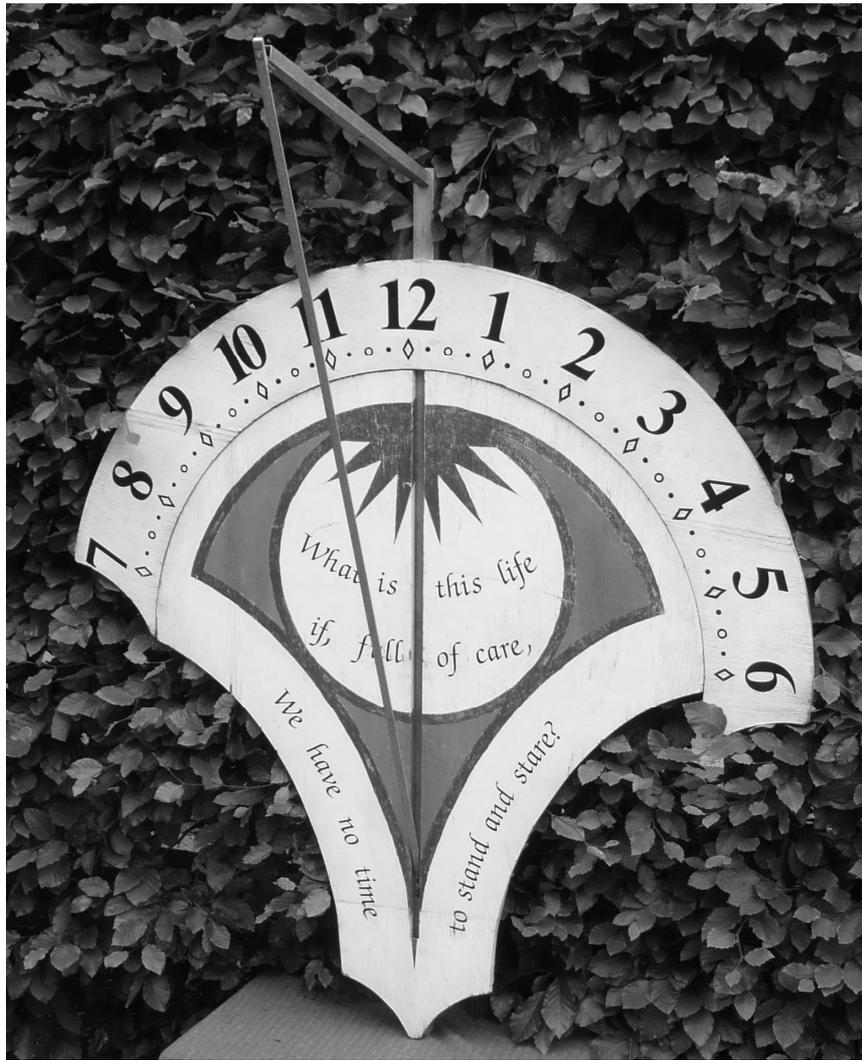


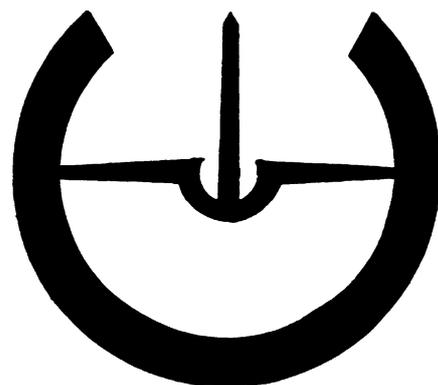
# The British Sundial Society



## BULLETIN

VOLUME 20(iii)

September 2008



# GUIDELINES FOR CONTRIBUTORS

1. The editor welcomes contributions to the *Bulletin* on the subject of sundials and gnomonics; and, by extension, of sun calendars, sun compasses and sun cannons. Contributions may be articles, photographs, drawings, designs, poems, stories, comments, notes, reports, reviews. Material which has already been published elsewhere in the English language, or which has been submitted for publication, will not normally be accepted. Articles may vary in length, but text should not usually exceed 4500 words.
2. Format: The preferred format for text is MS Word or text files sent by email to [john.davis51@btopenworld.com](mailto:john.davis51@btopenworld.com). Material can also be sent on CD or as a single-sided typescript, single- or double-spaced, A4 paper.
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4. Mathematics: symbols used for the common dialling parameters should follow the conventions given in the Symbols section of the *BSS Glossary* (available online on the Society's website). Consult the editor if in doubt or for help in laying out equations.
5. The *Bulletin* does not use footnotes. Where additional information is required, notes should be numbered as a Reference with a superscript number. For very long notes, use an appendix.
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Examples:  
A.E. Waugh: *Sundials, their theory and construction*, Dover, New York, (1973).  
D. Colchester: 'A Polarized Light Sundial', *Bull BSS*, **96.2**, 13-15 (1996)  
A.A. Mills: 'Seasonal Hour Sundials', *Antiquarian Horol.* 19, 142-170 (1990)  
W.S. Maddux: 'The Meridian on the Shortest Day', *NASS Compendium*, 4, 23-27 (1997).  
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**Front cover:** *The true south equiangular meantime sundial designed and made by James Richard, shown here with the gnomon displaced for winter delineation. See article on page 123. Photo: Graham Aldred.*

**Back cover:** *The well-known Saxon dial on St Gregory's church, Kirkdale, Yorkshire. It is dated to between 1055 and 1065. Compare this dial with the similar-looking 'transitional' one on the back of the March 2008 issue. For further details, see Alan Cook's new monograph on Mass Dials on Yorkshire Churches from which this photograph is taken.*

# BULLETIN

## OF THE BRITISH SUNDIAL SOCIETY

ISDN 0958-4315

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### EDITORIAL

Double horizontal dials, it seems, are like buses: you wait a long time and then three come along together. This issue carries three articles about such dials, all, remarkably, by John Marke and one of them in the *Register*, not recognised as a DH, since 1994. It just shows that, despite nearly 20 years of diligent recording by BSS members, there are still significant dials to be found. Also, the importance of re-assessing recorded dials is emphasized. The summer is not yet over so get out and look!

Another theme in this issue is the recovery of stolen dials. It is a sad fact that sundials get stolen. It is a great shame that it is sometimes necessary to take dials out of their natural environment so that they can be protected, both from the elements and from thieves. So, when an owner who is brave enough to leave a dial on show has it stolen, it is good to know that our Society can provide assistance in getting it

back. Please keep your eyes open for dials that might not have been legitimately obtained and consult the Registrar for advice if in doubt.

Also in this issue is another part of Tony Ashmore's 'Astrolabes' series. Tony has recently had a nasty fall so it will be some time before he is writing again. We wish him a rapid recovery. We also thank John Lester for taking on the rôle of proofreader in Tony's absence.

It is now well over two years since we conducted a readership survey to get members' views on what changes they would like to the *Bulletin*. I hope that we have been able to follow the wishes that were expressed there, at least in part. But I would be more than happy to get some feedback on whether there are other things that you would like to see, so please send postcards, emails or whatever to let me know.

# AN EARLY MERIDIAN LINE IN A FORMER STATELY HOME, HAMPSHIRE

DOUGLAS BATEMAN

**Summary.** *This article describes what may be the first meridian line in the British Isles, dating from around 1720. It is in a loggia in a fine Jacobean mansion, together with a very early west declining dial and a horizontal dial. In addition, there are photographic records of two other dials.*



*Fig. 1. Bramshill House: the north east side with the figure of Sir Edward Zouche high in the niche.*

Meridian line sundials with a line on the floor and an aperture gnomon are quite rare in the British Isles. Those that have been recorded are in the cloisters of Durham Cathedral (1829); the former Customs House in Ramsgate<sup>1</sup> (1819); and Bromley House, Nottingham<sup>2</sup> (1834). Whilst the Bramshill meridian is not of the same quality as the others (one with a fine brass strip), there is no question as to its authenticity and purpose. It does, for example, have its original aperture whereas Bromley House and Ramsgate do not. This particular meridian line is not indoors but in a dark loggia with access from a terrace and, rather intriguingly, seems to have been laid out in error.

Other existing dials at Bramshill House are a west decliner and good horizontal dial. Photographs show two more previously existing dials in the period 1890 - 1920.

The Manors of Great and Little Bramshill are recorded in the Domesday book and were successively owned by various knights, a Knight of the Garter and aristocrats. In 1605 the estate was purchased by Sir Edward Zouche who built the present house and set out the gardens. The official guide to Bramshill House (Fig. 1 & 2) records that Lord Zouche had a somewhat chequered political career of traveller and ambassador, Privy Councillor and holder of other high

offices. The house is a good example of Jacobean architecture and, apart from a fire some time in the 1640s that damaged part of the south west side of the building, is largely unchanged. The house is now recorded as a Grade I listed building. Architecturally, the house is similar to the more well-known Temple Newsam House in West Yorkshire.



