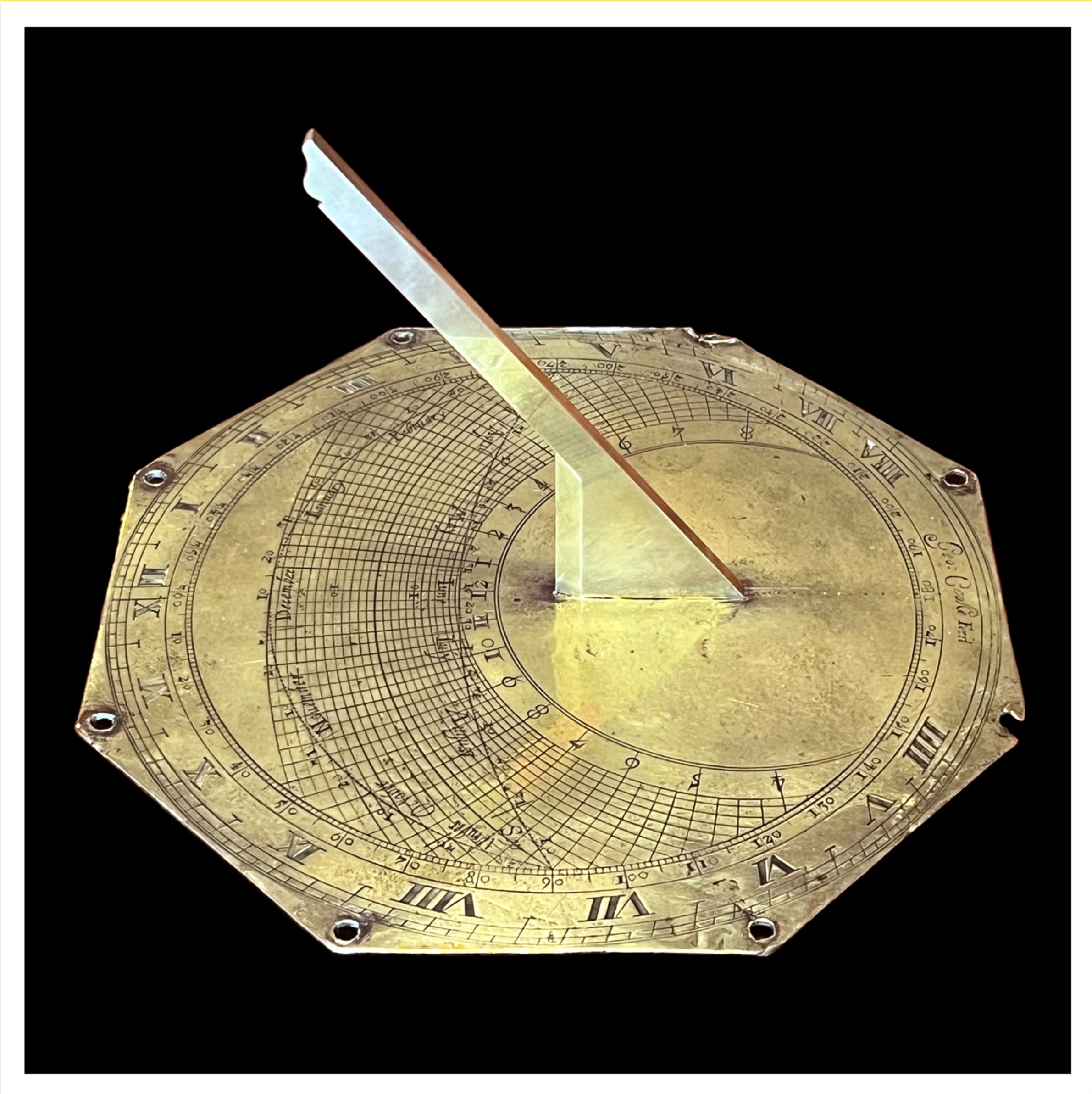
The British Sundial Society
BULLETIN



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CONTENTS

EDITORIAL

The lead article of this issue of the *Bulletin* describes an important new find, an intriguing double horizontal sundial by an apprentice of Elias Allen.

A curiously mounted equatorial dial is described by Sue Manston, and John Davis writes about an interesting 19th-century dial.

There is a most welcome return to our pages by Dennis Cowan. If you enjoyed his Thomas Ross series, you will enjoy this new article.

Still in Scotland, Sue Manston describes a brand-new dial that overlooks Loch Lomond.

Mario Arnaldi provides a comprehensive summary of ancient ways of reckoning time, and Ben Jones tells us about some fascinating scratchings on church walls.

We wish our readers a very Happy Christmas and hope for fruitful dialling in 2024. Please keep sending us your articles.

Frank King

ERRATA

On page 22 of the article 'The L'Abée-Lund Sundial Compass' by Roar Hagen-Diez (*BSS Bulletin* 35(iii), September 2023), there is a typographical error in the fourth sentence of the right-hand column. This should have read:

> "By contrast, the entries for March are not consistent: −30, −25, −10, 0, 5, 20, 25."

In addition, in Table 4 on the same page, each of the entries for July, August and December contains an error. The correct values are:

JUL 30, 25, 10, 0, −10, −25, −30

AUG 10, 5, 0, 0, −5, −10, −10

DEC −25, 0, 20

We apologise to the author and to readers for these mistakes.

A DOUBLE HORIZONTAL SUNDIAL BY GEORGE COOKE

MACIEJ LOSE

The concept of the double horizontal sundial, that is, an instrument integrating horizontal and stereographic sundials, was developed by English mathematician William Oughtred (1574–1660). Oughtred closely cooperated with the instrument maker Elias Allen (c.1588–1653), who made the first sundials of this type based on Oughtred's instructions in the early 1630s. Elias Allen was a very prolific instrument maker – aside from other mathematical instruments, so far some seventeen double horizontal sundials bearing his signature have been recorded.[1] It was largely his apprentices and their successors who spread the constructional knowledge of this sophisticated gnomonic instrument into its heyday during the 17th century and beyond.

Fig. 1. Plan view of the double horizontal sundial by George Cooke. Note the incorrect replacement gnomon. Photo: John Davis.

In contrast to Allen's list of dials, only a few instruments signed by his direct apprentices have been recorded so far. This small group comprises just five sundials – two by John Allen (who was possibly Elias's nephew), another two by Ralph Greatorex and one tentatively attributed to John Prujean.[2] In addition, two horizontal quadrants and one horizontal instrument – stereographic instruments akin to double horizontal sundials – may be added to the list.[3] Thus the collection of stereographic instruments attributed to the generation of makers following Elias Allen in his tree of knowledge is surprisingly limited, suggesting that our knowledge of the instruments and makers of the period may be incomplete.

The Sundial

Recently, in a local auction sale, a double horizontal dial surfaced, signed by George Cooke, which supplements this picture (Fig. 1).[4] The sundial was offered by Hansons Auctioneers of Etwall, which is 10 km to the south of Derby, at their 12–14 January 2023 *Four Day Antiques & Collectors Auction* as Lot 491. The very short catalogue description of the dial included information on the signature (expanded) "*George Cooke Fecit*" and size, and dated the dial to the 19th century. An oblique photograph of the dial was provided; this was of rather poor quality, but it was possible to see a stereographic projection that was not mentioned in the description. This, along with the overall structure of the dial's furniture and stylistic similarities, pointed rather that it comes from mid-17th century Elias Allen's workshop. With little interest from competing bidders, the dial was purchased for just slightly over two hundred pounds.

The dial is a regular octagon, 20.5 cm across the flats (nominal 8 inches), a size which places it in the mid-range of instruments by Allen. The plate is a thin sheet of brass, of an uneven thickness, tapering towards the southern direction (near the signature) and measuring from 1.6 to 0.8 mm. There are holes in the corners of the plate, with patina marks left on the brass at places where it had been originally attached to the pedestal with screws or studs. At two of the holes, the plate is torn, suggesting both that the screws were hard to remove, possibly due to corrosion, and that the dial had been removed from the stone base by force. As a result, the dial plate was warped and deformed – mostly at the edges, but it also bulged sideways in the area at the foot of the gnomon, which suggests that the

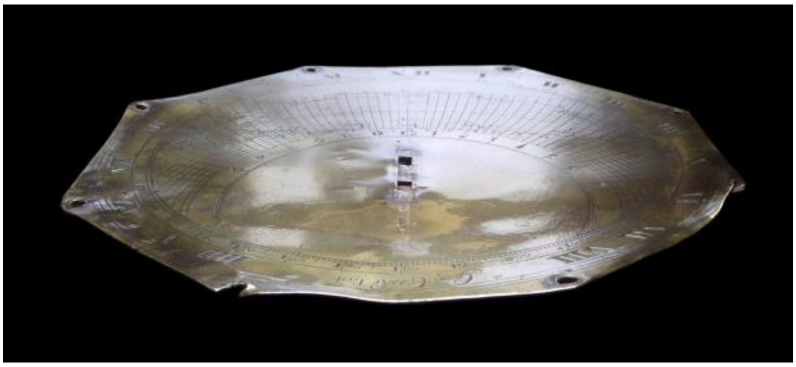

Fig. 2. Oblique view of the sundial plate – after a prior restoration – from the south side, with replacement gnomon removed and lightly cleaned surface, exposing its deformations and damaged areas.

original gnomon had been used as a lever to remove the dial from the base (Fig. 2).

The replacement gnomon (Fig. 3), which came with the dial, was loosely attached to it using the two original rectangular cuts in the dial plate. It was attached by soldering from the underside of the dial, though the solder-joints had fractured. Its angle was 45º, which does not correspond to the design latitude of the dial, and its 'toe' was set on the dial far from the 6 am – 6 pm hour line. X-ray fluorescence (XRF – see below) suggests that it was made of a modern brass, possibly slightly pre-dating 1900. Though far from correct in any aspect, it is possible that the dial survived thanks to it. As part of the dial's initial examination and cleaning, it was removed. The bottom of

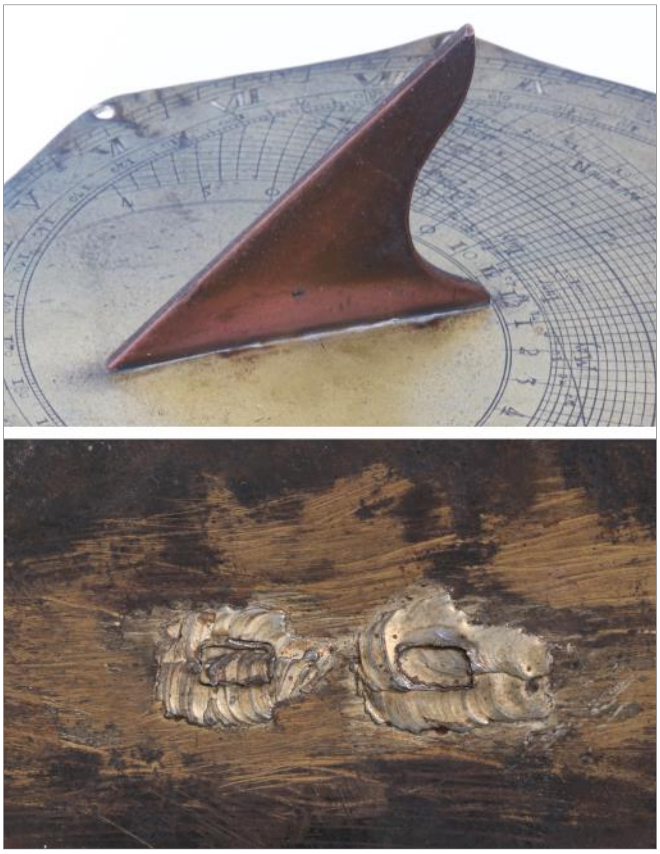

Fig. 3. Faulty replacement gnomon and its attachment to the dial plate with solder. The gnomon angle of 45º does not match the latitude of the sundial, its origin is offset from the 6 am – 6 pm hour line and it has no provision for the vertical gnomon serving the stereographic grid. Photo: John Davis.

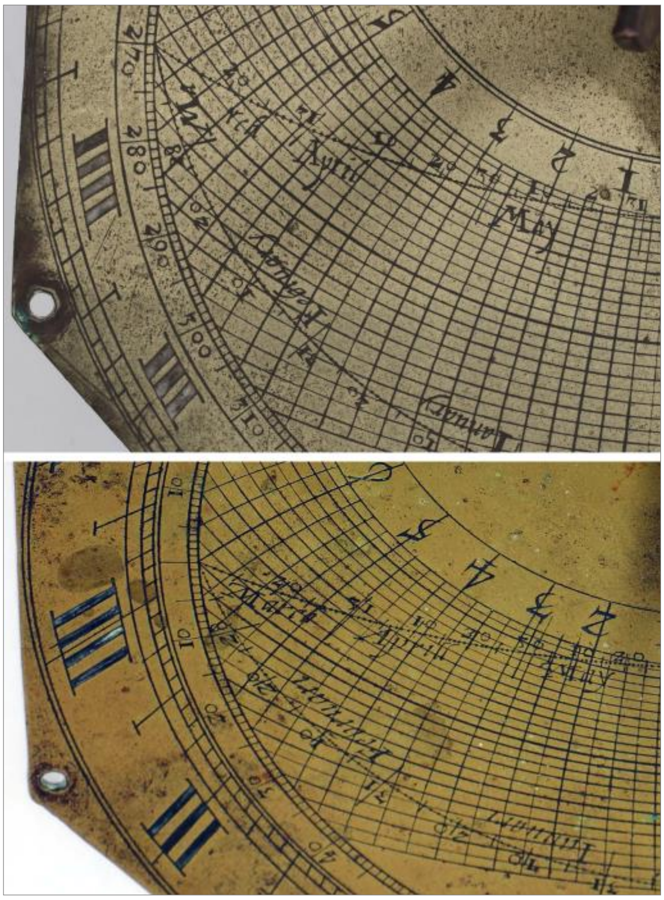

Fig. 4. Detail of the stereographic grid and of the perimeter time chapter ring on George Cooke's and on Elias Allen's DH-80 sundials. Note the form of the Roman numerals used for main hours descriptors – a clear deviation from Allen's style, and the lower-case letter 'p' in "April" along the ecliptic arc, strictly following the form used by Cooke's master. Photos: John Davis and Sworders Fine Art Auctioneers.

the dial plate has hammering marks – typical for the brass processing of the period.

On the upper side, the brass and original black infill of the engraving are preserved in good condition, considering the age of the instrument. The dial at some point must have been cleaned, possibly at the time of installation of the replacement gnomon. After removal of the gnomon it was again lightly cleaned to remove dirt and patina which had collected under the overly elongated gnomon foot.

The structure of the dial (Figs 1 and 4) has a perimeter minute chapter ring, followed towards the middle of the

Fig. 5. Elias Allen's Sun-and-moon dial from the London Science Museum (Inv. T1921-613; DH-3). Image used under Creative Commons Attribution Non-Commercial Share Alike 4.0 License.

dial by the main hour numerals and an azimuth scale ring. The stereographic grid in the centre follows the configuration of Allen's dial in the London Science Museum (coded DH-3 in the BSS monograph; Fig. 5). The labelling of the azimuth ring has the sequence (0)-90º-180º-270º-360º, starting from the north side, which is unique for double horizontal sundials and a clear deviation from Allen's workshop style.

The dial does not have an altitude ruler engraved – a feature also absent on early double horizontals from ca. 1630, but on all later dials it is standard. The style of Arabic numerals and the form of lowercase letter 'p', looking more like 'y' with descender to the left (see "April" on the stereographic grid) is similar to the form on Allen's dials. On the north side of the main hour chapter ring is a signature: *Geo: Cooke Fecit,* with the letters 'G' and 'k' having decorative serifs (Fig. 6).

An evident difference from Elias Allen's engraving style is the form of the Roman numerals for the hours (Figs 1 and 4). The numerals have a more modern-looking form, with lower height, broader strokes and with serifs within a single numeral merged in a way that gives it a very specific, possibly unique, look. Also, the interiors of the broad numerals' strokes are very uniformly engraved. The limited surface corrosion on the surface of the dial suggests this is due to the maker's actions rather than the result of weathering of the depressions.

Fig. 6. George Cooke's signature detail. Note the decorative left descender to the letter 'k', similar to the ones used for the lowercase letter 'p' in "April" on the stereographic grid.

The Maker

Joyce Brown lists "*George Cooke, son of Phil.(?)*" as having been apprenticed to Elias Allen in the Grocers' Company of London on "*(?)5th August 1635*".[5] In the available sources, there is no further information on the maker: also, no other instruments are known beside the sundial described here.

Considering the large number of extant double horizontal sundials by Elias Allen, it may well be assumed that it was his favourite dialling typology. It was also ideally suited as a potential 'master-piece' for his apprentices, owing to the geometric construction complexity and engraving skills required. It has been suggested by John Davis that the presence of the signature, together with the lack of other instruments known to have been made by Cooke, supports the thesis that this sundial was indeed a master-piece, a proof of acquired skills terminating the period of apprenticeship. On the other hand, Gloria Clifton points out that freedom in London Companies could be obtained by patrimony, which did not require any proof from the apprentice, and was a common practice.[6] As this aspect in the case of George Cooke is left unsettled, it is very likely that the instrument comes from his early years as a practising instrument maker. While the typical apprenticeship period in London guilds was seven years, for Allen's apprentices it took ten years or more to get their freedom.[7] Assuming that this was also the case for George Cooke and that the dial was made as his master-piece or early in his career, it can be quite firmly dated ca. 1645–47, which is also consistent with the style of the dial.

As this is the only instrument known to be by George Cooke, it has also been suggested[6] that he might possibly have died early from disease. The proposed dating of the dial actually corresponds very well with the plague outbreak in London in the years 1644–47, with a peak in 1647, which was the largest outbreak before the Great Plague of 1665–66.[8]

Hour Angle Analysis

The chapter ring of the polar dial, located around the perimeter, is divided into 7.5-minute intervals. In order to establish the design latitude of the sundial as well as to analyse the precision of the delineation, the angles between the noon line and the hour lines were measured at 30-minute intervals. The results of the measurements are shown in Fig. 7 where the difference between the measured angle and the theoretical one for an assumed latitude is designated the 'error angle'. The best fit (smallest errors) with average error of 0.1º and a standard deviation of 0.09º is for a latitude 52.7º N. The largest contribution to the error comes from the angles between the hours 4 am and 6 am. Neglecting this section of the graph gives the best fit

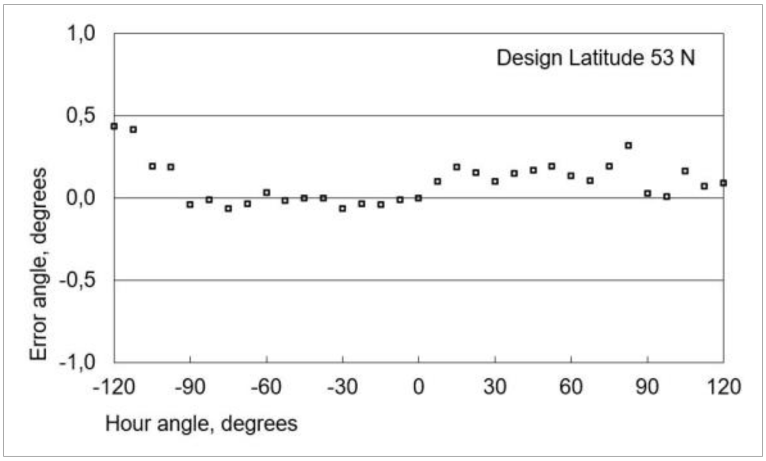

Fig. 7. The sundial delineation's average hour angle error for the latitude 53.0º N is 0.1º with a standard deviation of 0.13º. The best fit latitude is 52.7º N, with similar average error and standard deviation of 0.09º. Note the largest error for the hour lines between 4 am and 6 am (angles: −120º to −90º) and almost ideal fit for the 6 am to noon section of the dial.

for the latitude of 53.0º N with an average angle error of ca. 0.07º ± 0.1º, and with the hour-line angles between 6 am and noon almost perfectly laid out.

In making the measurements it was noted that the distance between the two starting points of the hour lines at the gnomon 'toe' differed from the width of the noon gap by some 0.3 mm (4.5 vs. 4.2 mm); also, the two points were slightly off the 6 am – 6 pm line.

The hour angle analysis also provided some insight into the sundial's delineation procedure. While the sections of the hour and half-hour lines between the narrow 7.5-minute chapter ring fit well with the geometrical lines originating from the centres of the delineation (marked with two holes at the gnomon toe), the T-shaped half-hour markers are drawn largely arbitrarily, which can be seen in Fig. 8. These clearly were engraved later.

Stereographic Grid Analysis

The purpose of the stereographic grid analysis was first to set further limits to the determination of the latitude for which the sundial was designed, and to verify its overall precision. Measurements were taken along the noon N–S line of the distances of the +23.5º, +10º, 0º, −10º and −23.5º declination arcs from the south point on the horizon circle. The horizon circle was chosen, instead of a delineation centre (hole) at the foot of the vertical gnomon, due to the relatively large size of the latter, making such a measurement uncertain. The measurements were cross-checked with the centre marks of the equinox arcs and of the one of the ecliptic arcs mark visible on the south side of the dial plate.

