left hand cross is in the process of disappearing, whilst the other two persisted. I would be most grateful if one of our readers could throw some light on all of this.

John Moir, London.

Canterbury Pendant

This modern replica of the Canterbury pendant, in silver and gilt with inset emeralds, is one of a limited edition of 750 pieces made by Ransom Gallery Ltd in the 1970s. It is quite a reasonable representation of the original which has agate stones.

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