*Fig. 2. The south west facing front and terrace. The meridian line is in the far loggia and the aperture is in the upper part of the ground floor window.*

Bramshill House is better known under the former title of the Police Staff College. The House and immediate grounds were purchased by the Home Office in 1953 and the college was created in 1960. More recently, the college and other police academies were combined under the auspices of the National Policing Improvement Agency (NPIA). Access is therefore restricted so that the existence of the meridian line had been known to only a few individuals and local historians and, even then, few of the current staff were aware of the discreetly located vertical dial.

During the 1850s some alterations were carried out by the then owner, the Rev Sir William Henry Cope. In his book on the history and architecture of Bramshill, a plan of the ground floor shows a passageway taking up part of the south loggia and embracing half of the bay window. The passageway was taking up a relatively large area of the loggia and must have been removed during the alterations. The book is undated although it is believed to have been published around 1880 whereas the meridian could well have been much earlier. A local historian<sup>3</sup> with extensive knowledge of Bramshill House and the families believes that the father of Sir John Cope (who purchased the estate in 1700)



*Fig. 3. The loggia, looking towards the aperture (just visible). The line runs from the corner below the aperture across the stone floor to the base of the pillar on the right of the photograph.*



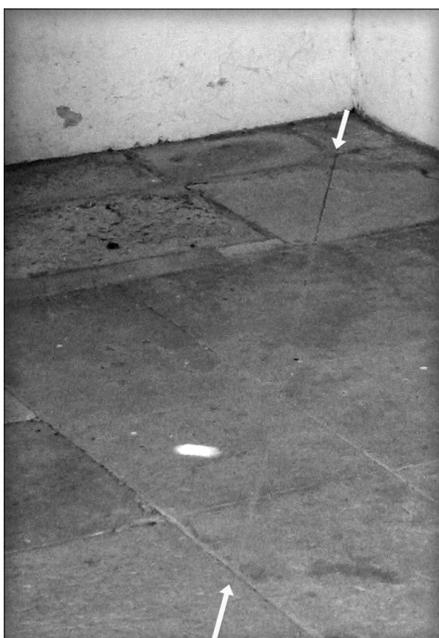
*Fig. 4. The aperture, about 20mm in diameter, and a spot of sunlight having crossed the line at solar noon, taken on 3 August 2007 (Photo credit Lindsey Kerr, NPIA).*

was probably the person who brought the idea of a meridian line sundial from Italy. He certainly travelled there, presumably on a ‘grand tour’. His diary records an interest in water gardens and fountains that could be turned on by a hidden ‘fountaineer’ so as to spray visitors as a practical joke. Apparently Sir John had a room in Bramshill House for experiments and “little inventions” and for the meridian line the historian adds (based on the diary and other writings) “it is typical that he did not get it quite right”. If we assume that Sir John (1634-1749) created the meridian line, it will therefore pre-date the other recorded lines in the British Isles by around a hundred years.

The prospect of viewing the meridian line on a sunny day was met with enthusiasm, only to be dashed by finding the spot to be a peculiar shape and showing the expected noon

to be about 9 minutes in error. Part of the answer is almost certainly due to the glazing to the outside of the aperture. In Fig. 4 some ‘framing’ can be seen in the wall to the left of the aperture, which are the visible parts of the mullions and transoms of the stone window frame. The whole of the window on the loggia side has been bricked up! This is obvious from the outside, see Figs. 6 and 7.

The answer to the distorted spot is due to the glass being far from flat. Indeed, the part of the spot of light on the floor that is nearest to ‘correct time’ is the weakest trailing edge. Given the faults in the window and aperture, it is interesting to speculate how the line was laid out in the first place. The line itself extends across part of the loggia, although somewhat worn where it is more exposed. It should also extend up part of the pillar but there is no clear evidence of



*Fig. 5. The best preserved part of the line with the elongated spot of sunlight, photographed at local solar noon, showing the large error in time (Photo credit Lindsey Kerr, NPIA).*

*Fig. 6. The ground floor window partially bricked up on the inside. The left window is functional, but with blinds.*

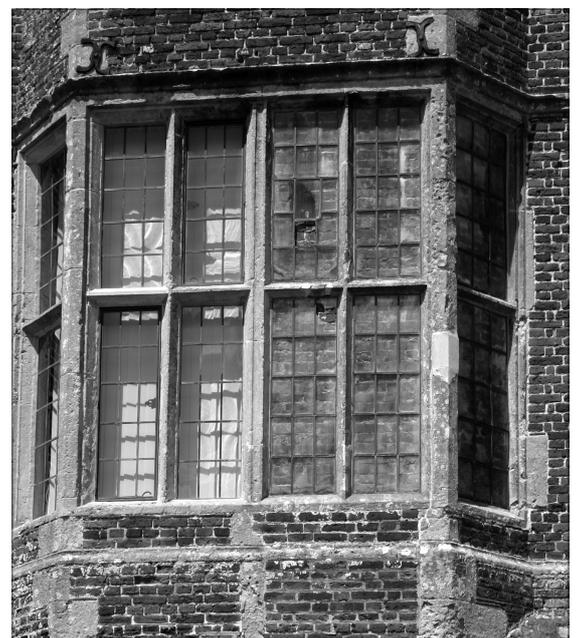




Fig. 7. Close up view of the window with the crude opening in the brickwork and slightly larger glass pane. The missing pane of glass just below, judging from very early photographs, has been missing for some time.

the floor line extending up the pillar, which it would do so by just over a metre.

A follow-up visit was carried out to draw a plan of the loggia and measure the angle of the line relative to the south-east – north-west wall (at right angles to the direction of the building as whole). The angle is  $31.6^\circ$ . The easiest way of determining the declination of the longest dimension of the building without on-site determination is to use a modern Google Earth aerial or satellite photograph with the overlay of the latitude and longitude. This angle is about  $34^\circ$  west of south and confirms that the line is seriously in error by some  $2.4^\circ$ , which is consistent with the observed error in time.



Fig. 9. The clearly engraved but anonymous dial, quite deliberately fixed to the stone balustrade.

One may speculate as to how the line was laid out and then to be in error, especially having gone to the trouble of creating a good aperture and the rather permanent extreme of bricking up a window. It is quite likely that the error was found soon after construction, and the distorting glass window was left in place when it could have been easily removed, although this would not have corrected the fundamental error.

Nearby is a horizontal dial and it is tempting to speculate that allegiance was transferred to the humble dial, probably set up to take over the task of time determination. This dial set on the balustrade quite near to the meridian line, as in Fig. 8. There is no maker's name or date, but the quality of the engraving is good and it could be as early as late 17<sup>th</sup> century. The setting on the balustrade is quite purposeful and in addition to being close to the meridian line, it is near to one of the principal rooms of the house. The specific location is reinforced by the fact that its overall time telling is severely compromised by being rather close to the wall in



Fig. 8. The horizontal dial (indicated by the arrow) is situated near to the meridian line in the loggia and outside the main hall. The buttress to the wall will cut off the afternoon sun after about 1.30 to 2pm, depending on the season.



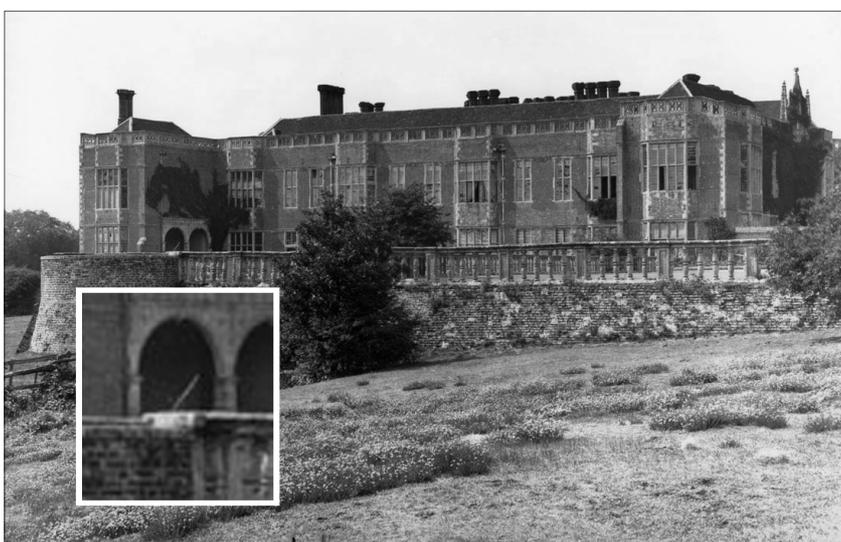
Fig. 10. The vertical west decliner is about 6m above ground level set across the re-entrant corner. Although 85cm wide, the dial appears relatively insignificant in this view.

the south westerly direction, with the angle from the dial south-direction to the buttress and wall about 23° and 30° respectively. Whatever the speculation, the dial is correctly aligned.