The construction of the measured points' location on the stereographic grid was then reverse engineered to establish the design latitude of the sundial. The geometrical procedure is shown in Fig. 9. It was assumed that the obliquity of the Ecliptic value chosen by the sundial maker was 23.5º, a value that is commonly referred to in contemporary Oughtred's text on this type of sundial.[9] The result obtained from the equinox is 52.95º, from the winter and summer solstice points 52.92º and 53.25º, and from the –10º and +10º declination points 52.74º and 52.76º respectively. The average from these five measurements is 52.92º.

The time scale on the stereographic grid is drawn in 15-minute intervals. Sunrise and sunset times for the summer solstice (SS) are ca. 3:40 am and ca. 8:20 pm, and for winter solstice (WS) ca. 8:20 am and ca. 3:40 pm. These almost ideally correspond with the latitude of 53º, for which the calculated times differ by only one minute (SS: 3:39 am, 8:21 pm, WS: 8:21 am, 3:39 pm).

Considering the combined investigations of the polar sundial and of the stereographic grid, it can be concluded

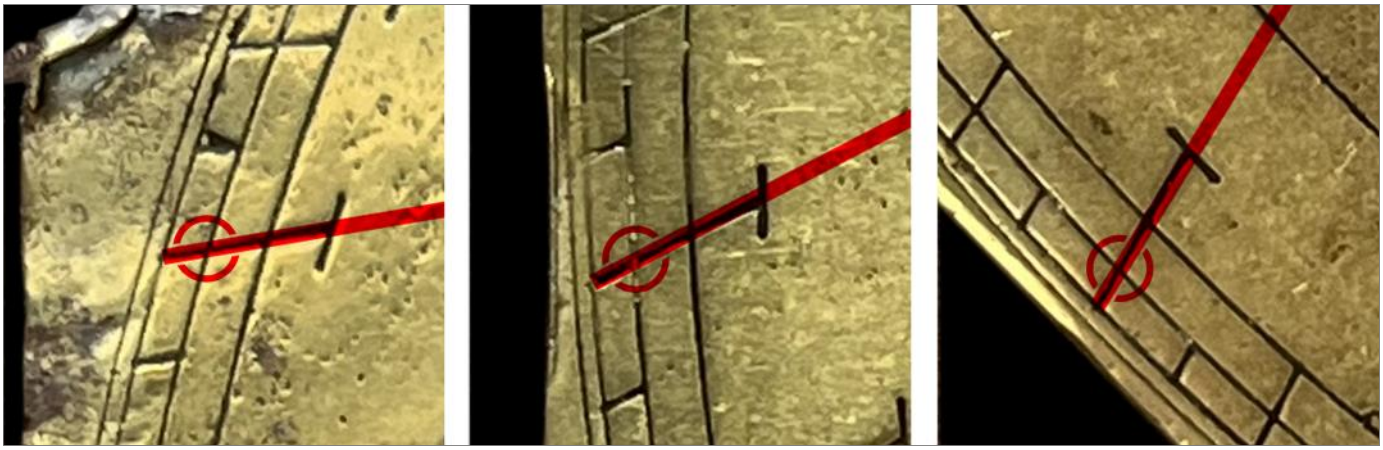

Fig. 8. Examples of half-hour T-markers, shifted from the geometric construction line (red) of the time chapter division. The red circle marks the position at the time chapter, at which hour angle measurements were made.

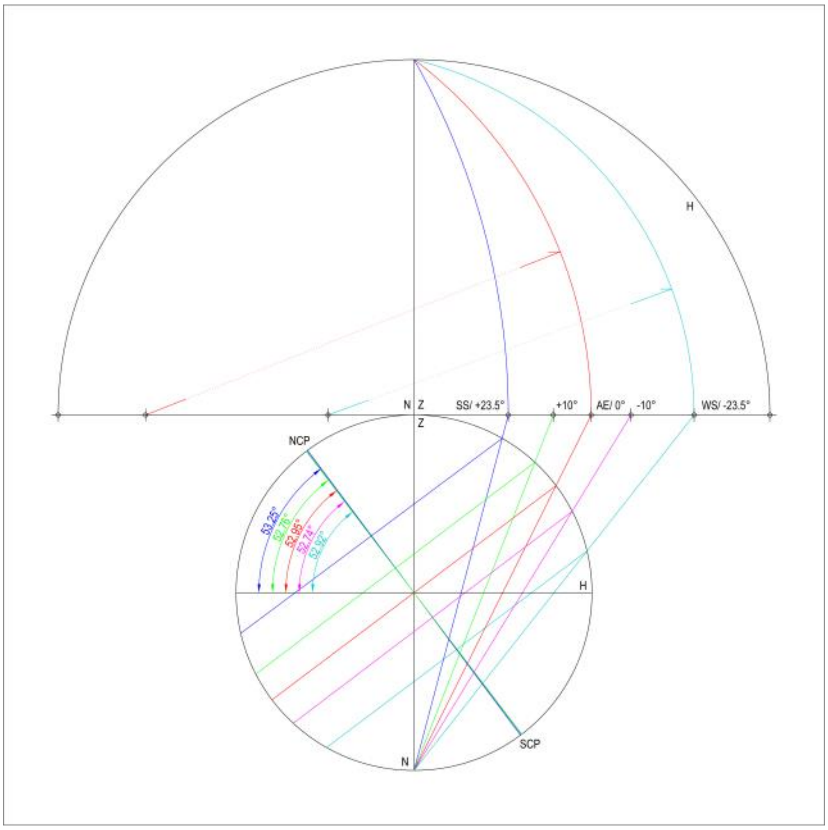

Fig. 9. The principle of the reverse engineering method used to extract the sundial's design latitude value from the measured positions of the declination and ecliptic arcs on the dial plate. The positions measured along the noon line on the grid are transferred onto the meridian circle. Then the Earth axis and given declination circle (represented as a line perpendicular to the Earth's axis) are rotated to match the point projected from the stereographic grid. The axial tilt value of 23.5º, used by Oughtred in his papers, was applied.

that the design latitude chosen by the sundial maker was 53º N. While the original location of the sundial is not known, it is to be noted that the location of the vendor offering the sundial was in Derby, where the latitude is 52° 55′ N, corresponding well with the design latitude of the dial. Thus, with some likelihood it may be inferred that it came from Derbyshire.

It is to be noted that, of the twelve double horizontal sundials by Elias Allen recorded in BSS Monograph No. 5, only one is designed for outside the London area latitude range (51 to 51.5º N).[10] This may imply that Elias Allen exploited his position and hoovered up all the local commissions, forcing George Cooke – a new adept of dialling craft – to search for distant and presumably less profitable ones.

Metallurgy

The metallurgy of the Cooke dial was analysed by John Davis using a Thermo-Scientific XL3t XRF analyser. The key results, obtained with a 45 keV primary beam, are shown in Table 1 (the other measurement conditions, processing methods and calibration were as published in previous publications). The most important finding is in the first row of the table where a spot on the back of the dial plate has been mechanically cleaned to remove all the patina and encrustation, exposing the core material characteristic of the source alloy. It shows a good quality brass for the period made using the cementation technique resulting in a typical zinc (Zn) concentration of around 23%. It is noticeable, though, that this is quite different from the material normally used by Elias Allen where the zinc levels are normally above 30% and approaching the

Area	Cu	Zn	Sn	Pb	Ag	Ni	Fe	As	Sb	Bi	Comments
Dial plate (back)	73.4	22.8	1.53	1.23	tr	0.27	0.29	0.43	0.02	nd	Mechanically cleaned
Dial plate (back)	74.8	20.1	1.95	1.55	tr	0.24	0.47	0.77	0.02	nd	Uncleaned – dark patina
Back: Soldered area around gnomon tenons	11.4	3.8	45.1	37.2	nd	nd	2.33	nd	0.13	nd	3 mm spot size
Dial plate (front)	72.8	23.3	1.57	1.38	tr	0.29	0.30	0.39	0.01	nd	Uncleaned area at S
Gnomon	64.3	36.1	0.14	0.09	nd	0.01	0.09	0.02	nd	nd	Uncleaned. Average E & W sides

Table 1. Compositions of the components of the Cooke dial as measured by XRF, in wt.%. nd = not detected; tr = detected at low level (below the Limit of Quantification). Results obtained by J. Davis using a Thermo-Scientific Niton XL3t with a 45 keV primary X-ray beam and a 90-second exposure.

maximum level achievable (on thermodynamic grounds) by the cementation technique. Instead, it matches well with the composition of the previously analysed John Allen dial from the Maidstone Museum (coded DH-7 in the BSS Monograph). This suggests that Elias, a master of both John Allen and George Cooke, kept the preferred brass sheets (which would have had a particularly appealing golden colour) for his own use.

The trace elements in the dial plate composition, particularly the very low silver (Ag) but relatively significant nickel (Ni) and medium tin (Sn) levels point to the source of the originating copper ore probably being in the Meuse Valley.

As expected, the uncleaned areas of the plate show a marked decrease in zinc levels ('dezincification') and an increase in various other impurities, particularly iron (Fe).

The solder used to retain the (replacement) gnomon is clearly a standard tin/lead 'soft' solder which was in use for a significant part of the 19th and 20th centuries.

The inappropriate gnomon that had been fitted is a more modern material with a zinc level which indicates the use of the co-melting technique. Whilst it is cleaner (i.e. lower Fe, Sn etc.) than the dial plate, it is not up to the quality of current brasses where the copper is electrolytically refined, thus suggesting that it may be late 19th century.

Some further analyses were made operating the XRF analyser in a different mode using a primary beam of 6.3 keV to look for lighter elements in the surface patina. These are not listed in Table 1 as they were not fully calibrated, but direct examination of the spectra showed that the principal element in the patina was sulphur (S) coming from atmospheric pollution. Analysis of the broad strokes of the engraving showed additional amounts of aluminium and silicon, likely to be in the form of alumina (Al_2O_3) and silica (SiO_2) which will be residues of cleaning chemicals used in the past.

Gnomon Reconstruction

After removal of the faulty replacement gnomon, the dial was cleaned to remove weathering along its overly elongated foot. On the underside of the dial plate, the solder was removed. The dial plate was also slightly flattened at its corners and at the bulged area in the centre, to the west of the gnomon foot.

The geometry of the gnomon of the double horizontal sundial is defined by (a) the location of the three centres of delineation – marked by the maker as holes on the dial plate, (b) the local latitude and the Sun's altitude at noon on the summer solstice which determine the minimum height needed for the vertical knife-edge. To meet these criteria, the width of the gnomon's 'tail' in elevation could be no more than 11.5 mm. Given the gnomon thickness of a mere 4.5 mm, that makes it a very fragile element and prone to damage.

The original method of gnomon attachment practised by 17th century sundial makers was by hammering its tenons sunk into cuts in the dial plate. The method was deemed inappropriate for the reconstruction as it would cause further damage to the dial. Instead, holes were drilled in the body of the new gnomon and it was attached by means of screws running through existing cuts in the plate. The form of the gnomon tip was chosen based on the contemporary example of John Allen's double horizontal sundial DH-75.

The reconstruction was performed by Torsten Hiller, an expert in manufacturing and reconstruction of astrolabes, armillary spheres and medieval astronomical instruments from *Chronos Manufaktur* in Brandenburg, Germany. Torsten, in the search for an appropriate brass plate, matching the specific thickness and colour requirements, surveyed many potential sources, including the inventories of the Dresden's Mathematisch–Physikalischer Salon.

The design width of the original gnomon was 4.4 mm and there was no readily available brass meeting the required criteria. Instead, a 5 mm plate of commercial grade MS63 (CW508L/CuZn37/2.0321) brass alloy was used. This was milled down 0.25 mm on each side, and a further 0.1 mm was removed by grinding and fine polishing the surfaces. The most demanding and time-consuming part of the work was the knife-edge vertical gnomon and especially its junction with the underside of the polar gnomon.

The extent of the works also included fine flattening of the bulged and warped sundial plate. After completion, the surfaces of dial plate and of the gnomon were protected with Renaissance wax. The mounting method of the reconstructed gnomon can be seen in Fig. 10 and the restored sundial is shown in Fig. 11.

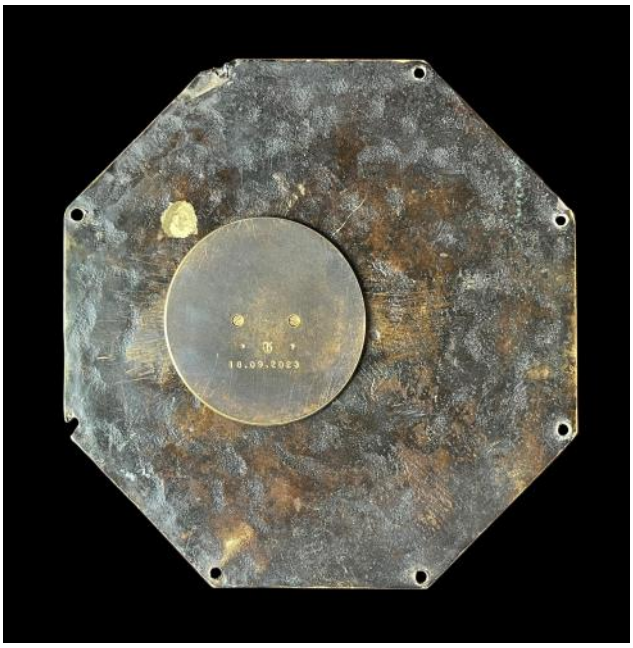

Fig. 10. Underside of the dial plate with visible traces of hammering throughout, a bright spot cleaned for XRF analysis and a mounting backplate of the reconstructed gnomon with Thorsten Hiller's monogram and date.

Conclusions

The overall quality of the sundial's delineation, evidence of skills of both the maker and his master, is comparable with the much larger and precise 12.4″ sundial by Robert Jole, from ca. 1680, discussed in one of my earlier articles published in the *BSS Bulletin.*[11] If the sundial was actually a 'master-piece', as suggested earlier, its geometric examination confirms that it matched the requirements one would expect from such an instrument.

The sundial, an inconspicuous but rare dialling find, broadens our knowledge of Elias Allen's tree of knowledge and highlights stark differences in access to quality materials and clients between a respected master and an apprentice taking his first steps in the dialling craft.

The minor differences from Elias Allen's workshop style also give an insight into a slow process in which changes were introduced by following generations of London 17th century instrument makers, and how only some of the innovations were accumulated and passed on, depending largely on whether apprentices were able to secure preservation of certain skills and knowledge. Survey of the recorded 17th century double horizontal sundials, both signed and unsigned, in the search for specific features present on the Cooke sundial, suggests that George Cooke was one of the branches of Allen's tree that unfortunately did not succeed in this regard.

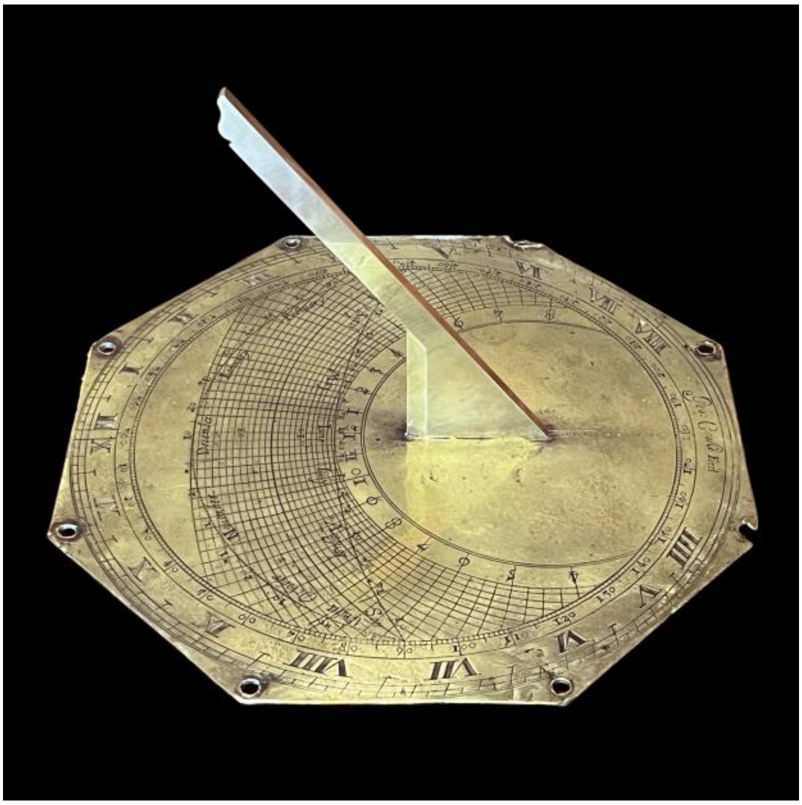

Fig. 11. The restored sundial with reconstructed double gnomon.

Our view of the conditions in which instrument-making craft flourished in 17th century London is partially impaired by the perspective of extant instruments and their successful makers, and only the long lists of apprentices' names found in Guilds' archives, not credited with any instruments or further records, show us the actual statistical perspective of the hard conditions in which this highly demanding craft, requiring years of training and complex networks of cooperation, existed – being impacted by plagues, fires, wars and predominating poverty. In this view the George Cooke sundial is a very illuminating and important instrument.

ACKNOWLEDGEMENTS

I would like to thank John Davis for initial inspection of the dial and conducting the XRF analysis as well for his comments on the maker and dial, Gloria Clifton for sharing her records of George Cooke and Torsten Hiller of *Chronos Manufaktur* for his excellent work in reconstructing the gnomon.

REFERENCES and NOTES

1. These 12 sundials are recorded in J. Davis & M. Lowne: *The Double Horizontal Dial – and associated instruments*, BSS Monograph No. 5. BSS, London (2009), ISBN 978-0-9558872-1-5, where they are coded as: DH-1, -2, -3, -4, -5, -8, -27 (Allen's signature reworked by Seller), -50, -51, -54, -57, -58. A further five examples have been identified since its publication. These are coded as: DH-67 (Allen's signature, but possibly different maker), DH-68, DH-78, DH-80, DH-82 in the extended register of stereographic instruments compiled by John Davis.
2. Ralph Greatorex: DH-20, DH-21; John Allen: DH-7, DH-75; John Prujean: DH-6 (tentative attribution). Instruments coded according to BSS Monograph No. 5 (note 1).
3. John Allen: HQ-1; John Prujean: HQ-4, Robert Davenport: HI-4. Instruments coded according to BSS Monograph No. 5.
4. The newly recorded sundial has been assigned a code DH-88 in the BSS register of stereographic instruments.
5. Joyce Brown: *Mathematical Instrument-makers in the Grocers' Company, 1688-1800*, Science Museum (1979), pp. 24-25.
6. Private communications with John Davis and Gloria Clifton.
7. D. J. Bryden: 'Made in Oxford: John Prujean's 1701 Catalogue of Mathematical Instruments', *Oxoniensia*, Vol. LVIII, 1993, p. 263 and ref. 3.
8. Andrew B. Appleby: 'Nutrition and Disease: The Case of London, 1550-1750', *Journal of Interdisciplinary History*, 6, No. 1 (Summer, 1975), pp. 1-22.
9. William Oughtred: *The Description and Use of the Double Horizontall Dyall*, Printed by M Flesher, London (1632).
10. Of the 12 double horizontal sundials by Elias Allen listed in BSS Monograph No. 5, the only one designed outside the 51–51.5º N latitude range is the sundial recorded as DH-2.
11. Maciej Lose: 'A Seventeenth Century Halachic Horizontal Sundial by Robert Jole', *BSS Bulletin* 26(iii), September 2014, pp. 10-15.

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JOHN LESTER, 1926–2023

Sadly, John Lester died in July 2023, at the age of 96. Many of us knew him as a dedicated sundial and mass dial enthusiast, but in his long life he was a busy GP, a rambler, climber, cyclist and motorcyclist, a wood carver and instrument maker, crossword enthusiast, and many things more.

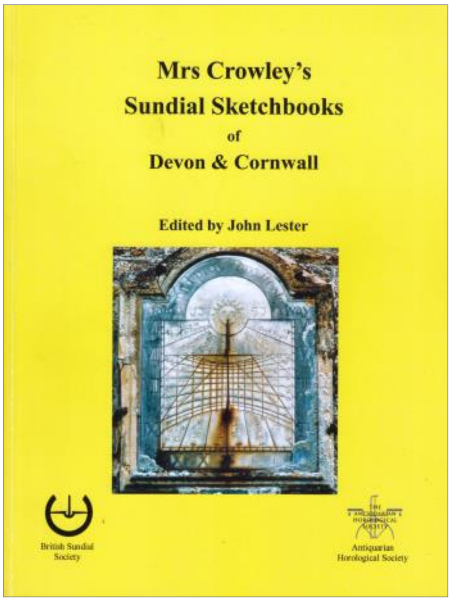
Following school in Uttoxeter, John studied medicine at Peterhouse, Cambridge. His National Service took him to the Korean War as a Medical Officer, where he became a Major. He spent time at St Bartholomew's Hospital in London, and at the Buchanan Hospital in Hastings, before settling down as a GP in Walsall where he stayed until he retired in 1986. He met and married Anne at Hastings and is survived by their two children Nella and Alex.

John had a well-equipped workshop, and in his time he made a seismograph, a spirograph, musical instruments, and of course many sundials, which he sold not only at our conferences but also at his local Astronomical Society, both as a fund raiser and to increase the awareness of dialling. He also made the gavel with 'impossible' dovetail joints which is now used at BSS AGMs.