The other sundial of possibly greater interest is a very early vertical west decliner, which is partly resting on the stone string line course of the north east wing, see Figs 10 and 11. The numerals are legible, as are part of the initials and a date, such as: R ? and 16???. The initials could be those of either Randall MacDonell, the 2<sup>nd</sup> Earl of Antrim, who was at Bramshill from 1637 until 1640, or Robert Henley who occupied the house until his death in 1656. However, even this sundial will be in the shade during the winter months due to the height of the roof line to the south and west. Nevertheless, there is a sound practical reason for the dial being on this side of the house in that this was the 'working' side of the house with two main doors giving access to the walled garden, stables and the north drive. Given the prominent installation of such a sundial leads to speculation if there were any other 'companion' dials on the house, but there is no evidence of such.



Fig 11. A close up of the vertical dial with the rusted horizontal rod gnomon.



The gardens are being very well maintained and, over the years, the house and gardens have attracted much interest. Gertrude Jekyll wrote about them in *Country Life* and, in her book on garden ornaments, she has two photographs of the east loggia and bowling green.<sup>6</sup> A search of the records of *Country Life* articles show that Bramshill House was written about thirteen times

Fig. 12. An old photograph of the south-east side where the gnomon of a sundial can just be seen silhouetted in the dark archway of the west loggia. The dial would have been near to where the photograph was taken for Fig. 2. (Photo credit IPC Media)

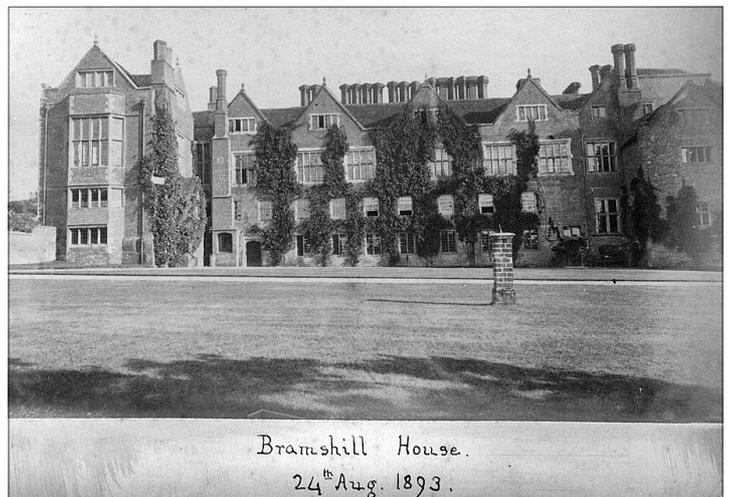


Fig. 13. An early photograph of the north east side showing the vertical dial on the north wing and a horizontal dial on a brick pedestal. The pedestal and its dial no longer exist. (Photo credit Violet Martineau.)

Regarding other dials, now missing, a photograph taken in 1891 of the main south-east side of the house just shows the outline of a gnomon on the stone balustrade on the southernmost side of the raised garden. The photograph was taken on 10 June 1891 by Violet Martineau.<sup>4</sup> Coincidentally, a search of the library records of the popular magazine *Country Life* found a similar photograph<sup>5</sup>, which is reproduced in Fig. 12. The photograph is undated but was in a folder covering the date range 1900-1920. The substantial gnomon implies a dial of some quality and there are recesses in the top of the balustrade where the dial could have been fixed. The weathering of the recesses indicate that the dial was removed some time ago. This is a pity because of all the dials at Bramshill House it is in the best location for sunshine throughout the day.

Violet Martineau took another photograph, this time on 24 August 1893, that shows the north west side with a dial on a brick pedestal, Fig. 13. Unfortunately the winter sun would be obscured by the house. This dial and pedestal have long since disappeared.

between 1899 and 1953, with only four articles since then.<sup>7</sup> The gardens continue to attract interest and there is the possibility of historically accurate replanting of one of the garden areas with assistance from the Heritage Fund.

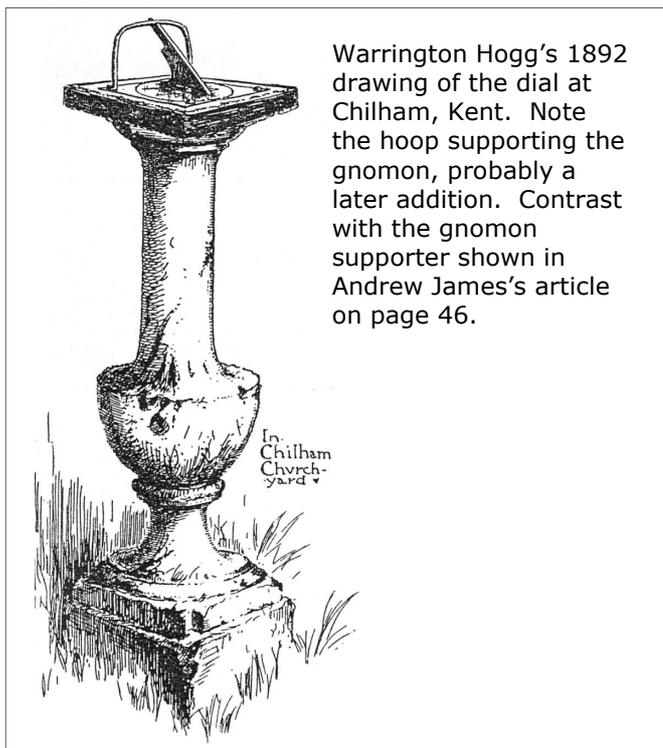
#### ACKNOWLEDGEMENTS

Mrs Sara Beer for bringing to my attention the existence of the meridian line and supplying much other information. Ms Lindsey Kerr, Curator, NPIA, for assistance, details of successive owners of Bramshill House, and further research.

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1. M R Norris: 'Meridian Line at Ramsgate', *BSS Bulletin*, **96.2**, pp.26-28, (June 1996).
2. D A Bateman: 'A Meridian Dial in a Subscription Library, Nottingham', *BSS Bulletin*, **11(ii)**, pp.55-61, (June 1999).
3. Mrs Sara Beer: Eversley, *private communication* (December 2007).
4. Copies of the photograph and one for Fig. 13 were very kindly supplied by Violet Martineau's great nephew, Mr Richard Martineau, who added that his great aunt lived at Park Corner, Stratfield Saye estate, with her father John Martineau who was a pupil and friend of Charles Kingsley and is buried close to him. Charles Kingsley was the Rector of Eversley Parish Church, less than 3 miles from Bramshill House.
5. Reproduced by permission from IPC Media, Southwark, London.
6. Gertrude Jekyll, *Garden Ornament*, first published by Country Life/George Newnes, (1918), reprinted by the Antique Collectors' Club, (1982).
7. Helen Carey: Librarian, IPC Media, Southwark, London (August 2007).

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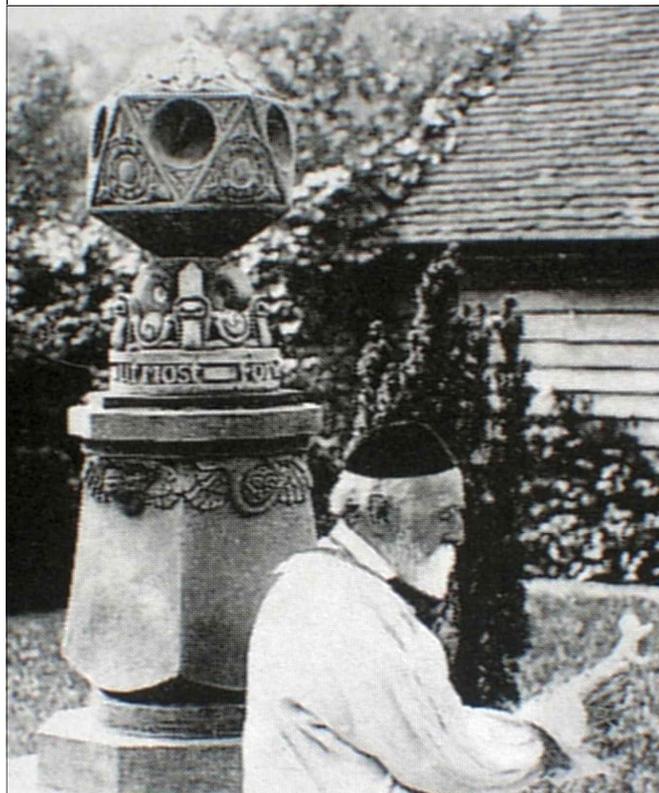


Warrington Hogg's 1892 drawing of the dial at Chilham, Kent. Note the hoop supporting the gnomon, probably a later addition. Contrast with the gnomon supporter shown in Andrew James's article on page 46.

## WATTS DIAL

In the last Bulletin, we showed a picture from Alice Morse Earle's *Sun-dials and roses of yesterday*, featuring the artist George Watts and his sundial. We asked "what has happened to it?". We now know that there is a rather better version of the photograph in Veronica Franklin Gould's biography *G. F. Watts, The Last Great Victorian* (published Yale, 2004, fig. 218 on p.335). An enlargement of the photo is also in the catalogue to the show *Mary Seton Watts (1849-1938) Unsung Heroine of the Art Nouveau* at the Watts Gallery, Compton. Veronica Franklin Gould is currently writing a biography of Mary Watts and was responsible for identifying her as the maker of the Tennyson sundial pedestal (*BSS Bull*, **19(iii)**, p.112) as well as the George Watts dial: we are grateful to her for permission to publish this picture. She is keen to hear of any other known terracotta sundials or garden ornaments by Mary's Arts & Craft Association at Compton.

Unfortunately, the dial was stolen from a private garden in the 1990s and has not been recovered despite being reported to the police. Can *Bulletin* readers do better?



# THE BELMONT SUNDIAL

CHRISTOPHER DANIEL

Last year, in May 2007, I paid a long overdue visit to Belmont House, a charming neo-classical 18<sup>th</sup> century mansion, built in 1780 and set in fine parkland at Throwley, about four and a half miles to the south west of Faversham. Belmont has been the country seat of the Harris family since the year 1801, when it was acquired by General George Harris, later the 1<sup>st</sup> Lord Harris, who had served in the army of the East India Company, defeating Tipoo Sahib, the ruler of Mysore, in 1799. Harris's descendants all held high office in the British Empire; the 5<sup>th</sup> Lord Harris, who became a great collector of clocks, saw both military and public service. His fine collection is one of the principal highlights of this handsome house, preserved by the charitable trust that the 5<sup>th</sup> Lord set up for this purpose. His son, the 6<sup>th</sup> Lord, still lives on the estate and farms much of the land.

During my visit, I met the Estate Administrator and, on enquiring as to the whereabouts of the sundial, she showed me the gnomon, which she had found to be loose and which she had removed to her office for safe-keeping. I subsequently inspected the sundial for myself, which was set on an elegant but damaged stone pedestal in the beautiful grounds of the old two-acre kitchen garden, restored in recent years by the Lady Arabella Lennox-Boyd. The sundial, a brass horizontal, bearing the signature of George Adams Jnr, (1750-1795), quite possibly dating from about 1780 when the present house was built, was in quite good condition.



With hindsight, I thought that the sundial, well away from the house and close to the public car park, was rather vulnerable. Nevertheless, it came as something of a shock to learn later that the sundial and its pedestal had been stolen. The loss was duly reported in the *Newsletter* and, as the sundial had been recorded earlier by Tony Wood, albeit after the removal of the gnomon, details of the dial and photographs of the dial-plate were quickly made available to the authorities. However, in the March 2008 edition of the occasional BSS publication *The Recorder*, the stolen sundial was reported and illustrated.

As it happened, a member of the BSS, Andrew James – already with a ‘recovered’ sundial to his credit – was inspired to make comparisons between the illustrations in *The Recorder* and pictures of a sundial that had seemingly been displayed on the website of Warehams, a dealer in Whitstable. [See the article on page 144 of this issue – Ed.] Specialising in antique garden ornaments and furniture, this firm is run by an enthusiastic entrepreneur with a passion for his enterprise. Apparently he had bought the sundial at an open antiques sale in the early autumn and had evidently not managed to check its provenance. Andrew James passed the images to me and I had no doubts that this was indeed the Belmont sundial.

The attractive pictorial website of Warehams describes the company as “a very trusted and respected name in the architectural and garden antiques business” and it is pleasing to say that, on discovering that his acquisition belonged to Belmont, the dealer lived up to his firm’s good reputation and restored the sundial to its rightful owner. Nevertheless, this is an example of the value of the BSS *Register* and the expertise of the Society’s members. Andrew James is to be congratulated on another recovered sundial to his credit!



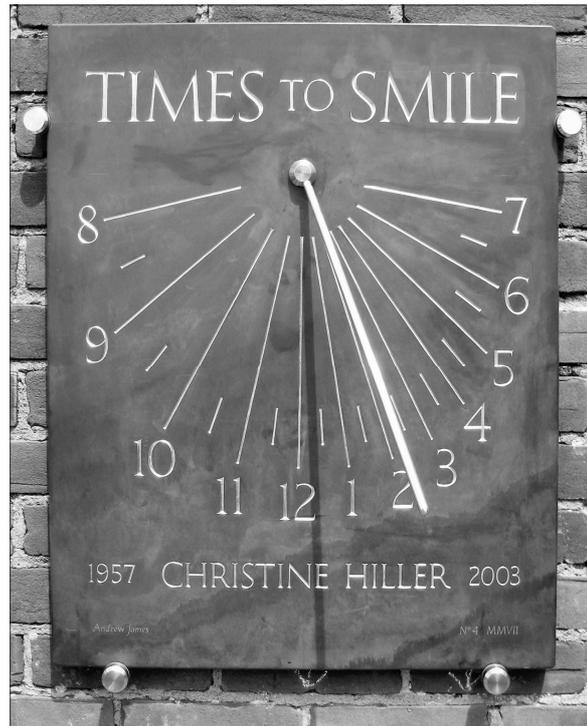
*The recovered dial plate.  
Photo: Crispin Maciejewski.*

*Left: The Belmont sundial on its pedestal, before the theft. Photo: Tony Wood.*

# SUNDIAL AT THE MOUNTBATTEN SCHOOL, ROMSEY

ANDREW JAMES

This project began when I was approached by Peter Ransom in September 2006. Peter teaches at The Mountbatten School, Romsey, and three years earlier Christine Hiller, a very popular receptionist there, had been tragically killed in a road accident. Pupils had raised a sum for a memorial but considerable time had passed and the project had not come to fruition. An analemmatic dial had been ruled out due to problems with health and safety. After a series of e-mails and telephone calls with Peter, and sending pictures of my earlier work to him for discussion with the School authorities, we agreed that I



should make a slate vertical sundial. A fairly simple dial with hours, half hours and Arabic numerals, and featuring Christine's name was clear, but the motto was not so obvious. Her happy disposition struck everyone, and so ideas such as 'Bring me sunshine' and 'Take the time to smile' were eventually refined to 'Times to smile' and a design agreed on, 24" wide by 30" high. I have an inexpensive CAD package and find it most useful: it is easy to ensure the correct angles of hour lines, and to change elements and adjust items of the layout for size and position. With a rod gnomon the time is read from the centre of the shadow, so there is no noon gap.

The design was kept fairly simple to avoid too much work on the limited budget. It shows Greenwich rather than local time – in other words, the longitude correction of 6 minutes is included. I favour terminating the hour lines on a superellipse for this layout. Whereas an ordinary ellipse has the Cartesian equation  $(x/a)^2 + (y/b)^2 = 1$ , the superellipse has  $|x/a|^n + |y/b|^n = 1$  where the power  $n$  is greater than two: first studied by Lamé in 1818, it was brought to public notice c. 1960 by the late Piet Hein, especially for  $n = 2\frac{1}{2}$ . With  $n = 1$  the figure is a diamond or rhombus and as  $n$  increases through 2, giving an ellipse, it approaches the bounding rectangle and the corners become progressively more square. In this case I chose  $n = 3$  and the hour positions lie on this curve (unseen), which makes the intermediate lines such as 9 and 3 noticeably longer than they would be if they

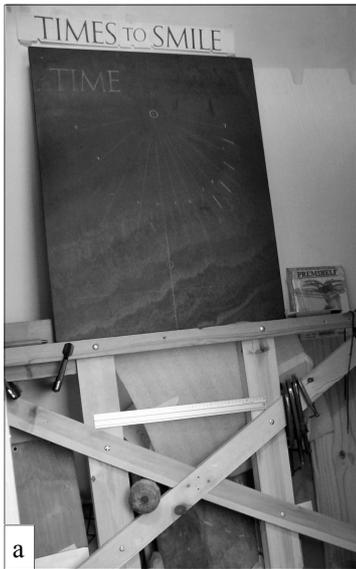
reached an ordinary ellipse passing through the 12 and 6 lines. I don't know how many other makers use this construction, but it appeals to my eye.