John and gavel at the 2018 BSS Conference at Norwich.

The gavel with its 'impossible' dovetail joints.

He was a prolific recorder of dials for the Fixed Dial Register, with over four hundred reports to his name, all well detailed and photographed. He also contributed much in the early days of the web Register, Bridol, when he rewrote many of the descriptions of dials, particularly those in Devon and Cornwall, to make them better suited to general public understanding. John was also a frequent contributor to the *Bulletin*. He started with a piece on 'Fundials' in 1995, and over the next quarter of a century covered a range of subjects from write-ups of Society meetings to scholarly notes on classical writers from Bede to Vitruvius. He also had a deep interest in Mass Dials, leading a study group in Southwell in 1999, and writing on Mass Dials in Normandy.



One of his main projects was the beautifully constructed summary of the work of Jeanie Crowley, who sketched and described dials in Devon and Cornwall in the 1950s and 1960s. John's resulting book is now a standard work of reference.

He will be greatly missed at our meetings.

John Foad

THE SKEIN DIAL AT RSPB LOCH LOMOND

SUE MANSTON

A new sundial, designed to mark the seasonal arrival and departure of Greenland White-fronted geese, has been installed at RSPB Loch Lomond[1] (Fig. 1).

Fig. 1. The gnomon of the Skein Dial at RSPB Loch Lomond. The gnomon comprises two steel sheets with a narrow slit between them. The upper end of the gnomon serves as the nodus. Photo courtesy of Hannah Imlach.

Designed by visual artist Hannah Imlach,[2] this is both an art installation and a sundial. It was created as part of Hannah's collaborative doctoral project, a partnership between the artist, the Royal Society for the Protection of Birds (RSPB) and the School of Geosciences, University of Edinburgh.

Hannah's inspiration for the dial was the internationally important population of Greenland White-fronted geese, a Red List species whose population declined from 35,000 to 17,000 between 1999 and 2022. The RSPB reserve is a prime site where these geese come to overwinter. Hannah's concept for her artwork was a visual image of skeins of geese flying in the sky combined with a sundial showing the times when the geese arrive and leave. White-fronted geese migrate from Greenland in the autumn, spend the winter at Loch Lomond, then return to Greenland in the springtime to breed.

The dial is 6.3 metres in diameter and the paving is made from resin-bound gravel (Fig. 2). The gnomon is Corten steel which has two distinguishing properties: corrosion resistance and tensile strength (Fig. 3). This alloy forms a stable rust-like appearance which eliminates the need for painting.

The gnomon angle is 56º. There is a narrow slit between the two sloping panels of the gnomon; sunlight passes through the slit to indicate the time of day. The shadows cast by the perforated gnomon move across the ground over the course of the day, giving the impression of a group of geese in flight (Fig. 4).

Fig. 2. Aerial view of the Skein Dial. Photo courtesy of RSPB Scotland.

Fig. 3. The Corten steel gnomon in the workshop. Photo courtesy of Hannah Imlach.

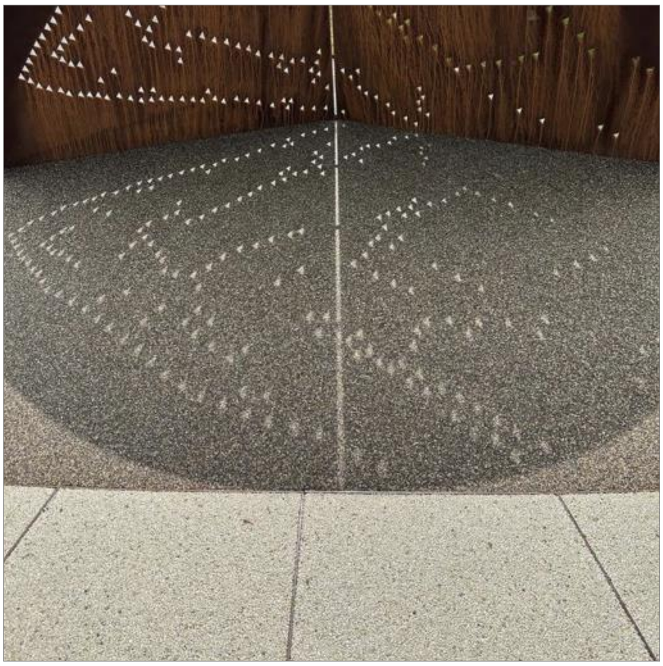


Fig. 4. The gnomon's shadow gives the impression of a group of geese in flight. Photo courtesy of Hannah Imlach.

The point where the two panels of the gnomon meet at the top is the nodus. The shadow of the nodus passes over coloured bands of paving on the ground, designed to represent the migration windows of the Greenland White-fronted geese. The 'Autumn' band lies between lines of constant declination for 5 and 26 October (Fig. 5). When the shadow of the nodus falls within this band, the geese are in the process of arriving into the Loch Lomond reserve. The 'Spring' band lies between lines of constant declination for 20 March and 10 April (Fig. 6). When the shadow of the nodus falls within this band, the geese are departing from Loch Lomond towards their breeding grounds in Greenland.

The creation of the Skein Dial involved ecologists, conservation staff and volunteers, fabricators and engineers, with sundial expertise provided by Macmillan Hunter Sundials.[3]

Fig. 5. When the shadow of the nodus falls within the 'Autumn' band, the Greenland White-fronted geese are arriving at Loch Lomond for the winter. Figure courtesy of Hannah Imlach.

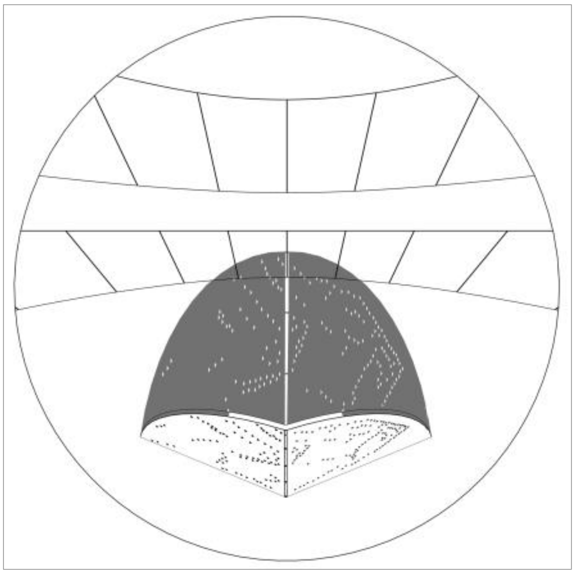


Fig. 6. When the shadow of the nodus falls within the 'Spring' band, the Greenland White-fronted geese are leaving for their breeding grounds in Greenland. Figure courtesy of Hannah Imlach.

ACKNOWLEDGEMENTS

Grateful thanks to Hannah Imlach for providing photographs and information about the dial and to Ian McNab of the RSPB for providing a photograph and the dial's location details.

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1. The dial (SRN 8438) can be found at latitude 56.052083 N, longitude 4.512046 W [56° 03′ N, 4° 31′ W], Grid Ref. NS 43652 87204, *https://w3w.co/humidity.unlisted.attention*
2. *www.hannahimlach.com*
3. *www.macmillanhunter.co.uk*

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TAK TENT O' TIME

DENNIS COWAN

There is a Scots proverb that has appeared on a number of Scottish sundials over the years, once just the first line, more often the first two lines, and, on one occasion, all three lines:

"Tak tent o' time
Ere time be tint
For time will no remain"

Mrs Gatty identified the motto,[1] crediting it to three sundials as follows:

"*It is one of eight mottoes that were inscribed on an octagonal pillar bearing a dial on each side, which stood in front of the Exhibition Buildings at Edinburgh in 1886. There was also an inscription stating that the Exhibition was opened by Prince Albert Victor of Wales, and the dial was called after him. The dial was removed when the Exhibition was taken down, and it is not known what became of it.*"

Mrs Gatty may not have known what became of the Prince Albert dial after the Edinburgh Exhibition, but we now know that at some point it was erected in the Meadows, a public park in Edinburgh. However, there is a problem. Gatty notes above that the pillar had a dial on each side. There is no evidence today that these dials ever existed, and today the pillar bears only a rather battered armillary sphere on its top. Of course, it is possible that a separate section of the pillar bore the dials and this section has now been lost. I have no doubts, though, that this is the actual pillar as described by Gatty as it is the same in all other respects. The first two lines of the motto are inscribed directly underneath the base of the sphere, the eight words of which fit neatly, one word to each side of the octagonal pillar (Fig. 1).

Fig. 1. The armillary sphere at the Meadows in Edinburgh which was originally at the Edinburgh Exhibition in 1886. The last two words of the second line of the motto can be seen directly under the dial.

Secondly, "*The same motto is at Whitchester, Duns, Berwick, on a dial erected for Andrew Smith Esq., by Mr. Bryson.*"

Andrew Smith, an Edinburgh brewer, bought Whitchester in 1878 and immediately set about an improvement of the house and gardens.[2] It was probably around this time that he commissioned the sundial from Mr Bryson. Unfortunately, the sundial is now missing.

Thirdly, "*It has also been inscribed on the new base of an ancient dial with twelve faces, a "dodecahedron" which was brought by Sir William Wedderburn, Bart., from Inveresk Lodge, Midlothian, and erected at Meredith Court, Gloucestershire. This dial is dated 1691.*"

Fig. 2. The twelve-sided sundial currently at the Marling School in Stroud as photographed by Andrew Somerville.

As Mrs. Gatty said, the twelve-faced dial was taken by Sir William Wedderburn from Inveresk Lodge to Meredith Court in Gloucestershire. Somerville tells us that it was then taken to Bisley in Gloucestershire and then to the Marling School in Stroud,[3] its current location. Strangely, he also said that it is a twelve-sided prism with hollow dials on all faces. This is obviously not true, as his own photograph in the BSS Fixed Dial Register clearly shows (Fig. 2). His accompanying report in the Register states that "*it is a polyhedral block sitting on its point, with four large diamond-shaped hollows on a central band with declining dials, and diamond-shaped facets above and below with reclining and inclining dials (12 dials in all)*". The first two lines of the motto are on the original plinth that now has two further steps below it.

Located in an enclosed courtyard of Huntly House Museum (now known as the Museum of Edinburgh) is a fine multi-faceted sundial (Fig. 3), previously described in the *BSS Bulletin* of March 2015.[4] It is almost certainly an 1886 copy of an Archibald Handasyde sundial from 1732 that was originally at Cramond on the western outskirts of Edinburgh and is now thought to be at the House of Aldie in Fife. This fine sundial has hollow (scaphe) dials as well as circular and square dials probably of copper (Fig. 4). The first two lines of the motto appear on the uppermost part of the sundial, one word to each of eight segments.

Fig. 3. The fine multi-faceted sundial at Huntly House museum in Edinburgh.

Fig. 4. Close-up of the Huntly House sundial, with "Tent o Time" near the top of the sundial.

A modern sundial is located in the garden of Abbot House in Dunfermline. It is a circular horizontal stone dial complete with its gnomon and an S scroll support (Fig. 5). The first two lines of the motto are carved widely spaced around the edge of the dial (Fig. 6) and are fairly difficult to see if you do not know where to look. The sundial was made by Lesley Alan Reid in memory of the late James Marshall and is made from slabs of Caithness stone decorated with Pictish symbols and some old-style spelling, i.e. Dunfermelyn and Rossyve for Dunfermline and Rosyth. James Marshall, a local lawyer and a past Chairman of the Carnegie Dunfermline Trust, was a vigorous supporter of heritage projects, particularly Abbot House. He was a keen hill-walker and many of the stones that he had collected in the course of his walks have been placed under the sundial.

Fig. 5. The modern sundial at Abbot House in Dunfermline.

Fig. 6. Close-up of the edge of the Abbot House sundial. "O Time" can just be seen widely spaced on the vertical edge of the sundial.

In Hawick's High Street at number 25 (Fig. 7), the four-storey tenement block dates from 1898. High up, the escutcheon between the dormers is inscribed: "Tak tent o' time ere time be tint" (Fig. 8). No date is visible but

Fig. 7. The escutcheon (circled) high up between the dormer windows at 25 High Street in Hawick.

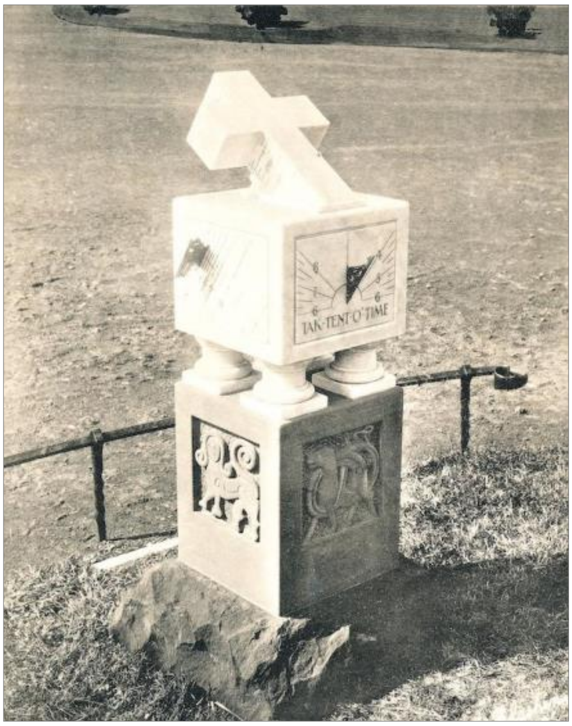

Fig. 9. The first line of the motto is carved on the north face of the missing McGlashen sundial.

Fig. 8. The first two lines of the motto are clearly carved on the escutcheon at 25 High Street, Hawick.

published sources state that it is part of a 1683 sundial which had been incorporated into a mid-18th-century building that previously stood on the site.[5] There is no sign of the sundial now, and although there are three sundials in Hawick's small museum, none of them is the missing one.

Ten years ago, Edinburgh City Libraries were attempting to find the present location of a sundial. All they knew was that this sundial, which is both a polar cross and a vertical sundial, was made by Stewart McGlashen & Son Ltd, who were based in Canonmills in Edinburgh and who were monumental sculptors as well as marble and granite workers. They were in business from the 1840s until the 1970s and it is known that this sundial was from 1908 or earlier, as it appeared in their catalogue of that date. Unfortunately, the library has had no responses to their request for information, so we do not know where it is now, or indeed whether it has survived. The first line of the motto was inscribed on the north face of this very white sundial (Fig. 9).

In the lovely Rose Garden at Saughton Park in Edinburgh, there is a tall ornately decorated structure raised on two octagonal steps (Fig. 10). There are four small almost

Fig. 10. The ornate structure containing four small circular vertical sundials in the Rose Garden at Saughton Park in Edinburgh.

Fig. 11. The south-facing sundial, one of four at the cardinal points, in the Rose Garden at Saughton Park in Edinburgh.

Fig. 12. The first two lines of our motto, one of several on the structure, are situated at the base of the structure.

Fig. 13. The modern copy of the sundial at Dunfermline Golf Club, which was originally the Pitfirrane estate.

Fig. 14. The dial plate of the sundial at Dunfermline Golf Club with the first two lines of the motto at the south side of the plate.

insignificant circular vertical stone dials facing the cardinal points (Fig. 11). The dials and finial are 17th century but the rest is 19th century. There were only the stubs of the four gnomons at my visit, but these have since been restored. There are Arabic numerals on all dial faces. The sundial is apparently the remaining vestige of Saughton Hall, a 17th-century villa that burned down in 1954. There are a number of mottoes on the sundial including the one we are interested in, which is positioned on one side of the base of the sundial (Fig. 12).

Near the clubhouse of Dunfermline Golf Club sits a modern copy of an old sundial originally from the Pitfirrane estate (Fig. 13), which is now the home of the golf club. A circular metal dial plate sits on a lion-shaped pedestal with the lion holding a shield containing the arms of Halkett of Pitfirrane. There is a gnomon in the style of a scripted H (for Halkett). The first two lines of our motto are inscribed on the south side of the horizontal dial plate (Fig. 14).

On a 1930s bungalow on the west side of Edinburgh, a large vertical sundial is situated on the front of the building (Fig. 15). It is thought to be contemporary with the house. The sundial is south-facing and is square inside a stone rectangular frame. It has Arabic numerals from 6 am to 6 pm with hour lines and part lines for the half hours. The framework has the zodiacal signs which are in blue circles matching the background of the dial plate. The motto of "Tak tent o time ere time be tint" is also in blue lettering

Fig. 15. The large vertical sundial at the front of the Edinburgh bungalow.

Fig. 16. Close-up of the Edinburgh bungalow sundial, clearly showing the first two lines of the motto.

(Fig. 16). There is what appears to be a nodus notch on gnomon but with no apparent purpose. The owner's son advised me that the sundial originally had swastikas, which was a good luck symbol, at the top and bottom of the frame, but that they had been reformed into crosses in the late 1930s when the swastika became a sinister symbol.

Fig. 17. The Jane Gaze 'sundial' in Harmony Garden in Melrose.

It is not only 'proper' sundials that carry our motto, as Harmony Garden in Melrose had some decorative ceramic garden ornaments for sale by Jane Gaze (Fig. 17), masquerading as sundials.

Finally, one of my favourite sundials is on the church (now a private residence) in the small hamlet of Stormontfield

Fig. 18. Stormontfield Church near Perth. The sundial is to the right of the door.

Fig. 19. The lovely vertical sundial on the church at Stormontfield, showing all three lines of the motto.

Fig. 20. The gnomon of the Stormontfield sundial commemorating Queen Victoria's Diamond Jubilee.

(Fig. 18), a short distance north-east of Perth. It is a square lead vertical sundial sitting inside a stone frame and decorated with thistles, and flowers with jewels (actually coloured glass), at their centre (Fig. 19). Here we have all three lines of our motto. The gnomon tells us that the sundial was made to commemorate Queen Victoria's Diamond Jubilee in 1897 (Fig. 20).

So I haven't actually told you what the motto means. It is in the Scots language and can be translated as "Make the most of our time as we don't know how long we have" or "Take account of time before your time is finished because time doesn't stand still".

Just as I was putting the finishing touches to this article, I travelled down to Galashiels in the Scottish Borders to see a sundial that I was aware of, but had never seen. It was situated at Lucy Sanderson's Cottage Homes. In 1927, James Sanderson (a local mill owner) bequeathed an estate for the establishment of these homes in his wife's name, to provide homes for retired local mill workers. It was one of Scotland's earliest sheltered housing complexes.

Fig. 21. The stone sundial at Lucy Sanderson's Cottage Homes in Galashiels.

The vertical stone sundial faces slightly west of south and is carved in relief. It has Arabic numerals from 7 am to 6 pm and appears to be contemporary with the building, and so likely dates from the late 1920s.

But why have I included it here? Incredibly, it has the first two lines of our motto carved at the top of the sundial (Fig. 21). What a lucky find, and just in time for it to be included in this article.

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The Dial of Ahaz at Rottingdean

This sundial is in one of the many beautiful stained-glass windows in St Margaret's Church, Rottingdean, East Sussex.

The Tree of Jesse Window (left) was made in 1897 by William Morris & Co. to the designs of Edward Burne-Jones (1833–98), who lived for some years in the village and designed several more of the Morris windows to be seen in the church.

It depicts ancestors of Christ: Jesse (possibly a self-portrait of Burne-Jones) lies sleeping at the foot of the tree with, above him, King David playing his harp, King Solomon holding a model of the Temple, then King Hezekiah holding the Dial of Ahaz. The next figures are King Josiah with what may be a scroll, perhaps representing the Book of the Law, and finally the Virgin and Child and an angel.

The 'Dial of Ahaz' is mentioned in the King James (Authorised) version of the Bible, at II Kings 20:11 and Isaiah 38:8. For a detailed discussion of what kind of dial (or other object) might have been referred to in these verses, see the article by John Wall: 'The Dial of Ahaz', in *BSS Bull.* 19(iii), 141-4 (Sept. 2007).

CHN

A NINETEENTH-CENTURY PROVINCIAL DIAL BY HILL AND PRICE

JOHN DAVIS

Provincial dials of the late 18th and 19th centuries are often more interesting than the contemporary ones made by London mathematical instrument makers. By this time, the design of the latter had become very standardised and although the quality of the engraving was excellent – it was approaching a machine-like consistency – the standard horizontal dial had almost become a commodity item and the products of different manufacturers were very similar in their layouts and furniture. The engraving was outsourced to specialists so the name that 'signed' the dial was really just the supplier. Provincial dials, on the other hand, were much more variable and idiosyncratic, likely to be the products of the workshop that actually signed them.

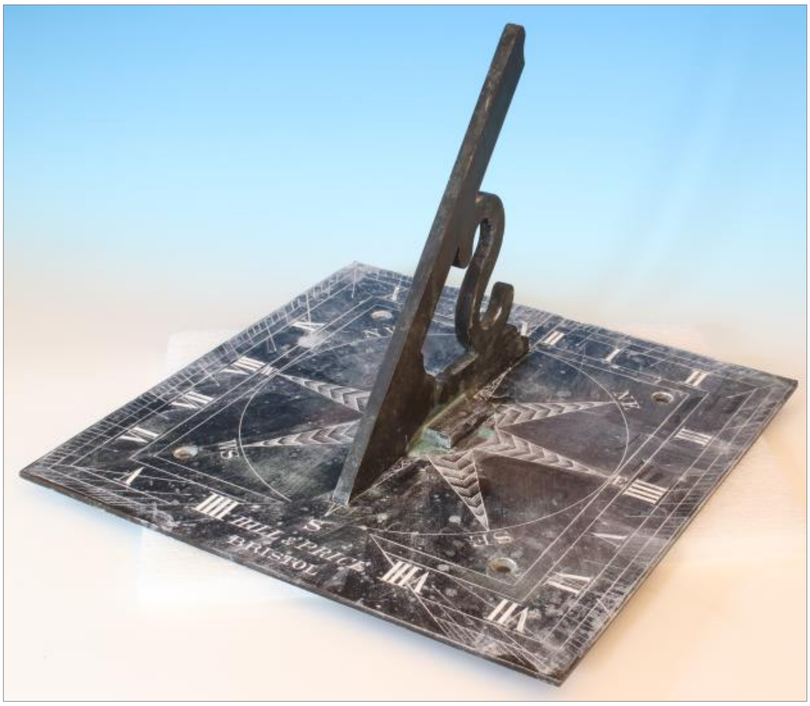

Fig. 1. General view of the Hill & Price dial (with talc to enhance the engraving).

A case in point is the dial shown in Fig. 1 and signed "*HILL & PRICE*, BRISTOL" which was recently purchased from a seller in Bristol and so it clearly has never travelled far. Gloria Clifton's *Directory*[1] describes the makers as "Optician, Nautical IM" and gives their working dates as 1842–83. The address is 1 Broad Quay in 1855 and 135 Bute St Docks, Cardiff, in 1883 and thus the date of the dial is likely to be mid-19th century. A local trade directory of the time describes them as "opticians and steam gauge makers" with the slightly different address of 2 Broad Quay. Being located in a major port, it is not surprising that instruments for mariners were a large part of their trade, and a sextant by them, with their trade label in the box, is shown in Fig. 2. The Broad Quay address had previously belonged to John Moor Hyde, described by Morrison-Low as "the main Bristol instrument-making business ...between 1841 and 1854".[2] Hill & Price were clearly a firm that followed the earlier tradition of instrument makers in Bristol.[3]

Fig. 2. A sextant by Hill & Price with their trade label.

The dial itself is 258 mm square (just over 10″) and is robustly made. As can be seen in Fig. 3, the centres of delineation at the 'toe' of the gnomon are offset towards the southern edge by a long way from the physical centre of the plate. In this way, it partly resembles some earlier horizontal dials made for locations in the West Indies, where the delineation is limited to 6 am to 6 pm.[4] The Hill & Price dial does allow for earlier and later times but it is notable that the lines for these 'back hours' actually originate from the wrong origins – not an uncommon error, even amongst experienced diallists. The compass rose

Fig. 3. Overhead view of the dial.

has points labelled E, W, and S read from the south, but whilst the intermediate points SE, SW etc. are inwards-facing, the W of SW is upside down.

The dial plate is very even in thickness (3.5 ± 0.1 mm) and seems to be made of rolled sheet rather than the hammered sheet of earlier dials of this size. The gnomon (Fig. 4), which is a substantial 3/8″ thick, also appears to be made of rolled plate: whereas the gnomons on earlier dials were invariably castings which include the integral supporting feet, here the two feet are formed from a separate piece machined into an 'H' profile and interlocking with the base of the gnomon blade. This is the technique which this author has used on many replica dials but this is the first time that it has been observed on an antique dial. The gnomon is mounted onto the dial plate by four screws: two into the gnomon itself and two into the feet. Its profile is slightly unusual in that it has semi-circular curves to the ends of the style and 'S' supporter suggesting it has been cut by machine or from a template. Details of the dial engraving such as the very straight and even serifs to the hour numerals also point to some mechanical assistance and not totally freehand engraving.

Fig. 4. Side view of the gnomon.

In contrast to the construction of the dial using what might be termed 'modern' techniques, the details of the brass alloy (as revealed by an X-ray fluorescence analysis[5]) show that the material has been produced by the time-honoured cementation technique rather than the current method of co-melting elemental copper (nowadays produced electro-lytically) and zinc. It is of quite good quality with a relatively high zinc concentration and a respectably low iron level. It is possible that it was produced by The Bristol Brass Company where the metallurgist William Champion (1709–1789) had developed and patented improved methods of making brass, still using the cementation technique.[6] Although James Emerson of Bristol had patented his method producing metallic zinc and using it for brass making in 1781, the material was expensive so he went bankrupt in 1803[7] and by the mid-19th century the industry had mainly moved to Birmingham with rolling mills powered by steam rather than by water.

Thus, in summary, this rather ordinary instrument fills in an important gap in the history of dialling when sundials were still proper scientific tools and not yet mere ornaments, but with modern construction techniques beginning to take over from pure artisanal skills.

REFERENCES and NOTES

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2. A.D. Morrison-Low: *Making Scientific Instruments in the Industrial Revolution*, Ashgate (2007), 60. She also illustrates (p. 23) the trade card of J.M. Hyde which includes a circular horizontal dial amongst many other instruments.
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4. Maciej Lose: 'A West Indies Dial by Thomas Wright', *BSS Bull.* 25(i), 8-14 and John Davis: 'West Indies Dials', *BSS Bull.* 23(ii), 51; and Tony Wood and Jill Wilson; 'West Indies Dials in Gloucestershire', *BSS Bull.* 22(i), 41.
5. The key XRF analysis of the cleaned dial plate shows that it comprises 67.5% Cu; 31.3% Zn; 0.7%Pb; and 0.3% Fe with trace amounts of Sn and Ni. The gnomon was of a similar alloy but with slightly more Pb. It is notable that the plate did not contain a significant amount of arsenic which was a noticeable trace element in copper ores from mines in the West Country at this time.
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7. Day, *ibid*., pp.123-4.

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ITALIAN HOURS: ORIGIN AND DECLINE OF ONE OF THE MOST IMPORTANT TIME-SYSTEMS OF THE PAST, PART 1

MARIO ARNALDI

This article, divided into two parts, was first published in the Italian gnomonic journal *Gnomonica Italiana*, issues 11 and 12, 2006. This is its first English translation, revised and formatted for a British readership.

Do we really know everything about Italian hours? How did they evolve and spread in Europe? What happened to these ancient hours once they fell into disuse?

It seems strange that up to a few years ago, even in Italian specialist literature, there still persisted many stereotypes and obscure points about the time system that came into being with the abandonment of the ancient time system of unequal hours. In this article, we try to establish some fixed points which, although they cannot be considered definitive, are certainly a significant advance in the understanding of Italian gnomonics during such an important period of history.

In addition to the unequal hours, also referred to as ‘temporal’ or ‘seasonal’, there existed alternative methods of calculating time in antiquity. According to the *Noctes Atticae* by Aulus Gellius (Rome, circa 115–165), we learn that Marcus Terentius Varro (Rieti, 116 BC – 27 BC) dedicated a chapter in his book *De Rerum Humanarum* to the division of the day. The passage quoted by Gellius states that, in Rome, it was customary to recognize the ‘birthday’ (*dies natalis*) of each individual. This day was divided into 24 (equal?) hours, beginning at midnight and ending at midnight the following day, and it was recognized for both civil and religious purposes. Explaining Varro’s chapter and also addressing information presented by Pliny the Elder (Como, circa 23/24 – Stabia, 79) in Book II, Chapter 79 of his *Naturalis Historia*, Gellius emphasizes that various other populations identified three different times for marking where one day ended and the next day began: Athenians: sunset to sunset, Babylonians: sunrise to sunrise and Umbrians: midday to midday.[1]

Later, in the third century, Censorinus described the computation of time in ancient Rome. Confirming what Gellius had written, he provided us with the two official and precise definitions of the day in Rome. The ‘civil’ day (*dies civilis*) was divided into 24 hours counted from midnight to midnight. The ‘natural’ day (*dies naturalis*) was divided into 12 temporal hours counted from sunrise to sunset.

In the eighth century, the English monk Bede, also known as the Venerable, distinguished between two methods of calculating a day. Like other Christian authors, he believed that the system of temporal hours was ‘vulgar’, i.e., not precise enough for scholarly pursuits or practical applications. Bede advised computational scholars to consider the full rotation of the Earth as the ‘true day’, which incorporates both the day and the night. The day, consisting of 24 hours, was understood in two ways – the older was counted from one sunrise to the next and the other from one sunset to the next. The reasons provided by Bede are mainly of a religious nature. He clarifies that in Moses’ era, as recorded in the Old Testament, the day began at sunrise, whereas in the New Testament, a fundamental text for the Catholic Church, the day is always counted from vespers; this is the choice made by Bede in his most famous book, *De Temporum Ratione*, which was the basic school text for the entire Middle Ages.[2]

However, outside the domains of science, computing and law, the unequal hours were those used by everyone, including the Church, and they were still in fact the current system of time.

In Europe during the mid-fourteenth century, when novel timekeeping approaches emerged, the temporal hours were an institution consolidated by long centuries of history; they had already been used by the Chaldeans, the Egyptians, the Greeks and the Romans. They were passed down throughout the Middle Ages and were utilized in sundials in various forms, from twelve or more divisions down to four.

No one could have anticipated that voices of disapproval with the old and well-established time system would emerge at the end of the thirteenth century: the times enforced by the archaic system, primarily used in the ecclesiastical sphere, no longer satisfied the needs of an urban community that was constantly evolving and expanding, developing a strong social structure made up of working classes of artisans, merchants, bankers, and so on. The irregular and highly fluctuating time, governed by unequal and above all canonical hours, was no longer able to regulate the productive activity of the urban population.

Furthermore, increasing displeasure and aversion towards the Church and its principal representatives compounded the issue. In the early fourteenth century, the papacy was moved to Avignon and a power struggle ensued between

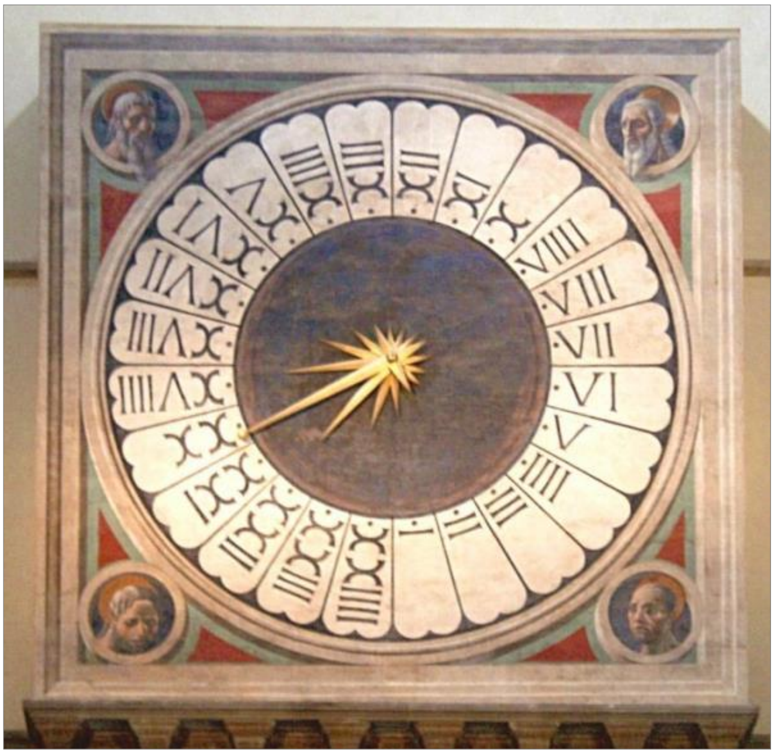

Fig. 1. Florence, Church of Santa Maria Del Fiore. The famous mechanical clock painted by Paolo Uccello in 1443. Photo: Mike Cowham.

the emperor, who sought complete independence from the pope, and Peter's representative, who was unwilling to renounce his theocratic power. During those years, the highest prelates appeared to be more interested in money than in spiritual life, with the 'gangrene' spreading from the papal palace, where the thirst for power and gold multiplied exponentially.

Even the Franciscan orders, established a century earlier to suppress similar vices, were steadily following the same course and, furthermore, a devastating famine in 1315 resulted in the deaths of thousands of people, wiping out entire populations. Amidst this general sense of dissatisfaction and unrest, the Church's once almost absolute control via unequal hours rapidly started to diminish. In the mid-fourteenth century, major Italian cities began to equip themselves with mechanical tower clocks that struck the twenty-four hours. This gave official blessing to the demise of the old unequal time system.

In fact, small time-measuring mechanisms were already being constructed in thirteenth-century Europe: specifically, we refer to the monastic alarm clocks or 'tower guardian clocks', which were essentially timers that could strike a bell at a predetermined time. We believe that in the early fourteenth century there existed large metal machines, equipped with gear wheels, which were also able to mark the time and strike the hours on a bell,[3] but as Arno Borst rightly pointed out,[4] despite these important inventions, there was no immediate revolutionary impact on the general populace.

The earliest clocks for towers did not appear to have dials or hands, but simply rang a bell every hour, which probably made people feel that they were being cheated as far as time was concerned. Only the construction of the first mechanical clocks equipped with 'displays' of the hours on city bell towers was appreciated by the population, as described in ancient chronicles. These machines were heavy, bulky, and filled with gear wheels and were considered wonders of metallurgical art. Each city competed to have one (Fig. 1). In the descriptions of the mechanisms, there are often sensational terms used, as people marvel at the ability of the clock's bell to strike twenty-four times without the assistance of the bell-ringer, a previously indispensable figure in the municipal statutes of each city.

The first 24-hour striking tower clock of which we have documentary evidence in Italy was the one installed at Milan on the church of San Gottardo in 1335,[5] and Galvano Fiamma describes it to us as follows: "*... est ibi unum Horologium admirabile... quod percutit unam campanam xxiiii vicibus secundum numerum xxiiii horarum diei, et noctis, ita quod in prima hora noctis dat unum tonum, in secunda duos ictos, in tertia tres, et in quarta quatuor, et sic distinguit horas ab horis…*" (There is an admirable clock there... which strikes a bell 24 times, according to the 24 hours of the day and night, so in the first hour of the night it rings once, in the second twice, in the third three times, and in the fourth four times, and thus distinguishes one hour from another…).[6] Like an uncontrollable fever, other cities taxed themselves to have at least one mechanical clock on their towers: Padua in 1344, Genoa in 1353, Bologna in 1356 and so on.[7]

However, historiography, mainly concerned with significant dates and events, often neglects small details. Despite the emergence of mechanical clocks in civic towers, the use of temporal hours persisted in daily life for at least a century. For at least 50 years after the installation of these clocks, Italian chroniclers recorded the events of their cities using both the new time system and the ancient medieval one interchangeably. In rural areas and remote parts of fourteenth-century Italy, the traditional ecclesiastical system persisted for some time and, in certain regions, until the sixteenth century. The adoption of mechanical clocks with standardized hours did not completely replace the use of unequal hours. In the astrolabe factory, the marking of hour lines other than the unequal hours ones was never used except on the 'limb'. In fact, the astrolabes themselves imposed their rules on the display of the major astronomical and astrolabical mechanical clocks.[8]

Italian Hours

In almost all of Europe, the civil time system adopted in place of the ancient 'unequal' hours was what we

Fig. 2. Carmagnola (Turin), Casa Piano – also known as ‘house of sundials’. One of the oldest sundials, painted in 1557 by Francesco Cugiaro of Chieri, showing Italian hours.

commonly still use today: it was then called ‘common’ or ‘equal’ hours.[9] In practice, the new time system varied from the old one primarily in that the hours were of the same length, known as ‘equinoctial hours’. They were always 24 in number and, like the ancient system, were divided into two groups of 12. But their counting began at midnight and midday respectively.

In Italy, which time system replaced the ancient one? The chroniclers, who praised the clocks that struck the hours in the new method, did not provide any specific names clarifying how the hours struck by the new mechanical clocks were designated. Only the general term ‘ore complete’ (complete hours) is known to have been used.[10] However, no further subjective evaluations can be made from the given text. The hours related to the facts mentioned were calculated *ab occasu solis*, which refers to counting hours from sunset. In other words, those that are commonly referred to as ‘Italian hours’, as Italy used them most extensively and for longer than other European countries (Fig. 2). This type of day, as it is understood, consisted of 24 nearly identical hours and was measured from sunset until the start of the next count, at the next sunset, which also marked the beginning of the new day.

In 1892, Gustav Bilfinger argued that the time systems adopted in Europe after the demise of temporal hours appeared almost simultaneously in the fourteenth century. Furthermore, he pointed out that all these systems were just modernizations of the old-time system, and they inherited the following three traits as they could not support hourly variability:

- the separation of the hours of night and day,
- the mobile start,
- two distinct series of twelve hours.[11]

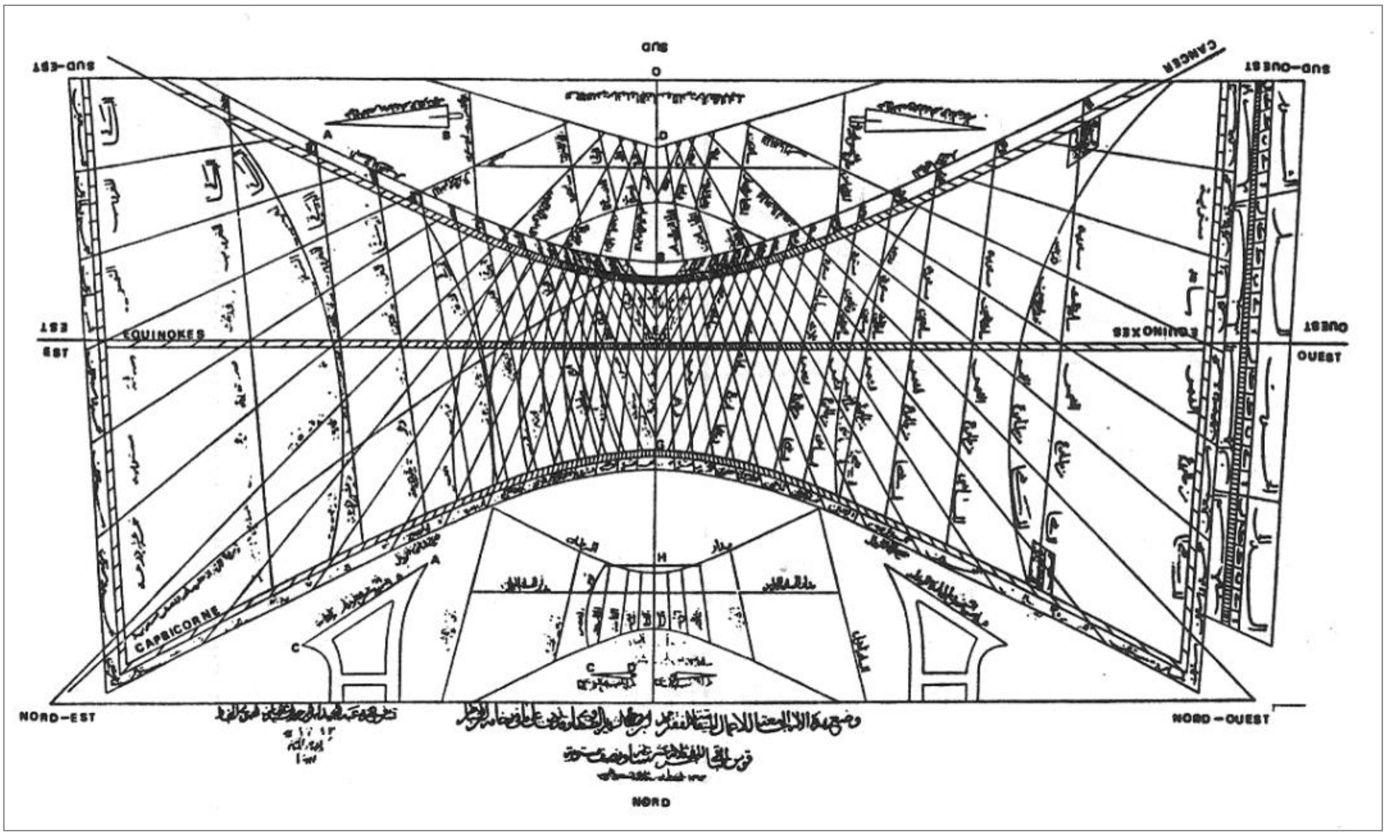

Fig. 3. Damascus, Umayade Mosque. Graphical reconstruction of the beautiful sundial built by Ibn Al Shatir in 1371–2 (773HE).