I made a full size drawing and looked at it from a distance to check appearance and legibility. The numerals are just under  $1\frac{3}{4}$ " high, and the larger letters in the motto just over  $2\frac{1}{4}$ " high. The form of the lettering – what in computer terms might be called the font, which is a typographic rather than lettering term – is based on the classical Trajan design, all in upper case, and the Arabic numerals (which the Romans did not use or have) are based on a set drawn by Father Catich, an expert on the Trajan Column inscription, designed to harmonise with it.

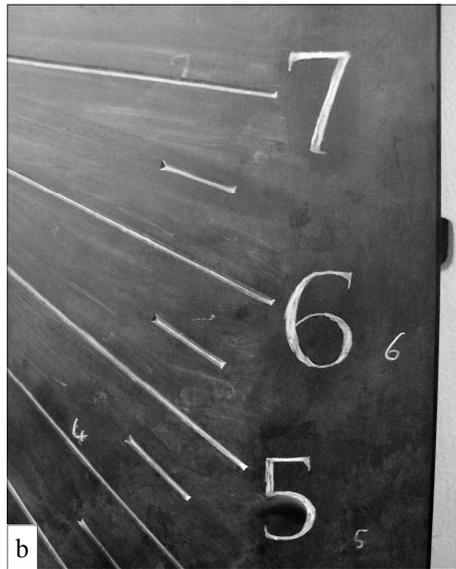
Peter was happily able to collect a piece of Welsh slate to my specification from Wincilate's quarry near Machynlleth over Christmas 2006. It was a few weeks before I could pick up the slate and begin work; it was fine and dark grey though with some included thin hard layers. Peter and I had double checked wall declination and my calculations for peace of mind – it is at  $50^\circ 59' N$  and  $1^\circ 28' W$ , declining  $25\frac{1}{2}^\circ$  West. I had taken my initial measurement from a large scale OS map (1:2500) and Peter's measurement (using a vertical shadow at local noon) did not differ by too much. I didn't actually see the wall until later and so the question of how nearly it was vertical was left in abeyance.

I transferred the drawing onto the slate using carbon paper and pricking through and then cut the slate in the traditional way with the stone more or less upright and the working area near eye level, using carver's dummy (round mallet) and tungsten-carbide tipped lettering chisels. A light central cut is made initially, and then enlarged working on both sides of the 'V'-shaped incision alternately. I find smaller letters harder to do as the margin for error in the first cut is reduced. No doubt much more practice will help!

I gilded all the lines and inscriptions (except my own name which is in much smaller letters and only just visible from the ground). The carved lines were first painted in red artist's oil paint and allowed to dry to give a base colour, then gilded twice, using extra thick 24 carat loose gold leaf, over



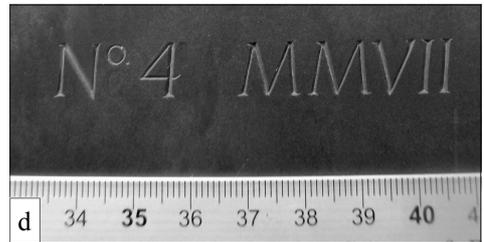
a



b



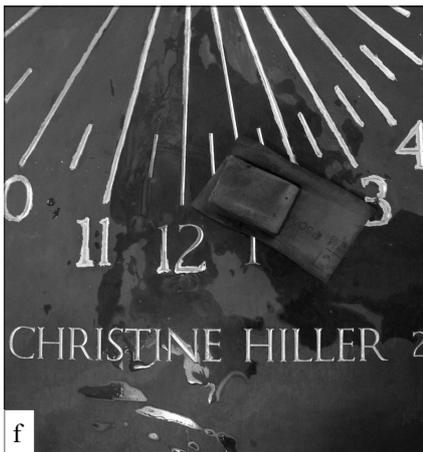
c



d



e



f



g



h



i



j

- a) slate on the banker ready for carving.
- b) some numerals drawn for carving.
- c) detail of larger lettering.
- d) detail of smaller lettering
- e) gilding in progress showing underpainting on 'S' and gold on 'TIME', both extending over the edges.
- f) showing rubbing off surplus gilding and paint with water and abrasive paper.
- g) gnomon fixing method.
- h) supporting 'nuts'.
- i) ready for hoisting, with the author (l) and Ken Lee (r).
- j) lifting the dial into place.

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

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



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

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

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

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## ENGLISH SCRATCH (MASS) DIALS: THE RAVAGES OF TIME

CHRIS H K WILLIAMS

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

For the first time it is now possible to scientifically estimate the rate of dial loss. The composite database<sup>1</sup> permits two quantitative indicators of dial loss: both are statistically very reliable as each is based on an analysis embracing a quarter of all dials ever listed. Together they reveal dial loss to have been considerably higher than scratch dial recorders or students have hitherto realised or envisaged.

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

pre-war listings<sup>2</sup> indicates an annual dial loss of 0.5% – one dial a fortnight! Continuation of such an exponential loss would halve those surviving (currently c.5000<sup>3</sup>) by 2150.

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

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

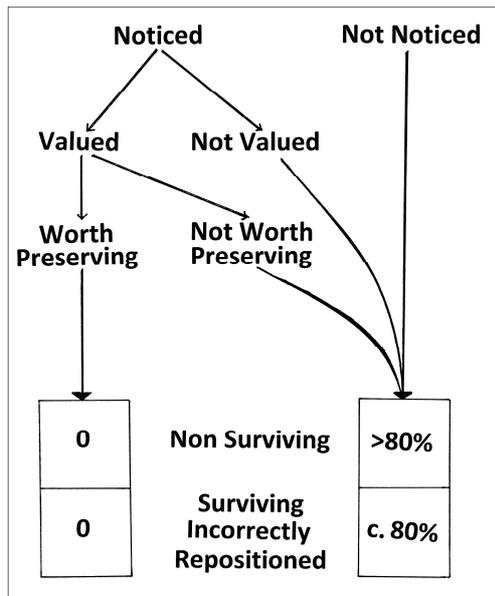


Fig. 1. The fate of moved scratch dials during rebuilding.

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

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

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

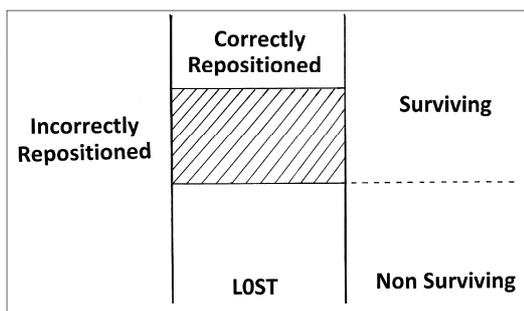


Fig. 2. Moved scratch dials – surviving and non-surviving.

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

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

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

## REFERENCES AND NOTES

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

# SHADOWY SECRETS

## Part 4 – The art and artifice of the gnomon

JOHN MOIR

[See Volume 14(ii), p.46 (June 2002) for Part 3 of this series. Ed.]

The gnomon can be thought of as a bracket, broadly triangular in shape, whose job is to provide support for the style edge. If it is only a bracket, one might ask why it is generally far more ornate than other 'common or garden' brackets, many of which are simple unadorned triangles. The answer is that the diallist tries to avoid giving the gnomon a straight rear edge because its shadow could be confused with that of the style edge. The sundial designer is therefore positively encouraged to experiment with all sorts of curved or articulated alternatives. Such alternatives may be decorative, contextual or a combination of both. Gnomons on earlier dials were mainly decorative with either a simple elegant curved rear edge or more elaborate filigree or scroll work embracing most of the gnomon. In the 20<sup>th</sup> century, contextual gnomons became much more common, typically making some visual pun or reference to an individual, organisation or the dial's location.



Fig. 1. Scrollwork at the Vyne, Hampshire (NT).

An example of a purely decorative gnomon is shown in Fig. 1. The type of scrollwork it displays can sometimes be seen in the more pretentious of domestic brackets, such as that shown in Fig. 2, designed to hold up the humble toilet seat. (The similarity between these two designs is remarkable.)

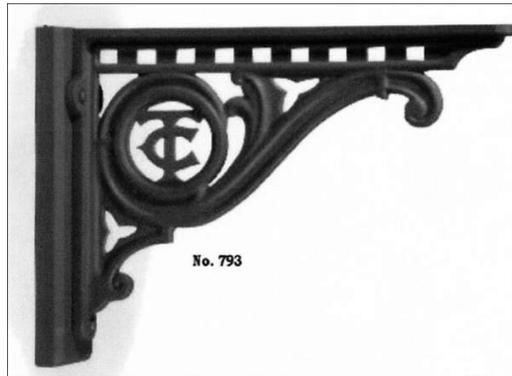


Fig. 2 (above). Zero latitude gnomon by Terence Conran? No! Universal W.C. bracket by Thomas Crapper.

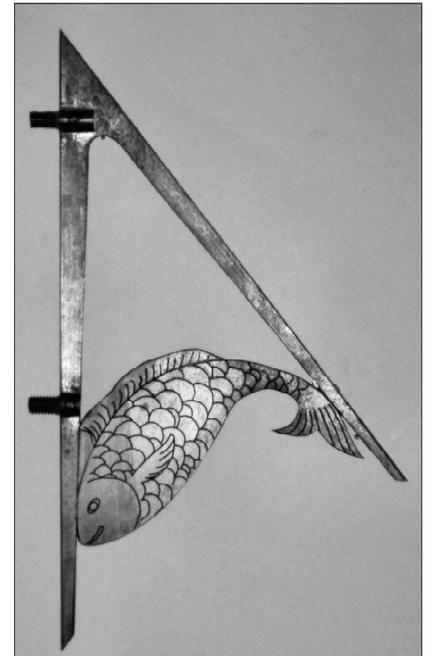


Fig. 3 (right). Visual pun, giving apt advice, designed by Ray Ashley.

R Ashley

A vertical gnomon by Ray Ashley is depicted in Fig. 3. It is a good example of a visual pun, based on the motto 'Carp(e) Diem' (seize the day). Gnomons incorporating a person's initials are not unusual nowadays. At least one such a dial (Fig. 4) was made by the late and sadly missed Tony Baigent.



Fig. 4. Personalised celebration of a retirement, by Tony Baigent.

T Moss

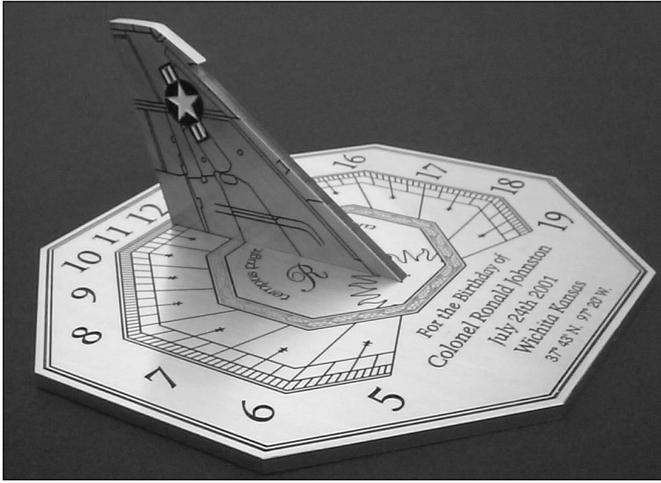


Fig. 5. Present for a pilot, by Tony Moss.

A birthday present made for an American pilot provides a fine example of a ‘job-related’ gnomon, Fig. 5. The designer and maker Tony Moss based the gnomon on the wing of a McDonnell Phantom. The straight trailing edge is placed up against the hour scale so there can be no confusion between its shadow and that of the style.

M Cowham



Fig. 6. Keeping up the style at Market Harborough.

The ‘Man with a plank’ dial, Fig. 6, by Michael and Marjorie Clements, makes entertaining reference to its canal-side location in Market Harborough. This and hundreds of other dials appear in *Sundials of the British Isles* edited by Mike Cowham. Perusing a book such as this makes one realise what a wealth of artistic invention is to be found in gnomon design. So far, all the examples I’ve mentioned can be appreciated whether or not the sun is shining. Now we want the sun to shine, to see some ways in which the gnomon can interact with its shadow.

C Daniel

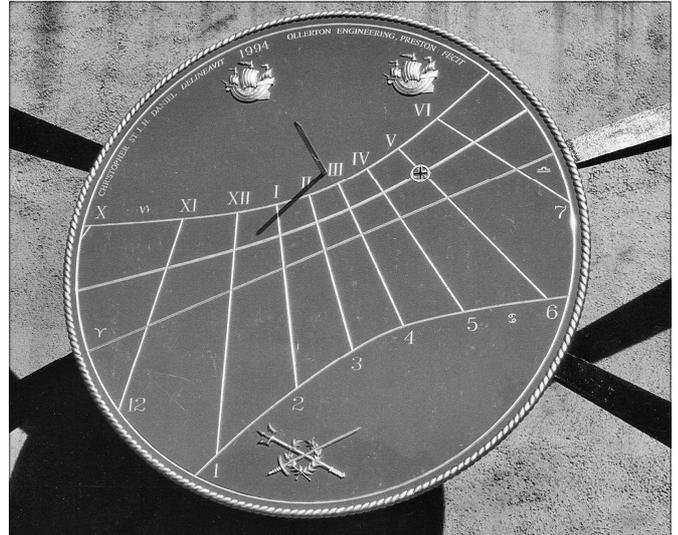


Fig. 7. The Nelson commemorative sundial, Chatham, designed by Chris Daniel.

### Shadow-Play

Apart from its normal function of indicating the hour of day, the shadow is often used to commemorate an anniversary such as a wedding or birthday. In such cases the gnomon is usually reduced to a short rod, the shadow of whose tip traces out the appropriate declination line. Chris Daniel took this idea further in his Chatham sundial recording Nelson’s death at Trafalgar, Fig. 7. An icon on the dial plate marks not only the date but also the moment of Nelson’s death.

Tony Baigent exploited the dial’s potential to amuse more than anyone I know. In his book *My Garden Dials, etc.* he described many of his creations, in particular two near-direct East vertical dials. I described his witty anniversary dial in *Bull BSS*, 11.1, 40-43 (1999) and refer here to his ‘Grim Reaper’ dial, Fig. 8. The book gives the following account. “The aluminium gnomon carries a cut-out of the Grim Reaper and his dog. As time progresses, the illumina-

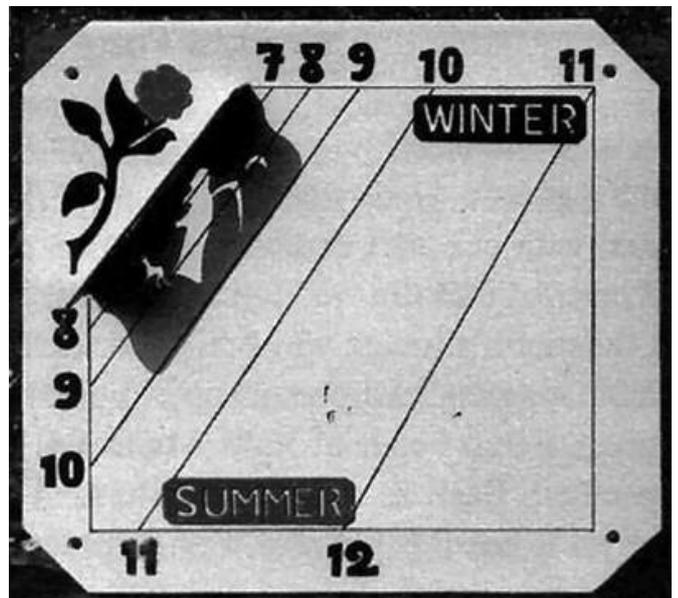


Fig. 8. The Grim Reaper sundial by Tony Baigent.

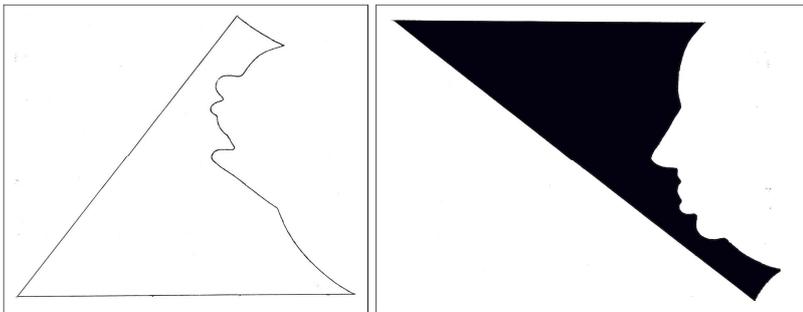


Fig. 9 (left). Alfred Hitchcock in disguise (best viewed upside down).  
 Fig. 10 (right). Alfred Hitchcock as revealed on his birthday.

tion of the old man moves across the dial face, causing him to stoop further and further forwards as the day and the Reaper age.”