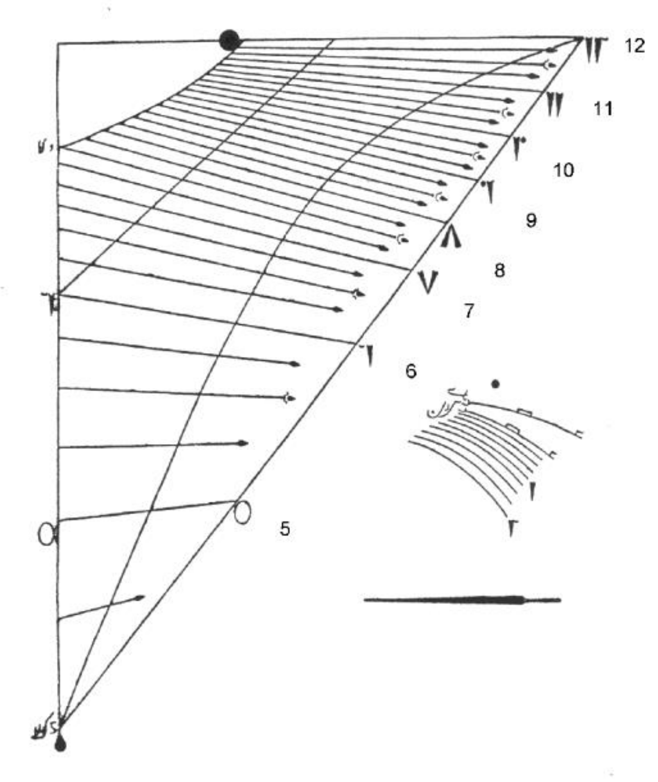

Fig. 4. Istanbul, Fatih Sultan Mosque. Graphical reconstruction of the oldest Turkish sundial, built in 1473 (878 HE).

It was not possible to combine all three traits, since doing so would not have generated any obvious differences from the old system, but some of them could be taken into consideration without problems. The first characteristic was maintained by so-called Nuremberg hours, Italian and Babylonian hours maintained the mobile start,[12] while common time maintained the separation between two series of twelve hours.

It is important to note that, during the Middle Ages, the Arabs were aware of the times *ab ortu* and *ab occasu*. However, they did not use them for actual time computation. The oldest Arabic sundial featuring the *ab occasu* lines was constructed by Ibn Al Shatir in 1371–2 (773 HE) at the Umayyad mosque in Damascus. This sundial is a remarkable example of gnomonic engineering (Fig. 3).[13] The Turks, however, adopted the '*ab occasu*' times employed in Byzantium and integrated them into their timekeeping system. The Turkish hours retained all three aforementioned concepts: that is, 24 hours were evenly divided into two groups of 12, beginning at sunset and sunrise, respectively, and ending at the subsequent sunset. The markings were similar to the Italian system, although the final hour of the Turkish day was the twelfth and last. At sunset, the nighttime calculation commenced for the next 12 hours. The most ancient surviving Turkish sundial can be found in Istanbul at the mosque established by Fatih Sultan Mehmet and goes back to 1473 (878 AH) (Fig. 4).[14]

Nuremberg Hours

The *ab occasu* hours used in Italy contrasted with the *ab ortu solis* hours, universally known as 'Babylonian hours'. During the fourteenth century, the clocks on Italian towers began to strike the same twenty-four hours, while the city of Nuremberg developed a unique time system, similar in some ways to the ancient one. The city's sundials displayed overlapping hour lines, one from sunrise and one from sunset. This was not a mere habit of the German gnomonists, but a necessity related to the time system adopted in the city. Penelope Gouk describes the Nuremberg time system as follows: "Nuremberg hours, or *horae norimbergenses*, combine both this system (the Italian and Babylonian) together. Hour reckoning begins at either sunrise or sunset. Daylight hours by this method were equivalent to Babylonian hours, numbered from 1 upwards, while night hours are reckoned by the Italian system, which also begin at 1 after sunset. It is for this reason that a dial calibrated for Babylonian hours is sometimes marked with the inscription "Nuremberg hours".[15] Four years later, Steven A. Lloyd would use almost the same words as Gouk, but this explanation is too simplistic and not sufficiently clear.[16]

It is indeed correct that Babylonian hour lines were used to count daytime hours from sunrise, and nighttime hours from sunset. However, these were still considered equal hours, although on certain days the Babylonian hour preceding sunset may not have been complete. Similarly, the Italian hour preceding sunrise faced the same issue. Thus, both diurnal and nocturnal hours had to be whole numbers. For this reason, we have considered the periods of the year when both day and night have a suitable number of hours. At the winter solstice, the length of the day was approximately eight hours. It then increased gradually, passing through nine, ten, eleven, twelve, thirteen, and so on until it reached about sixteen hours at the summer solstice. At that time, the Babylonian hour lines intersected with Italian ones on a sundial. Additionally, the Nuremberg hour line of that specific period of the year matched that point (ref. 19, ch. 35, pp. 218-21).

A perfect example of this time system can still be seen today in the sundial on the window of the second choir of St Lorenz's Church in Nuremberg (Figs 5 and 6). The clock was built in 1502 by Johannes Werner (1468–1522) together with the Austrian Johannes Stabius and is one of the clearest examples of this type of dial.[17]

This method, which disappeared for good at the end of the eighteenth century, was adopted by Nuremberg, Regensburg and other towns in Lower Germany.[18]

Italian or Bohemian Hours?

It was probably the unusual Nuremberg system in the sixteenth century that caused some confusion about the use of 'hours from sunset' and 'hours from sunrise' in some European countries. To tell the truth, there is still a great

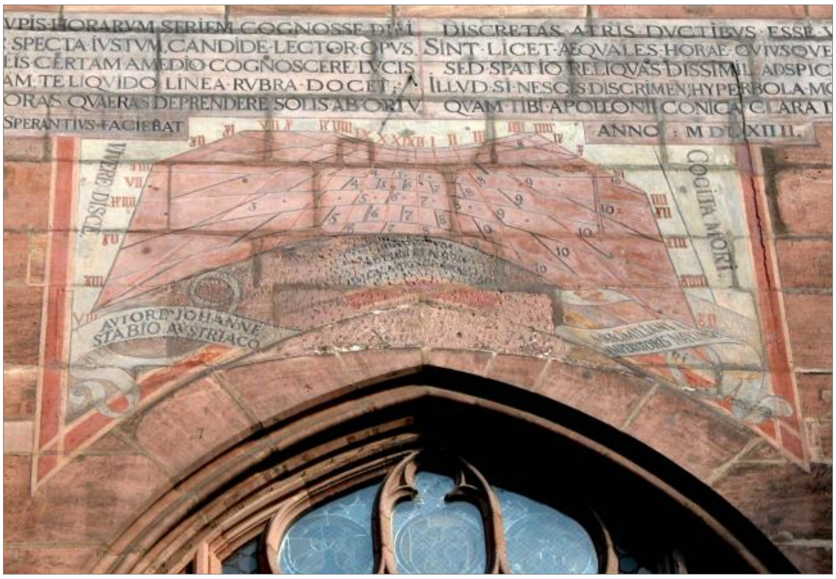

Fig. 5. Nuremberg, St Lorenz Church. The Nuremberg sundial, made in 1502 by Johannes Werner and Johannes Stabius (photo: K. Schwarzinger).

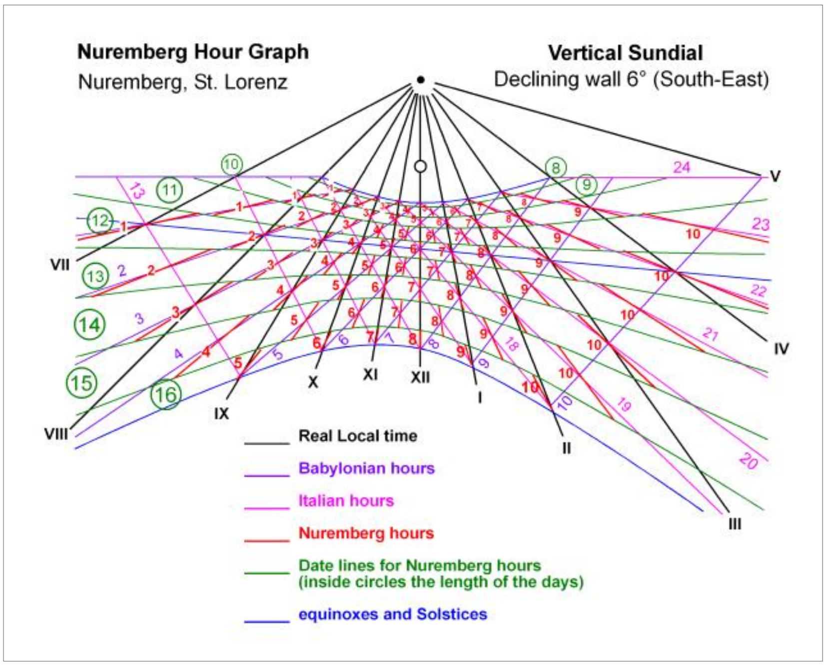

Fig. 6. Schematic diagram of the Nuremberg hours as placed on the sundial of St Lorenz Church in Nuremberg (design by K. Schwarzinger).

deal of uncertainty, especially in Italy, as to how Bohemian time should be understood: some call ‘Bohemian’ the hours counted from sunrise, while others consider ‘Bohemian’ the hours counted from sunset, like the ‘Italian’ ones. I will try to prove the correctness of the second version.

It is probably the result of an old misunderstanding, due to the fact that both the *ab ortu* and *ab occasu* hours were used for a long time, especially in Nuremberg and nearby Bohemia, but is more likely due to an error made by Sebastian Münster in 1533 in his book *Horologiographia*. Münster lived in Bamberg, a town very close to Nuremberg and not too far from the kingdom of Bohemia, so he was well aware of the time systems in both places. However, in chapter 33 of his book, he made a big mistake by confusing the Italian time system with the Babylonian one:

“*Caeterum horae Bohemicae sunt,* [he wrote] *quae incipiunt post solis occasum computari, numeranturque continuo, donec nox cum succedente die exacta fuerit. Nam cum sol per horam sese in hemisphaerium inferius abdiderit, numerant, Bohemi horam primam, deinde secundam, tertiam, quartam et sic consequenter usque dum sol sequenti die in occasu horizontem appetierit, tunc horologia solaria et fabrilia indicant et sonant viginti quattuor*.” And then, more strangely, continued: “*Idem mos observatur apud Italos, nisi quod has viginti quattuor horas ab ortu solis numerare incipiunt, sonantque horologia unum, quando sol per unam horam fuerit in hemisphaerio eorum. Quando vero jam ex hemisphaerio inferiori coeperit emergere, campanae sonant viginti quatruo*.”[19]

(“The others are the Bohemian hours, which begin to be reckoned from sunset, and are counted continuously, until the night is exactly with the succeeding day. For when the sun has set down for an hour in the lower hemisphere, the Bohemians count the first hour, then the second, the third, the fourth, and so on until the sun has reached the horizon at sunset on the following day… The same custom is observed among Italians, except that they begin counting these twenty-four hours from sunrise, and strike one o' clock when the sun has been in their hemisphere for one hour. But when it has already begun to emerge from the lower hemisphere, the bells strike twenty-four").

Today's reader, with a minimum of knowledge of gnomonic iconography, will have no difficulty in acknowledging that Münster made a significant mistake: he was perfectly aware that the Bohemian hours were indicated by the oblique lines that marked the hours from sunset on the Nuremberg sundials, but for some unknown reason he did not know that the same hours were used in Italy.

The Italian gnomonists of the time, who could not accept such a statement, probably thought it was a gross printing error, and it is easy to believe that they thought of putting things right by simply inverting the two counts: thus the Italian hours of Münster returned to their rightful place, but the Bohemians automatically took the opposite one. Thus, in 1565, Giovanni Battista Vimercato, from Milan, attributed to the Bohemian hours the characteristic reckoning of the Babylonian hours, leaving the correct attribute to the Italian hours, and, like Münster, compared the Bohemian hours with the same hours used in Nuremberg.[20] Also Egnazio Danti, in 1578, was convinced that the Bohemian hours were the hours counted from sunrise[21] and Mutio Oddi from Urbino maintained the same conviction in 1614.[22]

The error was corrected by Bartholomäus Scultetus in 1572,[23] by asserting that the hours used in Austria, his homeland, as well as in Bohemia, Silesia, and Moravia, were counted from sunset, as the Italian ones.[24]

Riccioli, in his *Almagestum novum*, written almost a century later, added further information about the use of Italian hours in other countries: "*Ab occasu solis* [he wrote] *diem incoarunt Hebrei, nec non Athenienses; et nunc Austriaci, Bohemi, Marcomanni, Poloni, Silesii, Sinenses, Cathaini, sed praecipue nunc Itali, unde nomen horis Italicis*".[25] ("The Hebrews, as well as the Athenians, began the day from the setting of the sun; also now the Austrians, the Bohemians, the Marcomanni [a Germanic tribe], the Poles, the Silesians, the Chinese, but particularly now the Italians, hence the name of Italian hours".)

Despite everything, it seems that in Italy the error was destined to be corrected only in 1581 by the authority of the well-known Cristoforus Clavius,[26] so much so that a few years later Valentino Pini, who greatly admired Clavius, would always refer to the dial with the hours counted from sunrise as 'Babylonic' and confirm that "already the ancient Athenians, and now the Bohemians, and also the Italians begin their day from one setting of the sun to the next".[27]

The *ab occasu* time system, therefore, was widespread in many European countries such as Bohemia, Poland, Silesia, Moravia, part of Germany, and Austria, and for this reason,

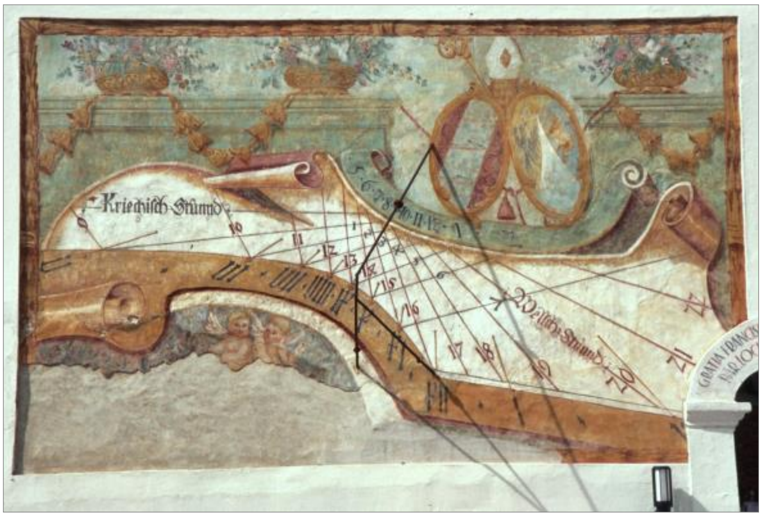

Fig. 7. Oissach, Carinthia, Benedictine Abbey. Sundial with Italian and Babylonian hours (photo: K. Schwarzinger).

the hours were called in various ways: 'Czech hours' or 'Bohemian', while in the Kraków region they were called 'Silesian hours',[28] or 'Polish hours' as they were identified on the sundial designed by Aleksander Glaser on the Gdansk Town Hall in 1588.[29] The hour lines *ab occasu solis* on the Oissach Abbey sundial in Carinthia (Fig. 7), however, are identified with the name 'Welsch Stund' (foreign hours), as opposed to the hour lines showing the *ab ortu* time system, i.e. counted from sunrise, that are called 'Kriechisch Stund' (Greek hours).[30] In Italy, however, they were better known as 'Italian' or 'Bohemian' hours.

We do not yet know with certainty what the origin, the inspiring model, of the Italian way of counting time was. The change of a time system from one day to another after centuries requires answers that are not simple, and perhaps it will not be possible to confirm all the possible deductions. In the first part of my original article,[31] I tried to investigate the historical events that took place in the years when large tower clocks began to be produced in northern Italy. What I deduced is not proven by any document, but I think it is interesting to repeat it here because I think it is still something to be studied. I am convinced that the re-reading of some closely related events will undoubtedly add new elements to the assessment of the subject dealt with in these pages.

- In 1331, John I of Luxembourg, king of Bohemia, travelled to Italy with his eldest son Charles,[32] summoned by the Brescia Guelphs who were threatened by Mastino della Scala from Milan. After conquering Milan almost without bloodshed, John I ruled practically all of northern Italy, including Lucca and Siena.
- Four years after his arrival in Italy, Milan was equipped with the first tower clock in Italy striking 24 hours.

Fig. 8. Prague. Monument to Charles IV, Holy Roman Emperor.

- In those years it was Pope John XXII (1316–34), the first pope who granted a few days of indulgence to anyone who stopped and recited the Marian prayer during the tolling of the evening and morning bell.

Charles succeeded his father, who had died during an Anglo–French war, and was crowned King of Germany at Bonn on 23 November 1346. In 1354–55 he travelled to Italy to be crowned in Rome with the imperial title of 'Charles IV', arousing great enthusiasm along the way.

Francesco Petrarca, one of the most cultured men of the time, was one of the greatest supporters of Charles IV's journey to Italy (he was also one of the most disappointed when he left shortly afterward, betraying the trust that the poet and the people had placed in him). In 1353, it was Petrarch himself who, in a letter sent from Milan to a dear friend, wrote that he was saved by the presence of a noisy man, more precisely by the "chiming of one of those recently invented and widespread clocks in the Po Valley, which indicated that the time of sunset was approaching".[33]

These few historical data are enough to make us think about the close connection between Bohemia and the origin of the Italian system of time, also in relation to the transition from the old to the new system of time.

Although today, as in the past, the hours *ab occasu solis* are defined as 'Italian', we might suspect that their origin cannot really be Italian. An interesting chronicle, which we will see in the second part of this article, relating to an edict of Charles IV, seems to me to point to Bohemia as the true country of origin of the Italian hours.

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1. Gellius: *Noct. Att.*, III, 2, 4-6.
2. Jacques-Paul Migne (ed.): *Venerabilis Bedae*, *De temporum ratione* (1862), Patrologia Latina, Paris, vol. 82, chap. 5, coll. 308-316 and *glossae* (1862).
3. We recall that Dante, too, more than once in his Comedy, compares the circles of Paradise to the 'spheres' of a mechanical clock. There are different opinions among experts on mechanical clocks as to whether the poet is referring to tower clocks or small chamber clocks: the description of the movement of the wheels seems to allude to the former, while the sound 'tin tin' seems to allude to a small bell.
4. A. Borst: *The Ordering of Time. From the ancient computus to the modern computer*, trans. A. Winnard, Polity Press, Cambridge (1993), p. 92.
5. Actually we know that an earlier clock existed in Milan, mounted in 1309 on the church of Sant'Eustorgio, but all scholars agree on the fact that it was a 'mallet' timepiece, i.e. a machine without a display, which at certain hours (we do not know, but most probably, canonical) would ring a bell.
6. Galvanei de la Flamma: *Opusculum de Rebus Gestis ab Azone, Luchino et Iohanne Vicecomitibus. Ab anno 1328 usque ad annum 1342*, Muratori, Rerum Italicarum Scriptores (RIS), II, col. 1012.
7. The one in Padua was made in 1344 (Vergerii: *Vitae Principum Carrariensium*, ed. A. Muratori in RIS, XVI, col. 171), in Genoa in 1353, in Bologna in 1356 (A. Muratori, *Corpus Chronicorum Bononiensium*, ed. A. Sorbelli, RIS, VIII, I , III, p. 67) in Siena in 1359, in Ferrara in 1362, in Vicenza in 1378; see G. Bilfinger: *Die Mittelalterlichen Horen und die Modernen Stunden*, II, 3, Stuttgart (1892), pp.178-180; A. Simoni: *Orologi italiani dal cinquecento all'ottocento*, Milan, ed. A. Vallardi (1980), pp. 29-30; C.M. Cipolla, *Le Macchine del Tempo*, Il Mulino (1981), pp. 15-21; D.S. Landes: *Revolution in Time: Clocks and the making of the modern world*, Harvard University Press (1983), pp. 197-206 [page nos. in the Italian edition of 1984].
8. E. Poulle: 'L'horloge a-t-elle tué les heures inégales?', *Bibliothèque de l'École des Chartes*, Tome 157, janvier-juin 1999, Paris – Genève (1999), pp. 137-56.
9. In Italy, since these hours were widely used in the countries beyond the Alps they also came to be known as 'Oltramontane', 'French', 'German', 'Spanish' or 'European'.
10. This information is given to us by Bilfinger (ref. 7); we are not sure if it is correct – I assume that he was misled by Matteo de Griffoni's chronicle of 1356, where we read in Bologna: "*De mense Maji Arlogium completum fuit pro horis pulsandi...*" ("About the month of May the clock was complete for striking the hours"). It is easy to see that *completum* could mean "it was finished", or that the clock, unlike the previous models, was complete with a dial. Simoni wrote that they were called "Celtic hours" because they were widespread in that part of Europe where the Celts lived in ancient times, but Simoni (ref. 7), p. 28, note 2 does not provide any documentary evidence in favour of his statement, and in my numerous searches and sources I have not found any written reference of this type.
11. Bilfinger (ref. 7), pp. 185-95.
12. It is known that the times of sunset and sunrise vary throughout the year.
13. G. Ferrari – N. Severino: *Appunti per uno studio delle meridiane islamiche*, printed in photocopies (1997), pp. 107-111; G. Ferrari: *Le meridiane dell'antico Islam*, Youcanprint, Lecce (2015), pp. 372-80.
14. Bilfinger (ref. 7); See also A. Unver: 'Sur les cadrans solaires horizontaux et verticaux en Turquie', *Archives Internationales*

d'Histoire des Sciences, 7, Paris (1954), pp. 254-66 (reprinted in *Islamic Mathematics and Astronomy*, vol. 96, Publication of the Institute for the History of Arabic-Islamic Science at the Johann W. Goethe University, ed. Fuat Sezgin, Frankfurt am Main, 1998, pp. 78-92).