Recently, I came across a sundial whose gnomon had a sinuous edge which, unintentionally, suggested the profile of a face. Could this, I thought, be the basis for a novel form of commemorative sundial? It would be great, also, if the shadow could be used to indicate a birthday, perhaps. The problem was that the shadow of the profile would be variously distorted according to the date and time. However, if I reversed the process by designing the distortion into the gnomon I could arrange for a true profile to appear in shadow form at any chosen time and day – exactly what is required in a commemorative dial.

To test out the idea I needed a distinctive profile that was easy to recognise and decided that the master of suspense, Alfred Hitchcock, would fit the bill. His distorted profile on the gnomon, Fig 9, was so designed that at 9am and 3pm solar time on 13 August, his birthday, a true shadow profile appears on the dial plate, Fig 10. The great man was considerate enough to pass away on the 29 April, when the sun’s declination is the same as on his birthday, so the sundial conveniently commemorates both days.

In homage to the master, I produced an upside down, negative profile on the gnomon in order to give no clue as to his identity. This would only be revealed, in shadow form, later in the plot! For anyone wishing to make their own silhouette sundial, the Appendix shows how to produce the distorted gnomon profile from a true shadow image. I should add that since a low sun produces considerable shadow distortion, the idea is more workable for summertime dates and mid-morning/afternoon times. Also, at hours close to noon the shadow is of course too slender to accommodate a decent sized profile. The gnomon should be thin, or have a chamfered rear edge, to avoid the sun’s rays casting confusing shadows from either side of the gnomon edge.

In conclusion, I would just say that the art of the gnomon is certainly not great art but, as many diallists have found out, it is surely much more fun.

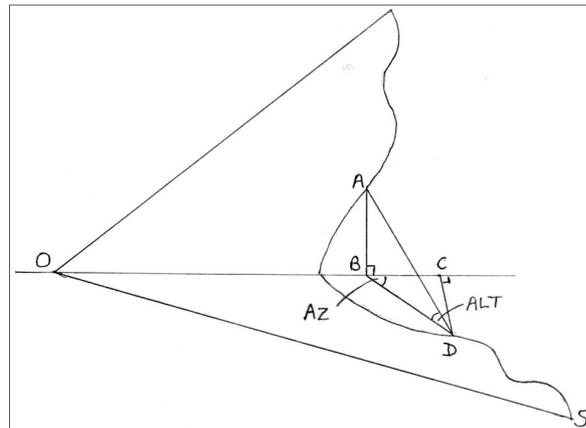


Fig. 11. Construction of a distorted gnomon profile from the true shadow image.

### Appendix

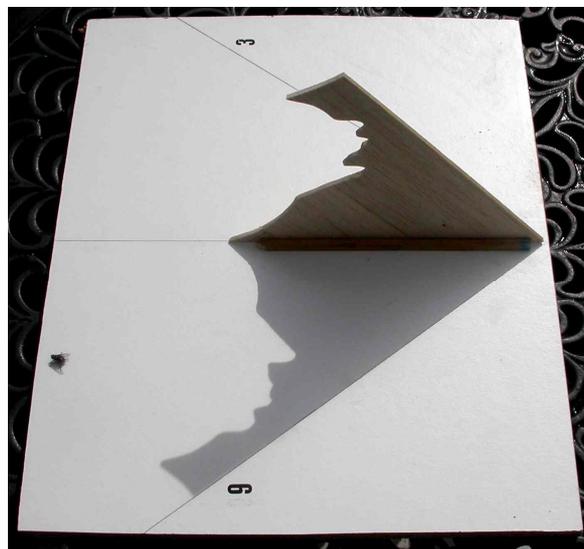
1. Draw the selected shadow profile (Fig. 11) on graph paper, ensuring that the shadow line of the style, OS, makes the correct angle with the meridian, OC, for the chosen hour of day.
2. Mark salient points, D, e.g. tips of nose, chin etc. About 20 points should suffice.
3. Look up sun’s altitude and azimuth, from South, for the chosen date and time.
4. Calculate AB and BC for each point D as follows:  

$$AB = CD \tan Alt / \sin Az \quad BC = CD / \tan Az$$
5. Plot points, A, on graph paper, and join up points to obtain the distorted gnomon profile.

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### POSTSCRIPT

The sun shone on Hitchcock’s anniversary (29 April) so it was possible to obtain this picture of the dial in action, complete with fly.



# PHOTO COMPETITION 2007

A further selection of the entries



**Double Time** - *M. Cowham*  
(top ten)



**Summer Solstice—Noon**  
*A O Wood*

Summer Solstice - Noon



**Red Sky in the Morning...** - *J Davis* (top ten)



**Accidental Gnomon** - *R D Hicks*



**A Vintage Sundial** - *I Hayton*

A VINTAGE SUNDIAL



Marked by time

**Marked by Time** - *S-O Larrison*

# OVER THREE HUNDRED YEARS IN THE SUN: thoughts of an old double horizontal dial

As told to IRENE BRIGHTMER



“I have enjoyed a varied life, in and out of the limelight but always in the sun on my own terrace in a North Wales garden. When I was brought here in about 1674 from London where I was made by John Marke (I carry his signature “Joannes Marke London fecit”) I was probably the first double horizontal dial in the area. I was shown off to one and all, much admired and wondered at. They needed me, too, to regulate their clocks and watches. I have long outlived most of these, including the original gatehouse clock which kept good time, thanks to prompts from me. The one which now looks down on me was replaced by Joyce of Whitchurch a century ago; their man still turns up regularly to service it. But they can all live without me now and had forgotten that I exist. Even the head gardener hadn’t noticed me, never mind walked up to check my time.

“I had a useful life until about a hundred years ago when they moved me along the terrace a few metres. This was just because they wanted some symmetry when they replanted the terrace below with a fashionable rose garden. But I have never been the same since. You see, they didn’t make a good job of it and I am not quite horizontal. I

suppose they didn’t bother too much because they didn’t need my precision any more. But I would look much finer if my pillar were upright and I would also be able to do my job properly again. The times and stereographic projection on my dialplate can still be read, but the engraved text under John Marke’s signature is faint; only I know what it says, although no doubt one of those clever BSS members will squeeze it out of me before long!

“They have now started noticing me again and have realised how special I am, so I am back in the limelight which I am enjoying! But a new threat now hangs over me; they want to protect me from further effects of aging and hide me away from the weather. They mean well but the sun will no longer light up my dial. I shall

be safe, but will they forget me all over again? I hope not. There aren’t many double horizontals left, and very few of us are in our original gardens. So perhaps I have been lucky to have enjoyed a quiet life in my North Wales garden until now.”



# JOHN MARKE'S DOUBLE HORIZONTAL DIALS

JOHN DAVIS

Irene Brightmer's discovery of a double horizontal dial by John Marke in a North Wales garden is a tremendously important find. It is the first known DH dial by this maker though several are known by his master, the great Henry Sutton.

John (Johannes) Marke (c.1641 to after 1673) was originally from Northampton. He started his apprenticeship to Sutton in 1655 in the Joiners' Company although he also became a Brother Clockmaker in 1667. Like his master, from whom he eventually took over, he could work in brass, silver, ivory or wood and made the whole range of mathematical instruments of the time. His premises were at the Golden Ball in the Strand, near Somerset House. He made instruments for both Robert Hooke and John Flamsteed but he is probably best-known for the instruments he made for James Gregory to equip the new St Andrew's Observatory when he came to London in 1673 on a purchasing expedition. These included a new plate for the latitude of St Andrews ( $56^{\circ} 25'$ ) to fit to the Humphrey Cole astrolabe (already a century old) which is still in the St Andrew's Museum. The stereographic projection on that instrument is a testament to Marke's skills.

The North Wales double horizontal dial is not in good condition as it now has a thick blue-green patina though it does

still have its gnomon intact and was clearly once an excellent instrument. Like the dials produced by his master Sutton, it is about 12" across and characterised by a rather narrow main chapter ring. Further studies are needed to discover its other features.

The search for Marke led to some engravings from a similar DH dial by him held the archives of the Royal Society as part of the Boyle Papers (vol. 35). Folio 201 shows the dial normally and folio 219 has a pair of mirror images, one on each side of the sheet. It is probable that the mirror images were pulled directly from the inked dial plate and that one was then used, with the ink still wet, to produce a 'counterproof', reversing the image again for a normal view. Fig. 1 is from an electronically-reversed photograph of the darker of the reversed images on folio 219: the 'normal' view of folio 201 has been bound into the archives along a fold and is thus difficult to photograph properly. The extreme similarity of this dial design with at least two engravings of dials by Henry Sutton has been noted and is currently being researched.