15. P. Gouk: *The Ivory Sundials of Nuremberg 1500–1700*, Cambridge (1988), p. 18.
16. S.A. Lloyd: *Ivory Diptych Sundials 1570–1750*, Harvard University Press, Cambridge, Massachusetts, and London, England (1992), p. 15.
17. This has recently been explained in more detail by Karlheinz Schaldach in his new book *Sonnenuhren des Mittelalters und der frühen Neuzeit*, self-printed in 99 numbered copies (2023), pp. 11-12.
18. G. Dohrn-van Rossum: *History of the Hour. Clocks and Modern Temporal Orders*, Thomas Dunlap (transl.), Chicago & London (1996), p. 115.
19. S. Münster: *Horologiographia*, Basel (1533), ch. 33.
20. "*Sogliono molti in Italia cavar' non poca dilettatione dell'Horologio solare Boemicho, che s'usava anticamente appresso i Babiloni, & al presente in Norimbergo: & appresso li Balleari qual addimandano ab Ortu solis*..." (Italy derives no small enjoyment from the Bohemian sundial, which was used in ancient times among the Babylonians, & at present in Nuremberg: & among the Ballearians as they demand ab Ortu solis).; G.B. Vimercato: *Dialogo della descrittione teorica et pratica de gli horologi solari*, Ferrara (1565), pp. 105-106.
21. E. Danti: *Dell'uso et fabrica dell'astrolabio et del planisferio*, Florence (1578), p. 284.
22. M. Oddi: *Degli horologi solari nelle superficie piane*, Milan (1614).
23. B. Scultetus: *Gnomonicae de solariis, sive Doctrina practica tertiae partis astronomiae* (1572).
24. See K. Schwarzinger: *Katalog der Ortsfesten Sonnenuhren in Österreich*, Innsbruck (1993). The borders of Scultetus' Austria, in the sixteenth century, extended from Trento and Trieste (Italy) to the borders with Bohemia and Moravia. Probably he refers only to a part of the Austrian archduchy because most of the Austrian sundials of that century do not show the Italian hours. Bartholomäus Scultetus (1540-1614) studied in Wittenberg where he became Magister Philosophiae in 1564. From 1570 until 1586 he taught in Görlitz, Bohemia. Becoming judge in 1589 and burgomaster of Görlitz in 1592, his knowledge of the times used in Bohemia, Moldavia, and Styria is therefore beyond doubt.
25. Riccioli: *Almagestum novum*, Bononiae (1653), I, p. 34; Bilfinger, ref. 7, p. 190.
26. C. Clavius: *Gnomonices libri Octo*, apud Franc. Zanettum, Romae (1581), p. 6, line 52 et seq.; especially line 56: "*Athenienses autem, quos nunc sequitur tota Italia una cum Bohemia, diem definiebant ab uno solis occasu ad occasum alterium, indequae horas aequales numerabant: quae iam italicae nuncupatur ab Italia, ubi maxime earum usus viget*." (But the Athenians, who are now followed by the whole of Italy together with Bohemia, defined the day from one setting of the sun to the setting of the next).
27. V. Pini: *Fabrica de gl'horologi solari*, Venetia (1598), p. 5v.
28. T. Przypkowski: *Storia dell'Astronomia in Polonia*, vol. 1, undated, p. 208.
29. T. Przypkowski: 'The art of Sundials in Poland from the Thirteenth to the Nineteenth Century', *Vistas in Astronomy*, vol. 9, 1967, fig. 5, p. 17; cf. also J. Lenfeld: *Slunecni hodiny ze sbirek UPM v Praze*, Praha, Umelecko prumyslove muzeum v Praze, 1984, p. 31, and B. Polak: *Staroprasske slunecni hodiny, Praha*, Nakladatelstri Cs. Akademie ved 1986, p. 16.
30. R.J.R. Rohr: *Sundials: History, Theory and Practice*, Dover, New York (1970), p. 105, fig. 178; See also Gouk, ref. 15; Lloyd, ref. 16; K. Lippincott: 'World Time and the History of Now', *Amsterdam Talk*, 21 September 2002; This is confirmed also in the *Nuovo Almanacco per l'anno bisestile 1776 arricchito di notizie utili e dilettevoli*, Venezia, undated but 1775/76, p. 52, "*I Greci d'oggidì sono i soli, che incominciano il giorno al levar del Sole*" (The Greeks of today are the only ones who begin the day at sunrise).
31. Mario Arnaldi: 'Le ore italiane. Origine e declino di uno dei più importanti sistemi orari del passato', *Gnomonica Italiana* issue 11, July 2006, pp. 10-18 (first part) and issue 12, May 2007, pp. 2-10 (second part).
32. Charles of Luxembourg was born in Prague on 6 May 1316. His father John, known as the Czech, was the son of Emperor Henry VII and his mother Elizabeth was the sister of Wenceslas III, king of Bohemia.
33. Francesco Petrarca: *Epistolae de Rebus Familiaribus et Variae*, vol. III, epistola 44, edited by G. Fracassetti (1863); see also the interesting article by G. Brusa: 'L'emblema di Hora', *La Voce di Hora*, no. 1 (December 1995).

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At the Newbury Meeting

Lunch in the garden.

Waiting for the show to begin.

The Report of the 2023 Newbury Meeting is on pages 37-43 of this issue.

AN EQUATORIAL SUNDIAL BY JOHN WHITEHURST OF DERBY

SUE MANSTON

In late July this year the BSS Help and Advice Service was contacted by Annie Wright. She had recently purchased a sundial from an antique dealer in Leicester who said it was an unfinished piece but did not know any more about it. Annie recognised the name engraved on the dial as a well-known firm of clockmakers and asked if we could give her any further information.

Fig. 1. Dial plate with hours marked from 4 am to 8 pm.

The dial is shown in Fig. 1. The dial plate is a circular disc, probably brass, 95 mm in diameter. There is a sturdy gnomon which is normal to the disc. Hour lines are marked from 4 am to 8 pm.

Fig. 2 shows the other side of the dial which also has a gnomon normal to the disc, with hours marked from 6 am to 6 pm.

Fig. 2. Dial plate with hours marked from 6 am to 6 pm.

The inscription (Fig. 3) is "*Whitehurst*", "DERBY" and "1761". The latitude is given as "53^{D} : 00^{M}" (the latitude of Derby is around 52.9°).

John Whitehurst FRS (1713–88) was the son of a Congleton clockmaker and the grandson of a minor land-owner with an estate in Staffordshire. He came to Derby in 1736 and worked as a clock and instrument maker, gaining his freedom to trade in 1737. He was elected a Fellow of the Royal Society in 1776 and moved to London in 1780. He is known to have made a number of sundials and is credited with designing others, notably the interesting dial over the door at St Lawrence's Church, Eyam (SRN 0486).[1,2] The Whitehurst business was large, with many employees and apprentices; making sundials was only a minor part of their work. Whitehurst was also a mechanical engineer, hydraulicist, meteorologist and geologist, and he had a hand in the development of the steam engine.[3]

Fig. 4 shows a side view of the dial, set vertically into a wooden base. It was described as a double-sided wall dial, but is actually an equatorial sundial, currently oriented as if it was located on the Equator. Fig. 1 shows the Summer side of the dial and Fig. 2 shows the Winter side.

The Roman numerals are read from the outside of the dial. There are two centres of delineation, marked by dots at the corners of the gnomons. As far as I can tell from the photographs, the hour lines are all at 15° intervals and are measured from the correct centre of delineation, including the back hours. There are divisions for 30 and 15 minutes and a wide gap at noon to allow for the width of the gnomon. The dial appears to be a well-made equatorial dial

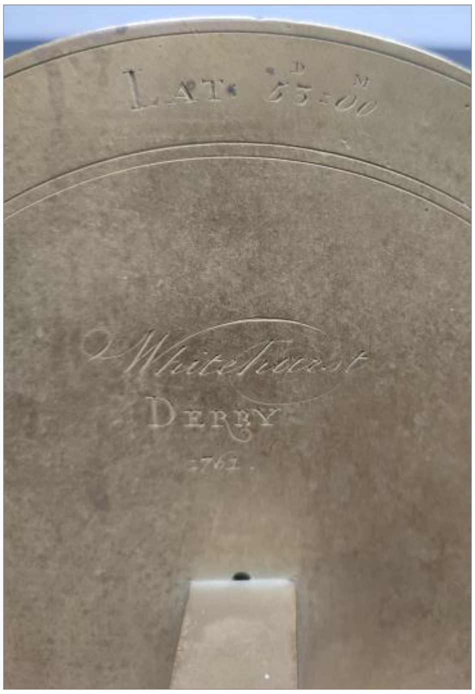

Fig. 3. Inscription: "Whitehurst", "DERBY", "1761" and "LAT: 53^D : 00^M".

Fig. 4. Side view of dial showing gnomons and wooden base.

Fig. 5. Summer solstice line on the gnomon with the Zodiac symbol for Cancer.

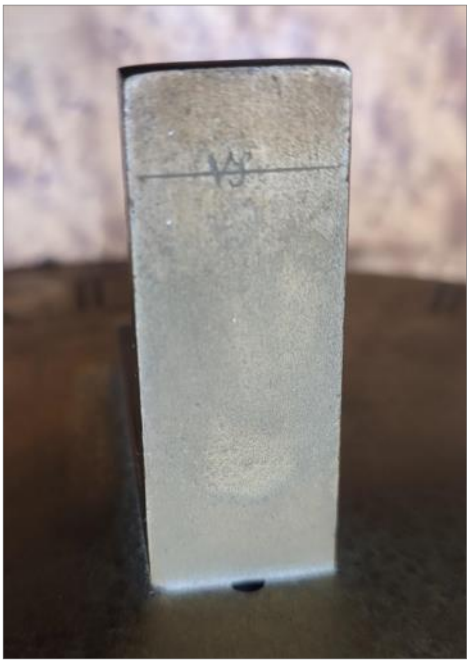

Fig. 6. Winter solstice line on the gnomon with the Zodiac symbol for Capricorn.

that could be positioned to work at any latitude in the northern hemisphere, but the fact that the hours are marked from 4 am to 8 pm suggests it was intended to be used at the inscribed latitude of 53°. There is a large 'tab' at noon which would enable the disc to be set into a base at the correct co-latitude.

There are solstice lines marked on both gnomons (Figs 5 and 6). At the Summer and Winter solstices, at local solar noon, the shadow of the dial will fall onto the appropriate solstice line on the gnomon (Fig. 7). The lines are marked with the symbols for Cancer (Summer) and Capricorn (Winter).

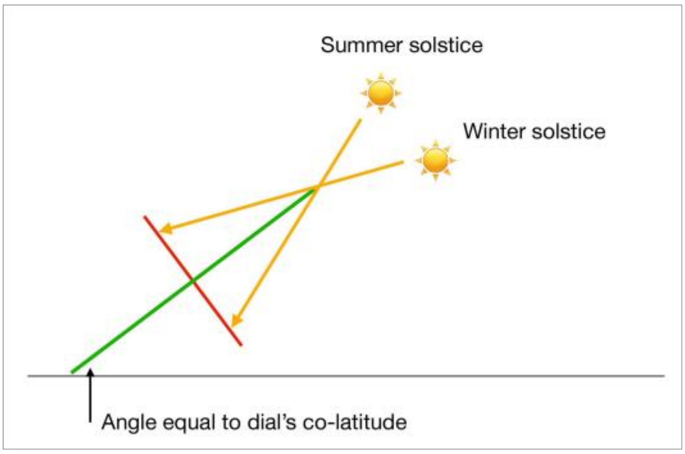

Fig. 7. Diagram showing how the shadow of the dial will fall on the gnomons at the solstices.

Fig. 8. Winter side of the dial showing errors on numerals I, IIII and V.

Closer examination of the underside of the dial shows errors in the engraving of the Roman numerals. There are several dots on the numerals I, IIII and V (Fig. 8). The numerals IIII and V were originally engraved as VIII and VII. The engraver obviously realised the mistake – the numerals go *anti-clockwise* on the Winter side of an equatorial dial in the northern hemisphere – and attempted to remove the material of the error and near surroundings by a series of drillings.

The dial is probably rather awkward to read. The wide gnomon will give a shadow with two straight edges and it may not be immediately obvious which edge to use because the hour lines do not extend right in to the centre of the dial.

Conclusion

This is an interesting and unusual dial, possibly unique. It may have been an experimental one, perhaps made by one of Whitehurst's many apprentices.

ACKNOWLEDGEMENTS

I am grateful to Annie Wright for her assistance with photos and measurement of the dial, and to John Davis for his expert advice on John Whitehurst.

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Photos courtesy of Annie Wright.

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BSS BULLETIN FOLLOW-UP: 25 OCTOBER 2023

FRANK H. KING

On 25 October the BSS hosted a second Zoom event which followed the pattern of the inaugural event hosted on 25 July.[1] In order to avoid using a brand name in the title of this series, we are now using the term 'BSS Bulletin Follow-ups'.

Videos of both the July event and the October event can be seen by visiting the BSS YouTube channel at:

https://www.youtube.com/@the-bss

Unfortunately, Mario Arnaldi was not available to introduce the lead article about the Erfurt Rule[2] so that task fell to me. I built up a single diagram (see Fig. 1) which demonstrated a graphical method for determining the angles specified in both the Erfurt rule and the Modified Erfurt rule. This used an idea proposed by Geoff Thurston at the rehearsal for the event. You imagine a simple triangular gnomon on a direct-south-facing wall and arrange for the lower edge to be perpendicular to the wall and the sloping edge to be polar oriented and set for the local latitude. Then, on the day of an equinox, you mark the positions of the shadow of the tip of the gnomon at hourly intervals from sunrise or 6 am to sunset or 6 pm.

The highlight of the event was the discussion of David Brown's article[3] on his magnificent restoration of a Richard Melvin sundial which featured on the front cover of the September *Bulletin*. David was able to direct the camera on his computer at his steeply sloping worktop and he demonstrated how he used some of his chisels. See the screenshot in Fig. 2 with its description by David himself.

The Postscript this time was inspired by Roar Hagen-Diez's article on a Norwegian Sundial Compass.[4] Unfortunately, Roar was not available himself so I discussed the challenges of converting solar azimuth to solar hour angle in a way that could be understood by ordinary hikers or cross-country skiers. In Norwegian latitudes, you could simply supply graphs showing hour angle versus azimuth. This is not very far from being a linear relationship at all times of year. By contrast, in the Tropics, the graphs become unexpectedly complex and would be of very limited use to those who enjoy exploring rain forests. See Fig. 3 as an example.

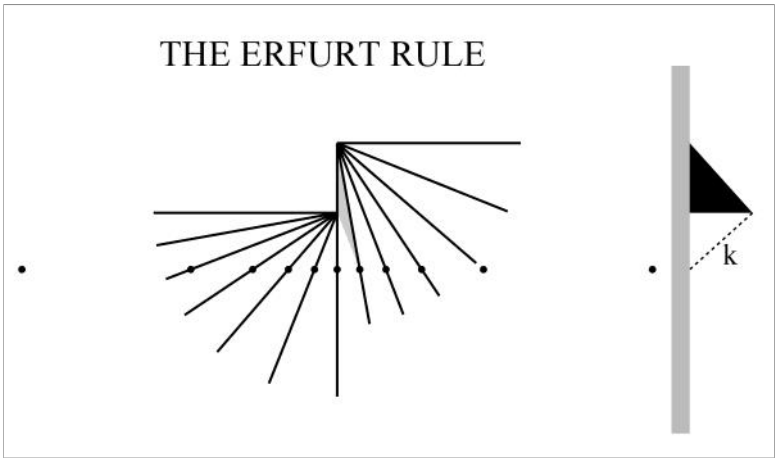

Fig. 1. A diagram showing how the hour lines of the Erfurt rule (left-hand side of the midday line) and the Modified Erfurt rule (right-hand side of the midday line) can be built up on a direct south-facing wall using an imagined triangular gnomon. The assumed latitude in this example is 48° north.

Fig. 2. Whereas a dummy mallet is needed to drive a letter-cutting chisel into slate for deep/wide incisions, a much more gentle approach is needed for the typical copper-plate letters and numerals and other elaborate decorations found on a Melvin/Melville sundial. David is using a 4 mm wide tungsten-carbide tipped chisel that he has narrowed down to 2 mm. A band of masking tape provides a ridge for the right hand to drive the chisel while the left hand acts as a controlling and restraining force. The slate being used here is a scrap piece for demonstration purposes only.

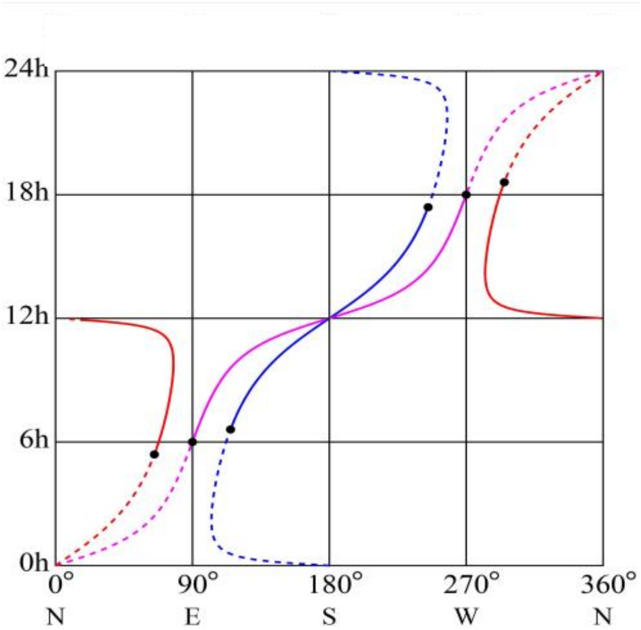

Fig. 3. A diagram showing three plots of hour angle versus azimuth at 20° north. The broken line sections of the plots indicate when the sun is below the horizon. The equinoctial plot (magenta) is not very different from the equivalent plot in British latitudes. The sun is due north at midnight, 0 h, and rises due east at 6 h (black spot). It sets due west at 18 h (another black spot) and returns to due north at midnight, 24 h.

At the summer solstice (red-brown) the sun is due north at both midnight and midday. When the azimuth is around ESE, the hour-angle is ambiguous; it could be around 6 am or 11 am.

At the winter solstice (blue) the sun is due south at both midnight and midday.

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SOME SCRATCH DIALS AND OTHER GRAFFITI

BEN JONES

This article is based on a talk given at the Exeter BSS Conference in April 2023.

Many people who are interested in sundials are perplexed by scratch dials. These dials are mostly small, crude and devoid of any intriguing mathematics. The simplicity of their 'design' has an appeal for a few, but it is probably their age and the unlikeliness of their survival along with the puzzle of who made them, why and how, that most often captures the imagination.

Finding a dial is oddly pleasing too. At first you may see nothing but then the light changes and there it is. Such was the case with the dial at St Wendreda's in March in Cambridgeshire (Figs 1 and 2). The dial is on a Romanesque doorway now built into the mainly 14th-century church and covered with a porch. St Wendreda's is most famous for its stunning double hammerbeam roof and the 120 carved angels on it.

My interest in scratch dials started when my wife Pru, who is an archaeologist, took up the study of Historic Graffiti. This is a relatively new area of archaeological research, having really taken off only in the last 10 or 20 years.

For most of us the word graffiti means vandalism, so it is odd to think that scratching away at church fabric and making marks was once an accepted part of church life (Fig. 3). Many symbols seem to be votive or apotropaic and others are secular such as the merchant's mark in Fig. 4.

Fig. 1. A scratch dial on the Romanesque doorway of St Wendreda's Church, March, Cambridgeshire.

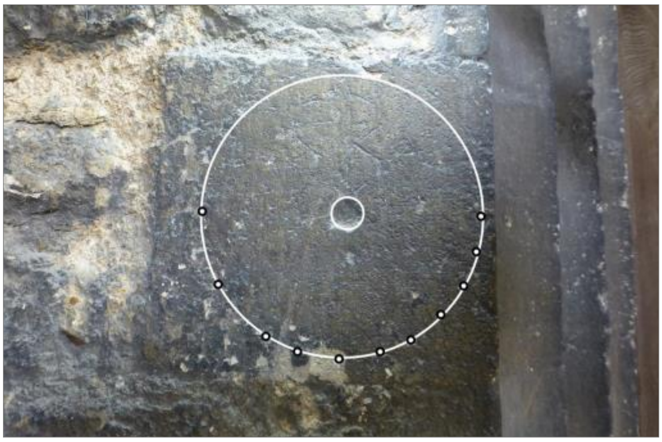


Fig. 2. The highlighted scratch dial of St Wendreda's Church, March, Cambridgeshire.

Fig. 3. A great many different types of graffiti carved into a pillar in the church in Offwell, Devon.

Fig. 4. A merchant's mark and other graffiti inside the porch entrance in Bondleigh, Devon.

Fig. 5. Hexafoil and other graffiti on the Rood screen rail in the church in Totnes, Devon.

Hexafoils of different diameters are a very common graffito (Fig. 5). A few hexafoils found on the outside of churches have been recorded as 'petal dials' by Mass dial recorders.

People interested in historic graffiti often record scratch dials even though the dials are not strictly speaking graffiti and sometimes they too debate how and why these things were made and what were they used for.

I am most definitely not an expert in either subject but since starting to look after the Mass Dial Register and having assisted with graffiti surveys, I have found some oddities that I hope are worth mentioning and will be of interest to you.

Doorways, Displaced Dials and Dating

While recording graffiti in the church at Topsham, Devon, I found a dial (Fig. 6) inside the tower and next to the outside door. Within a week or so I found another dial by a main door in the nearby church at Woodbury (Fig. 7). Both of these dials look more carved than scratched. The Woodbury dial showed eight hours while the Topsham dial showed twelve hours. Rightly or wrongly, it surprised me to find two dials only three miles apart that showed different hours. Both dials are well weathered.

After such a flying start, I did not find another inside-doorway dial for another couple of years, until I went to a

Fig. 7. An old dial, set upside down, by the entrance door inside the church in Woodbury, Devon.

funeral in Barford St Michael, Oxfordshire, where I suddenly noticed, opposite my pew, a dial built into the entranceway of the south door (Fig. 8). The old turret clock stands next to it silently gathering dust.

These three dials would all seem to have been deliberately kept and built into doorways, but for what reason? Such a tiny number of examples certainly cannot show if there is any pattern or significance to their siting.

However, dials in odd places are well worth recording for the very practical reason that displaced dials could provide a reliable way of dating some scratch dials. For example, we know that in Barford St Michael the church was built in the mid 12th century, remodelled in the 13th century, then had the south aisle widened and the doorway probably reset in the 14th century. This means we can reasonably suggest that the dial was made before the end of the 14th century when it was built into the doorway.

The tower at Topsham was completed by the mid 15th century and it would be nice to be able to say that the dial was therefore made before the mid 15th century. But the uneven stonework round the outside of the doorway

Fig. 6. An old dial set next to the doorway inside the tower of the church in Topsham, Devon.

Fig. 8. An old dial set by the south doorway inside the church in Barford St Michael, Oxfordshire.

suggests that the doorway was inserted into the tower at a later date and this would not be surprising as St Margaret's has been severely rebuilt several times.

Reliable dating would support or disprove a number of ideas about the development of scratch dials, but precise dating for the re-building of most churches is not easy to establish and to date a statistically significant number of dials would take a great deal of very careful work.

Unusual Dials and Symbols

In the Mass Dial Register, the church at Shute, Devon is recorded as having a dial on it. But no description or position is given and the only clue as to what the dial might look like is the very low-quality photograph in Fig. 9. The church has been thoroughly searched and no such dial has been found, which of course does not mean it is not there.

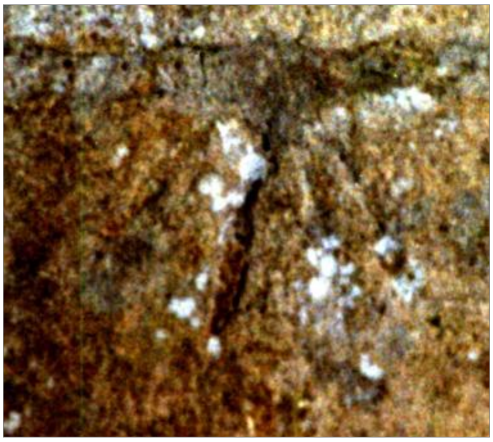


Fig. 9. A very low-quality photograph of a dial that is recorded as being on the church at Shute, Devon.

Fig. 10. The church warden will tell you this is the Mass dial on the church at Shute, Devon.

However, the churchwarden at Shute will tell you that there is a Mass dial on the front of the porch, one that looks nothing like the thing in our photograph. The 'dial' is 100 mm in diameter and has a central hole with metal in it (Fig. 10). If this is a scratch dial, it is an unusual one.

As far as I can see, we have only one other like it in the register, at Colne Engaine in Essex (Fig. 11). No diameter is recorded but the hole is 25 mm deep. It might just possibly have a second, much fainter inner circle but it is hard to tell from the photograph.

Fig. 11. This device from the church at Colne Engaine, Essex, is possibly similar to the Shute 'dial'.

If the Shute dial is not a dial, then what might it be? A known Christian symbol is an 8-armed device and you may find examples of these graffitied inside churches. There are various explanations for the symbol including that it is a combination of an upright cross with the monogram of Jesus Christ using the Greek letters Ι and Χ. It also happens to be the symbol of St Catherine who was martyred on a wheel. It is also a symbol used by the Romans and predates Christianity. But none of these symbols requires a central hole with a metal rod.

A similar well-known Christian symbol is the 6-armed cross which is also possibly a monogram of Jesus Christ made up of the Ι and Χ but without the upright cross.

The register has one recording of a dial like this. It is at Hutton Cranswick, Yorkshire and has a diameter of 64 mm (Fig. 12). The central hole is a 4 mm in diameter which is narrow and only 2 mm deep which is shallow.

If you visit Exeter Cathedral and enter through the west doorway and look down to your left, you will see the device in Fig. 13 deeply carved into the stone. It is approximately 65 mm in diameter. No one at the Cathedral seems to know what it is or why it is there. It has not been recorded as a Mass dial.

In historic graffiti terms something like this is often categorised simply as an 'asterisk', to avoid attributing a particular meaning to something that is not fully understood or may have had more than one meaning at any one time or at different times in the past. We seem to have some recorded as Mass dials, which of course they might be, just very odd ones.

Fig. 12. This device, recorded in the Mass Dial Register, is on the church at Hutton Cranswick, Yorkshire.

Fig. 13. This device is to be found just inside the glass doors in the entrance at the west end of Exeter Cathedral, Devon.

Fig. 14. Otherwise almost-invisible graffiti shown up with a raking light on the main doorway to the church at Sidbury, Devon.

Fig. 15. The highlighted hexafoil and oddly dial-like graffito found on the main doorway to the church at Sidbury, Devon.

Dial-like Graffiti

If you visit a medieval church, take a torch with you and shine the light across the stone or wood surfaces. You may well be surprised by what you find.

The doorway inside the porch on Sidbury church in Devon looked completely blank to me: just the usual old and well-worn stone you might expect to find. But the instant that a raking light hit the surface, all sorts of graffiti were suddenly revealed. Figs 14 and 15 show the stonework and the tiny hexafoil that appeared. But the thing I was surprised to find was a strangely dial-like little object. It is less than 2 inches in diameter and has no central hole so it surely cannot be a scratch dial. Except for the surprise in finding it, this minor oddity might have been forgotten. But when visiting the church in Ashwell in Hertfordshire I found other dial-like graffiti.

If you should ever find yourself near Ashwell, do visit the church. It is spectacularly covered with historic graffiti. In the tower there are two large texts high up on the wall (Fig. 16). One translates as

1350 Miserable, wild, distracted 1350
The dregs of the mob alone survive to witness

This refers to the Black Death epidemic during the reign of Edward III.

The other translates as:

And in the end a tempest full and mighty
This year 1361 thunders mightily in the world

This last line probably refers to the devastating storm in January 1361 which may have cleared the air of any remaining traces of the bubonic plague. Textual graffiti

Fig. 16. Latin and Greek graffiti referring to the Black Death, carved into a wall in the tower of Ashwell church, Hertfordshire.

Fig. 17. A remarkably detailed graffito showing Old St Paul's or Westminster Abbey, in the tower of Ashwell church, Hertfordshire.

recording a historical event are pretty rare, so these are very special indeed.

Also in the tower is a graffito (Fig. 17) often identified as old St Paul's Cathedral in London, but it could also be an image of the transept of Westminster Abbey. Either way, it's a fabulous drawing. There are a lot of other historic

Fig. 18. A piece of graffiti that looks not unlike an eight-hour scratch dial. On a pillar inside the church at Ashwell, Hertfordshire.

Fig. 19. More graffiti including empty circles and another asterisk symbol on a pillar inside the church at Ashwell, Hertfordshire.

graffiti all round the church but what most caught my eye were some more oddly dial-like features.

On a pillar near to the south doorway there is something that looks like an 8-hour scratch dial (Fig. 18). It is, however, indoors and on a pillar that was never outside so it cannot be explained by the past rebuilding of the church and the reuse of old stone. That there are features that look like dials, but can never have been dials, is something to consider.

On the corresponding pillar to the north, you will find more graffiti including empty circles and another asterisk symbol (Fig. 19). You will also find another feature which again looks like some of the dials in the register (Fig. 20).

Then over to your west on the tower wall you will find lots more graffiti, including the circular device with many drilled dots shown in Fig. 21. Nearby there is also another dial-like feature (Fig. 22).

I am not suggesting that any of these *dial-like* pieces of graffiti at Ashwell or Sidbury were ever or could ever have been sundials of any sort. But they do resemble dials though the significance of so very few examples is uncertain. But it may be worth bearing in mind the

Fig. 20. There are dials in the register similar to this graffito which is on a pillar inside the church at Ashwell, Hertfordshire.

Fig. 21. A detailed graffito made of circles and dots. Inside the church at Ashwell, Hertfordshire.

Fig. 22. Another dial-like piece of graffiti from inside the church at Ashwell, Hertfordshire.

possibility that some features which have been, or may in the future be, identified as Mass dials, could have had other meanings or functions.

Please keep sending me good photographs of any scratch dials you come across. One square-on close-up photograph of the dial and one good location shot are ideal. And good luck with your graffiti hunting.

MassDials@sundialsoc.org.uk

NEWBURY ONE-DAY MEETING

23 September 2023

About thirty BSS members and friends met once again at Sutton Hall, Stockcross for the annual Newbury meeting and were greeted, as last year, by clear blue skies and bright sunshine.

Some early arrivals helped organiser David Pawley arrange tables and chairs, and others helped Wendy by setting out mugs, tea, coffee and other refreshments in the kitchen. Meanwhile, Elspeth Hill, making her final appearance in the role of 'Sales', arranged a large display of sundial-related non-BSS publications for sale. Doug Bateman had brought a selection of material from the collection of the late Mike Cowham, including all four editions of 'Gatty', and a bulging folder of notes prepared by Mike. In another part of the hall, Martins Gills' table attracted much interest.

Morning

Peter Ransom, our regular Master of Ceremonies, welcomed us all on this, the day of the equinox. He expressed his pleasure at seeing so many people, some of them attending the meeting for the first time, and several of them from long distances – including Latvia. He then handed over to our first speaker.

Frank King: The Oronce Fine Quadrant – Some additional thoughts

Frank explained that he had greatly enjoyed reading David Coffeen's lead article in the June 2023 *Bulletin* about

the Oronce Fine Quadrant. A key feature of this instrument is that all the hour lines are straight, whereas on most quadrants they are curved. The implication in the article is that this straightness can be achieved by having a suitably non-linear date scale (declination scale) in the side panel of the instrument.

By reverse-engineering the delineation, Frank found that, outside tropical latitudes, it is possible to start with straight 12 o'clock hour lines and force the declination scale to fit. It then transpires that the other hour lines are very nearly straight but not quite. At 48.5° N (the design latitude of the quadrant), the curvature of the correct hour lines is so small that replacing them by straight-line approximations hardly degrades the accuracy. Did Oronce Fine in the early 16th century realise this? We cannot know.

The approximation requires the noon altitude of the sun to increase monotonically from the winter solstice to the summer solstice. This is true north of the Tropic of Cancer but, in the Tropics, the highest noon altitudes are on the two days each year when the solar declination matches the local

Display of items by Martins Gills, including his London Sundials walking guide.

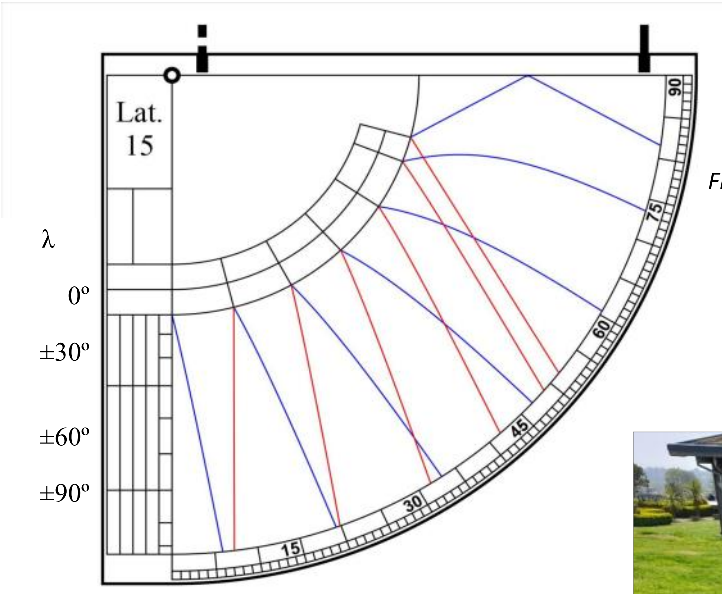


Fig. 1. An Oronce fine quadrant delineated for 15° N.

Fig. 2. Analemmatic dial at Brading.

latitude. Fig. 1 shows the quadrant marked out for latitude 15° N. At noon on the day of an equinox the altitude matches the colatitude, 75°. At noon on the day of the summer solstice, the altitude is 81.56° (180–(75+23.44)). On the two days of the year that the solar declination is 15°, the noon altitude is 90°. The best one can do is to have the 12 o'clock line formed by two straight-line segments as shown in blue in Fig. 1. The 12 o'clock line for the winter half of the year really is straight and is shown in red. Most of the other hour lines are nearly straight except the summer 11 o'clock line.

Peter Ransom: Some Dials from the Isle of Wight – Spanning two millennia

When Peter was invited to give a talk to the Vectis Astronomical Society in April on the Isle of Wight, this allowed him and his wife to spend a few days exploring the island and seeing three dials he had not before.

The first was the analemmatic mosaic dial at the Brading Roman Villa (Fig. 2).

The next was the obelisk of the median dial given by Sir Thomas Brisbane (the

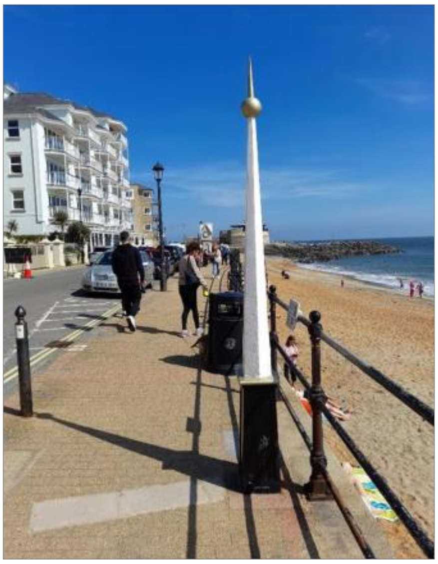


Fig. 3. Brisbane obelisk at Ventnor.

Fig. 4. Pilkington & Gibbs heliochronometer at Ryde.

founder of Brisbane in Australia) to Ventnor in 1851 (Fig. 3). Only the obelisk and part of the noon line remain; the stone marking the other end of the line is in the local museum.

The third dial was the Pilkington & Gibbs heliochronometer in the cemetery at Ryde (Fig. 4). This is on the grave of John William Towers-Clark, who died in the First World War on 1 July 1916. It has serial number 638 on it. Although not tilted at the correct angle, the rest of the mechanism does move.

Geoff Thurston: Finding True North

Geoff Thurston described his investigation of discovering true north using only rudimentary techniques. A recent *Bulletin* article considered the use of a magnetic compass to align a dial and this prompted the idea that there should be a practicable and more elegant method using only the sun.

Photo: Mike Shaw.

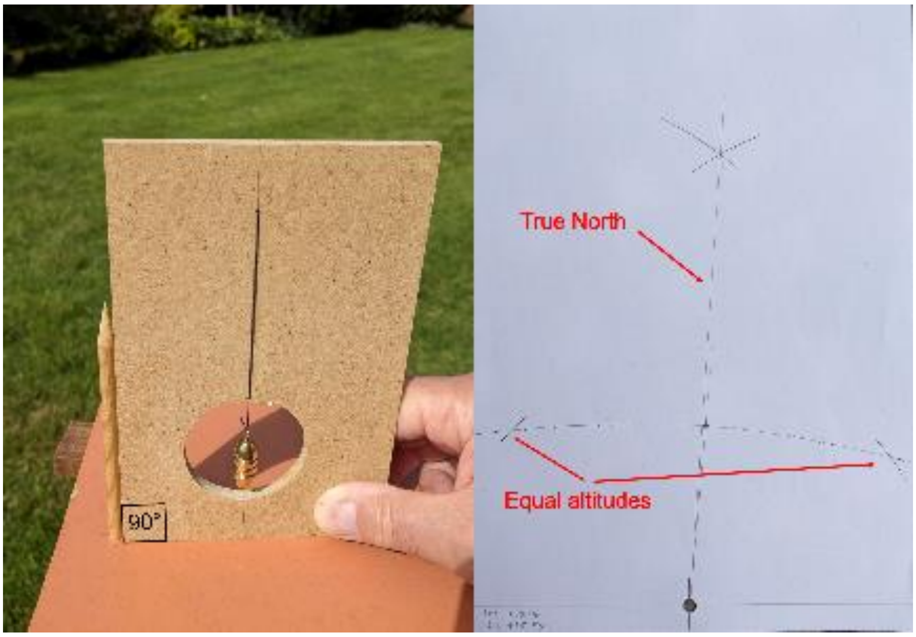


Fig. 5. Plumbline in use and construction of true north from shadow plot.

At true local noon, the sun is due south at its maximum altitude but the altitude changes slowly so the instant of noon is hard to determine. However, the sun's path in the sky is symmetrical about the meridian so, if we measure the azimuth of the sun when it is at equal altitudes before and after noon, we only have to bisect the angle to find true north.

A simple plumb-line level was manufactured with one corner a right-angle and a datum line drawn parallel to one side (Fig. 5). Using this device it was possible to level the dial face and adjust the gnomon to be vertical.

Three experiments were carried out. Each involved plotting the sun's shadow at intervals during the three hours before and after noon, noting equal altitudes on either side of noon and bisecting their azimuths. In each experiment the direction of north was measured within 1°–2° of the true direction determined by the shadow at true noon according to a clock adjusted for longitude and the equation of time. The effect of the sun's changing declination during the day was considered but calculations indicated that this should affect the result by no more than 0.1°.

It appears that the method of equal altitudes is practicable and offers an accuracy of about 2° in dial orientation.

Martins Gills: Sundial Atlas for the BSS

The Sundial Atlas (*sundialatlas.net*, SA) possibly is already known to members of the BSS, and in recent years it has become better suited to the needs of the BSS. This universal database of sundials, developed more than a decade ago by Italian sundiallist Fabio Savian, lists tens of thousands of sundials globally. At the time of the Newbury meeting, it listed

4088 UK sundials. Ideally, each sundial has at least one photo, a brief description and the geographical location – either the exact one or an approximation. Recent improvements in

the Atlas include a link from the sundial record in SA to the appropriate sundial information in Bridol, the British Dials Online register accessible via the BSS website. At the same time, there are no links in the opposite direction – from Bridol to SA. Although Bridol lists 4483 sundials, there are still sundials listed only in the SA. As the Q&A session revealed, there is an ongoing work from the BSS side to improve the records and links. For the participants at the Newbury meeting, Martins had prepared a one-page visual instruction on various options of navigation through the SA. If anyone is interested, Martins is ready to send it as the pdf file.
Email: *saulespulkstenis@gmail.com*

John Foad: John Lester

John Foad reminded those who had not yet heard, that John Lester had died in July. He did not propose to give a eulogy, but said that he was writing an obituary (see p. 9 of this issue of the *Bulletin*), and would be glad to hear any reminiscences that might be included.

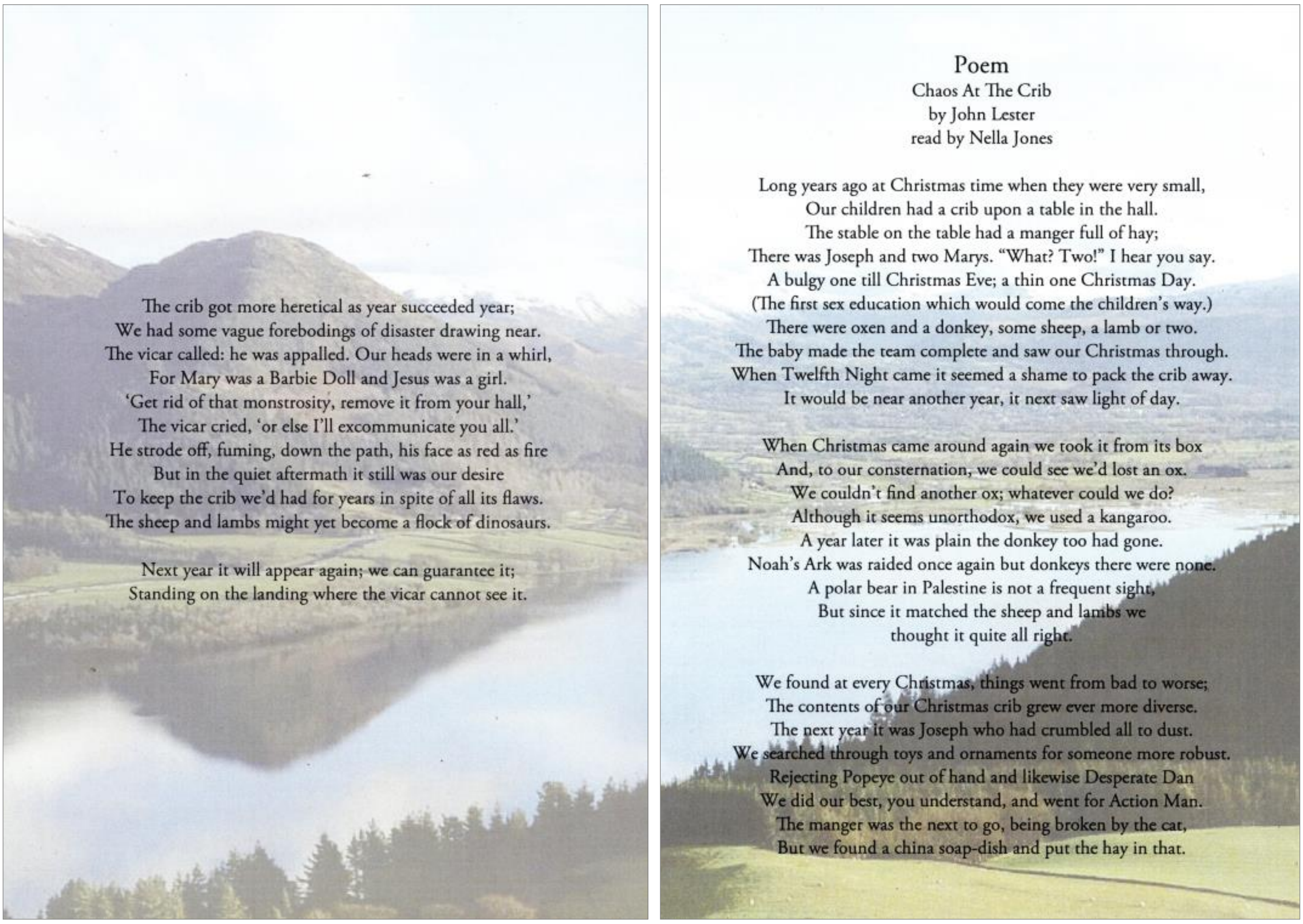
He was then about to read a Christmas poem of John's (Fig. 6), but was

delighted when Mike Shaw stood up ready to declaim it all by heart – he had known it from long ago!

Ben Jones: Two Scratch Dials

Ben spoke about two scratch dials of which he had recently been sent pictures.

The first (Fig. 7) was a very crudely engraved device that might not be a dial at all. The 'dial' has 24 possible lines and 20 very unevenly spaced dots, but most of the lines are curved to varying degrees, probably from being roughly re-engraved. The fainter lines are possibly straighter. The stone block was removed from the old abandoned church in 1949 and is now stored in the new church at Flaunden in Hertfordshire. The ruins of the old



Poem
Chaos At The Crib
by John Lester
read by Nella Jones

Long years ago at Christmas time when they were very small,
Our children had a crib upon a table in the hall.
The stable on the table had a manger full of hay;
There was Joseph and two Marys. "What? Two!" I hear you say.
A bulgy one till Christmas Eve; a thin one Christmas Day.
(The first sex education which would come the children's way.)
There were oxen and a donkey, some sheep, a lamb or two.
The baby made the team complete and saw our Christmas through.
When Twelfth Night came it seemed a shame to pack the crib away.
It would be near another year, it next saw light of day.

When Christmas came around again we took it from its box
And, to our consternation, we could see we'd lost an ox.
We couldn't find another ox; whatever could we do?
Although it seems unorthodox, we used a kangaroo.
A year later it was plain the donkey too had gone.
Noah's Ark was raided once again but donkeys there were none.
A polar bear in Palestine is not a frequent sight,
But since it matched the sheep and lambs we
thought it quite all right.

We found at every Christmas, things went from bad to worse;
The contents of our Christmas crib grew ever more diverse.
The next year it was Joseph who had crumbled all to dust.
We searched through toys and ornaments for someone more robust.
Rejecting Popeye out of hand and likewise Desperate Dan
We did our best, you understand, and went for Action Man.
The manger was the next to go, being broken by the cat,
But we found a china soap-dish and put the hay in that.

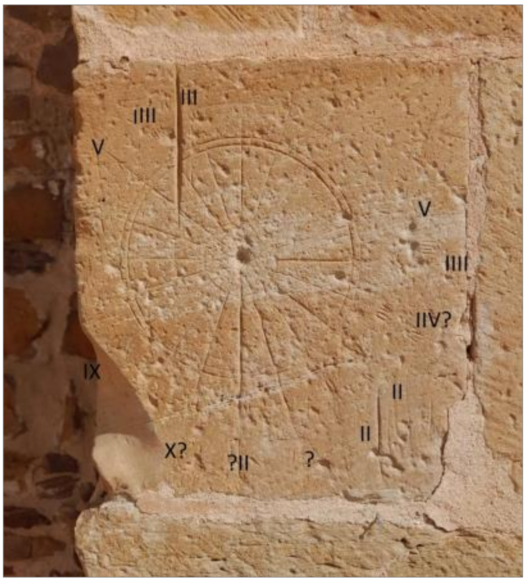
The crib got more heretical as year succeeded year;
We had some vague forebodings of disaster drawing near.
The vicar called: he was appalled. Our heads were in a whirl,
For Mary was a Barbie Doll and Jesus was a girl.
'Get rid of that monstrosity, remove it from your hall,'
The vicar cried, 'or else I'll excommunicate you all.'
He strode off, fuming, down the path, his face as red as fire
But in the quiet aftermath it still was our desire
To keep the crib we'd had for years in spite of all its flaws.
The sheep and lambs might yet become a flock of dinosaurs.

Next year it will appear again; we can guarantee it;
Standing on the landing where the vicar cannot see it.

Fig. 6. John Lester's poem in the Order of Service. The start of the poem is on the right here to keep the background picture together.

Fig. 7. Is this a dial?

Fig. 8. Dial from Torrenueva La Mancha. Photo: Esmonde Kelly.



church have been demolished. It is not known which way up the block sat though we know it was once part of a doorway. There is a second but much smaller circle engraved on the block along with a lot of scratches and random dots.

Though the 'dial' is a bit of a mess, Ben wondered what information could be gleaned from a detailed tracing. So a tracing on acetate was made and while this failed to show a convincing underlying set of hour lines it did reveal a possible abandoned attempt at constructing a compass-drawn cross.

Quite what this means is open to question but this sort of cross can be found on other dials, notably at Shere in Surrey which has eleven scratch dials on its Romanesque doorway. It would be great to know what tool the average graffiti maker had to hand to engrave circles and semi circles.

The other curious dial that Ben had received a picture of was from Torrenueva La Mancha in Spain (Fig. 8). The ten hour lines and the numbering of those lines looked odd. Perhaps you have an explanation; if so, it would be gratefully received by Ben. There also seemed to be possible knife- or sword-sharpening marks in the stone block, but that is an entirely different subject.

London sundials
From Aldgate to The Queen's Walk

London, the capital of the United Kingdom, hosts more than a hundred outdoor sundials that delight residents of and visitors to the city. Let's get a glimpse of eight of them by following a walking path that starts at Aldgate underground station and finishes at London City Hall.

90 minutes
2 miles
8 sundials

1. Exit Aldgate underground station on to Aldgate High Street. Turn right towards the high-rise buildings. In some hundred metres, fork right at the "Y" junction onto Leadenhall Street. Some hundred metres further, on the right between some tall buildings, is St Katharine Cree church with a street-facing sundial created in 1662. Ironically, it has the motto "Non Sine Lumine" ("Not without light") but most of the time it spends in the shadows of the nearby buildings. It might not be easy to see the golden dial markings, but pay attention to some special hour lines besides the traditional time – Babylonian (from sunrise to sunrise) and Italian (from sunset to sunset) hour lines. SRN = 2273, SA = UK412.

2. Continue walking along the same street and turn left at the junction with Billiter Street, then cross Fenchurch Street and continue on Mark Lane. After some 40 metres, turn right beside a rising arm barrier and enter the Dunster Court – it is open to pedestrians. On the south-facing brick wall of Clothworkers Hall on your right you will notice a

Fig. 9. Part of the first page of Martins' new walking guide.

Martins Gills: A New London Sundial Walk

London, the capital of the United Kingdom, hosts more than a hundred outdoor sundials that delight residents of and visitors to the city. Now there is a new two-page guide to eight sundials in the area around the Tower of London (Fig. 9). The original description and the walk *in situ* was prepared by Martins, and the guide was verified and edited by Bill Visick. The proposed path starts at Aldgate underground station, it is 2 miles long and ends at The Queen's Walk. All eight sundials can be visited within an hour and half of walking. At the time of the Newbury meeting, the guide was in a format of a double-side printed A4 page. Martins proposes this guide be published as a downloadable PDF file on the BSS website. Possibly, there are other compact locations in the UK that offer a nice collection of outdoor sundials. If they are accessible by occasional visitors, such a collection could be a good candidate for the next sundial walk guide to be described and published.

Peter Ransom: Update on the Hythe 'Undial'

At last year's Newbury Meeting, Peter spoke about the polar sundial at Hythe that appears to lack hour lines. However, visiting it in the rain a couple of times this year, he realised that the lines are faintly visible. He therefore supposed that this is still a sort of undial, as you cannot see the hour lines when

Fig. 10. The Hythe Undial in the rain, with hour lines faintly visible.

the sun is shining and there is a shadow, but when it is raining and there is no sun you can see the hour lines (Fig. 10).

AGM and Discussion

Peter's talk was followed by the formal AGM whose draft minutes are recorded on page 44.

After the AGM, Frank King, as Chairman, spelt out some unpalatable facts. In short, we are losing volunteers and no one is coming forward to replace them. The age of volunteering seems to be in steep decline and charities and more informal groups are going out of existence. The British Sundial Society is not immune from this...

Our long-standing head of sales, Elspeth Hill, is retiring after many, many years of service. Given the absence of a successor, the Trustees have decided that we shall no longer sell any non-BSS items. John Davis has kindly offered to look after the sales of our Monographs and John Foad has kindly agreed to look after the sales of our Fixed Dial Registers in both the printed and electronic formats. Ben Jones has likewise taken over the selling of the printed and electronic forms of the Mass Dial Register.

Another major loss is Bill Visick who has looked after our website and much else besides. No one has offered to take over and, for the moment, the website is dormant.

Frank stressed that we urgently need new blood, new members who can take the Society into a new era. This is one of the motivations for running the *BSS Bulletin Follow-up* programme. The intention is to advertise this more widely in the hope that when we look at our screens in Gallery Mode we might spot some likely newcomers.

Try enthusing your children, your grandchildren and anyone you know who might show an interest!

Many people then took advantage of the sun to eat their lunch in the attractive garden behind the hall, and before the afternoon talks began we all lined up there for Mike Shaw to take the customary group photograph.

Afternoon

Martins Gills: Two Sundials at Turaida Castle

For Martins, the global pandemic put on hold the designing of some new sundials, and developed a new interesting cooperation with Turaida castle museum, located some 50 kilometres from Riga, the capital of Latvia. The archaeological excavations at the ruins of this medieval castle in the 1980s revealed two dial plates. The round one, made from dolomite, had been part of a horizontal sundial. The hour lines are not accurate, but on average correspond to latitudes slightly north of Turaida (57.2°). The second sundial, made of burnt clay, was classified shortly after unearthing as an equatorial sundial, but during the recent research a more plausible version was proposed – this could have been a mass dial. This seems to be the first such find in the Baltics. Now, replicas of both sundials have been made with added gnomons and placed outdoors in Turaida castle courtyard (Figs 11 and 12).

Peter Ransom: Update on William Wales

Peter explained that when he wrote about the Fort Prince of Wales dial in *A Dozen Dials* in 1998, he mentioned a letter on constructing sundials that had appeared in the *Gentleman's Magazine*

Inside the hall at the AGM. Photo: Mike Shaw.

Figs 11 and 12. Reconstructions of the dolomite and clay dials at Turaida Castle.

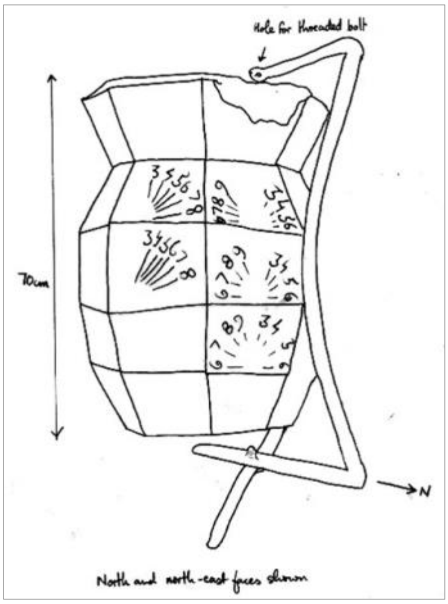


Fig. 13. Sketch probably made by William Wales.

at the time (1769) from a person who signed his or her name with a W.W. at the end. He wrote that this letter might have been by William Wales, who was at Fort Prince of Wales in Manitoba, Canada at that time. Fred Sawyer contacted Peter at the start of the year with compelling evidence that this would be most unlikely, though the dial (sketch shown in Fig. 13) was probably made by William Wales.

Chris Lusby Taylor: Portable Plane Altitude Dials– Recent studies

Like Frank King, Chris had been struck by the straight hour lines in the Oronce Fine Horary Quadrant and had also appreciated that they are not truly straight lines. He had taken his analysis further than Frank had and, using a spreadsheet, he had discovered that the time error from having strictly straight lines rather than the correct slightly curved lines was never more than three minutes.

He also gave us some of his thoughts on using free software and he singled out the versions of two packages which are useful for diallists: GeoGebra and Enscape™. There is much information about both packages on the Internet.

Nick Orders: Bromley House Library

Nick explained that he had met with staff from Bromley House Library (BHL) in Nottingham earlier that week and was able to provide a brief update. In terms of people accessing the BSS books, they said that they were unaware of anyone from the BSS coming to the library (apart from the librarian) but that some of the BSS books are read by BHL members on site. A few specific areas were discussed, namely:

The original Memorandum of Understanding between BHL and BSS was drafted and signed in July 2000. It was agreed that we should look at this to see if it needs updating.

Digitisation: BHL is about to start digitising their entire library and asked if BSS wanted its collection to be included. This would obviously allow more people, including BSS members, to view the books. It may incur a cost, and we will

need to take care of some of the more valuable/older volumes (especially those with pull-outs), but the Newbury meeting were supportive of Nick pursuing this matter further.

Space: BHL is running out of space for its own needs and, whilst allowing small numbers of books to be added to the BSS collection, it cannot expand the current allocated space. They asked if they could remove duplicates/earlier editions. As Nick also does volunteer work in the library at the Museum of Timekeeping in Upton Hall near Southwell, he suggested that they might take some of these additional volumes. This would safely house them as well as further raising the profile of the BSS. Those at the Newbury meeting were broadly in support of Nick pursuing this option.

BSS Bulletins: Related to the space issue, BHL does not currently display the bound copies of the *BSS Bulletin* and of the NASS *Compendium*. Again, given that these publications are available online, the hard copies could be stored with the Museum of Timekeeping.

BHL subscription: the BSS is required to pay the equivalent of two corporate membership subscriptions each year to BHL to cover the cost of housing and insuring the collection. Due to an oversight (possibly by BHL) this has not been paid for some time. Nick agreed to investigate further.

Finally, MC Peter Ransom proposed a vote of thanks to everyone involved in making the day a success, especially to organisers David Pawley and Wendy, and to Chris Lusby Taylor for assisting with several tasks.

The photos of the speakers are by Mike Shaw, and the summaries (and most of the accompanying Figures) are by the speakers themselves.

MINUTES OF THE 33rd BSS ANNUAL GENERAL MEETING

Newbury, 23 September 2023

The AGM was chaired by Frank King (Chairman) with Jackie Jones and Ben Jones in attendance.

1. **Receive 2022 accounts and trustees' report**

   The 2022 accounts and trustees' report were circulated to all members in the June 2023 *Bulletin*. As no comments had been received by the Trustees, they were taken as read.

2. **Election of charity trustees**

   Bill Visick retired as a charity trustee.

   Frank King retired by rotation and offered himself for re-election.

   Frank King was elected to the office of charity trustee.

3. **Appoint examiner for 2023 accounts**

   Counterculture LLP were (re)appointed to examine the 2023 accounts.

4. **AOB**

   No other business was raised.

The Trustees
1 October 2023

Footnote:

The three-year 'retirement and re-election' rule did not strictly apply to Frank King until next year but, to balance the three-year cycle, it made sense for him to 'retire and seek re-election' a year early.

Postcard Potpourri 65: Maud Heath, Kellaways, Wiltshire

Peter Ransom

This card features Maud Heath's Monument, the dial recorded as SRN 0401. The following description is taken from the Fixed-Dial Register.

"*Memorial stone square pillar with 3 face cube dial surmounted by a stone ball. Several mottoes around top & bottom of cube. That on top of West face is almost illegible but is reported by Gatty as "Redibo, tv nvnqvam" and that at the bottom of West face reads: "Haste Traveller the sun is sinking now, He shall return again but never thou". On the East face : "Volat Tempus" and: "Oh Early passenger look up be wise and think how night and day-time onward flies". S face reads: "Dum Tempus Habemus Operemur bonum" [While we have time let us do good]. Under: "He steals away this hour. Oh man, is sent thee. Patient to work the work of Him who sent thee". Recently repaired after being struck by a car in 1996. (Despite an injunction in the memorial inscription to 'Injure me not'!)*"

There is no indication of the date on the card, but the printing on the reverse mentions that it is published by Houlston, Chippenham and is part of the Wilkinson's Series. Further investigation discovered an identical card that had a postmark of 1906, so this image shows the condition of the dial no later than 1906.

The monument is Grade II listed, dated 1698 and dedicated to Maud Heath who died in 1474. About 3 metres high, the ashlar pillar has arched-headed sunk panels with pendant keystones and carved spandrels on three faces, the west side panel inscribed "Chippenham Clift", the east "Wick Hill" and the front with "*To the memory of the worthy MAUD HEATH of Langly Burrell Widow who in the year of Grace 1474 for the good of Travellers did in Charity bestow in Lands and houses about Eight pounds a year forever to be laid out on the Highways and Causey leading from Wick Hill to Chippenham Clift. This Piller* [sic] *was set up by the feoffees in 1698.*"

Anyone visiting this monument should also explore the 1974 memorial sundial to Maud Heath on The Green at East Tytherton (SRN 3089).

ransompeter687@gmail.com

GUIDELINES FOR CONTRIBUTORS

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 the text should not usually exceed 4500 words.

1. **Format**: The preferred format for text is MS Word or text files, which should be sent by email to *editor@sundialsoc.org.uk*. Material may also be sent on CD or via WeTransfer.com

2. **Figures**: Pictures should be sent as separate jpg or tiff files – do not embed them in Word files or in the body of the email. For email attachments, do not exceed 15 Mbytes per message. Each figure should be referred to in the text, and a list of captions for the figures should be included. Captions should be sufficiently informative to allow the reader to understand the figure without reference to the text.

3. **Mathematics**: Symbols used for the common dialling parameters should follow the conventions given in the Symbols section of the *BSS Glossary* (available at *sundialsoc.org.uk/discussions/glossary-a-z/*). Consult the Editor if in doubt.

4. **Notes**: The *Bulletin* does not use footnotes. Where additional information is required, each note should be numbered as a reference with a superscript number. For very long notes, use an appendix.

5. **References**: Sources are referred to in the text by a superscript number. They are listed in numerical order under the heading 'References' (or 'References and Notes') at the end of the article. The *Bulletin*'s convention is as follows:

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

   Examples:

   A.E. Waugh: *Sundials, their Theory and Construction*, Dover, New York (1973).
   J. Davis: 'The Zutphen quadrant', *BSS Bulletin*, <u>26</u>(i), 36–42 (March 2014).
   A.A. Mills: 'Seasonal hour sundials', *Antiquarian Horology*, <u>19</u>, 142–170 (1990).
   W.S. Maddux: 'The meridian on the shortest day', *NASS Compendium*, <u>4</u>, 23–27 (1997).

6. **Acknowledgements**: These should be as brief as is compatible with courtesy.

7. **Address**: The email address of the author should normally be given, right-aligned and in italics, at the end of the article unless the author, when submitting the article, expresses a wish that this should not be done. Authors may, if they wish, supply a very short biography and photograph (see previous editions of the *Bulletin* for examples).

8. **Copyright**: Articles published in the *Bulletin* are copyright of the BSS and the author. The copyright of photographs belongs to the photographer; <u>authors who use photographs other than their own must obtain permission and should acknowledge the source in the caption</u>. Authors who re-publish elsewhere material already published in the *Bulletin* are asked to refer to the *Bulletin* in the re-publication.

Front cover*: Double horizontal sundial, possibly a 'master-piece', by 17th-century maker George Cooke, one of Elias Allen's apprentices. In his article on pages 2-8, Maciej Lose describes the dial and its restoration, and examines Cooke's place in Elias Allen's 'tree of knowledge'. Photo: Maciej Lose.*

Back cover*: Elaborate Father Time and cherub pedestal by Caius Gabriel Cibber (1630-1700) at Belton Park (NT), Grantham, Lincolnshire, bearing a 1997 dial (SRN 4144) that replaces a stolen Thomas White dial of 1724 (SRN 0619). It is also known as the 'Moondial', on account of its appearance in a 1980s children's book and television serial by Helen Cresswell. For more details about this and other 'Father Time' sundials, see Roger Bowling: 'Sundial Supporters Part II', BSS Bulletin 97.2, 45-7 (April 1997). Photo: Cynthia Moore.*

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