The scientist Robert Boyle (1627-1691), of *Boyle's Law* fame, moved from Oxford to his sister's (Lady Ranelagh) house in Pall Mall in 1668, (on the present site of the Royal Automobile Club) where he lived until his death. Boyle also had a retreat in the City "my Message or Dwelling House in St Michael Crooked Lane London". Not all of the material in the Boyle Papers actually belonged to Boyle so we cannot be completely certain that he was the owner the dial of the engraving. However, the dial's recorded latitude,  $51^{\circ} 32'$ , is the conventional value for London and so it seems quite possible that the dial was made for one of Boyle's residences. This possibility is considerably enhanced by an essay that Boyle wrote to Henry Oldenburg in 1688, discussing the purposes of the eye. He wrote:<sup>1</sup>

Suppose that a Country Man, being in a clear day brought into the Garden of some famous Mathematician, should see there, one of those curious Gnomonick Instruments, that show at once, the *place* of the

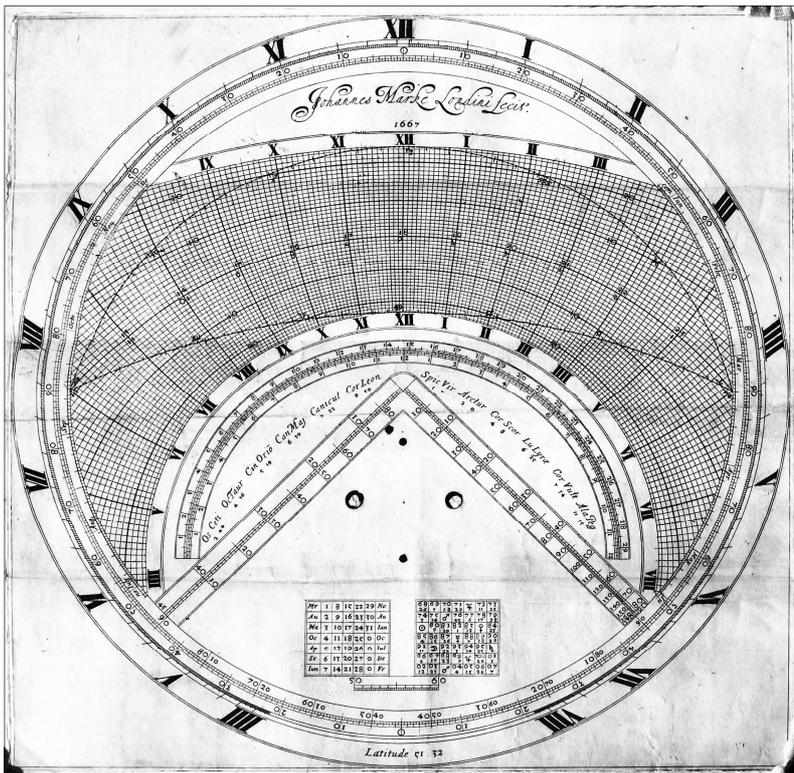


Fig. 1. Author's photograph of the engraving in the Boyle Papers, vol.35, folio 219 (photographically reversed). Reproduced by kind permission of the Royal Society.

*Sun in the Zodiack, his Declination from the Æquator, the Day of the Month, the Length of the Day, &c.* It would indeed be presumption in him, being unacquainted both with the Mathematical Disciplines, and the / several Intentions of the Artist, to pretend or think himself able, to discover all the Ends, for which so Curious and Elaborate a Piece was framed. But when he sees it furnished with a Stile, with Horary Lines and Numbers, and in short, with all the Requisites of a Sun Dial, and manifestly perceives the Shadow to mark from time to time, the Hour of the Day; 'twould be no more Presumption than an Error in him to conclude, that (whatever other Uses the Instrument is fit, or was design'd for) it is a Sun-Dial, that was meant to shew the Hour of the Day.

This can surely only refer to a double horizontal dial and the writer was clearly familiar with its operation. One further intriguing piece of evidence links Boyle with John Marke. This is a small brass altitude dial and clinometer of unusual design, made by Marke and now in the London

Science Museum as part of the *Boyle Collection*, itself part of the larger King George III Collection.<sup>2</sup> This instrument is now being viewed in a fresh light.

How many more double horizontal dials are waiting to be discovered?

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1. 'Whether and How a Naturalist should Consider Final Causes' printed in *The Works of Robert Boyle*, Vol. 11, pp.89-90, *The Christian Virtuoso and other publications 1687-91*, Ed. Michael Hunter and Edward B Davis, Pickering & Chatto (1999).
2. A.Q.Morton and Jane Wess: *Public and Private Science: the King George III Collection*, OUP, (1993).

#### ACKNOWLEDGEMENTS

It is a pleasure to thank Irene Brightmer for supplying details of her find, Rupert Baker (Royal Society librarian) for access to the Boyle archives and Prof. Michael Hunter (Birkbeck College, London) for making me aware of the Boyle quotation.

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## READERS' LETTERS

### A Surrealist Sundial Face

The beautifully illustrated article by Mike Cowham on sundial faces in the recent issue of the *Bulletin* (Vol 20(ii)) probably made us all think of our own favourite sundial faces. You may already be inundated with examples: perhaps a new regular entry in the *Bulletin*?

My own offering is a vertical surrealist dial in Paris by Salvador Dali, signed by the artist himself. I read that he hired a cherry picker to lift him up to make his signature in the wet concrete in 1966 and the whole affair was televised. You will find the dial quite high up on a shop wall in Rue Saint Jacques in the Latin quarter. It was designed for Dali's friend who owned the furniture store. It is now a bagel café and next door is a Latin American restaurant, interestingly called 'el Sol & la Luna'.

The dial depicts a blue-eyed female face in the form of a scallop shell (coquille Saint Jacques). Is this a visual pun by Dali on the name of the street? (See p.148 for an article by Julian Lush on scallop shell sundials in Armenia.)

Within less than an hour you can see this dial and also two historic meridians. There is the meridian line in the Church of Saint-Sulpice, begun in 1727: the brass inlay crosses the floor of the north-south transept and goes up the 11 metre high white marble obelisk, dated 1743. The latter was

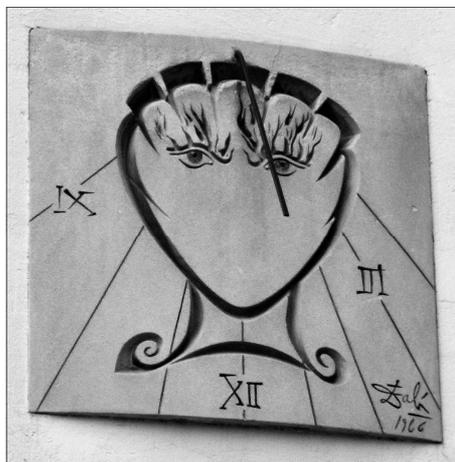
defaced during the Revolution when they scratched out the inscriptions referring to God and King. The remaining inscription includes the declaration that it is an astronomical gnomon to determine precisely the spring equinox. The work was commissioned from the Englishman Henry Sully (1680-1728), primarily to fix precisely the date for Easter, and was undertaken in collaboration with the Paris Observatory.

Only a couple of blocks away from the church, along Boulevard Saint Germain, you can see a 12 cm brass disc in the pavement marked with the name 'ARAGO' and north & south pointers. This marks the official Paris meridian which passes through the Paris Observatory and was recalculated in the early 19<sup>th</sup> century by the astronomer Francois Arago (1786-1853). It is one of over a hundred Arago medallions which were placed along a 5.7 mile stretch of the Paris meridian in 1995. (Look for another one in the Louvre courtyard near the Pyramid.)

Your non-dialling friends should also enjoy this short detour during their Paris sightseeing; or you can give them an extra hour for coffee by the Seine!

Irene Brightmer, Staunton Harold.

more letters on page 141



# THE DILLINGTON DOUBLE-HORIZONTAL DIAL AND JOHN MARKE

FRANK COE

The double horizontal dial was first published<sup>1</sup> in 1636 by William Oughtred and its design, construction and operation have well been described by Sawyer.<sup>2</sup> Among the thousands of horizontal dials recorded, relatively few are double horizontals. Those in the UK have been listed by Lowne<sup>3</sup> who notes that further examples may yet be discovered. It is therefore pleasing to be able to report an addition to this list together with a new maker name.



Fig. 1. The double horizontal dial at Newchurch IoW.

All Saints church at Newchurch, Isle of Wight, was built by William Fitz Osborne in William the Conqueror's reign and traces of the original building remain. From the 13<sup>th</sup> to the 17<sup>th</sup> century the present vestry was a chantry which, tradition has it, was built in 1204 by Eudo de Morville of nearby Knighton Manor so that masses might be said for his father who was one of the four Knights who in 1170 had murdered Thomas à Becket. When the de Morville family became extinct, Knighton Manor was bought in 1562 by Antony Dillington of Somerset. His descendent, Sir Robert, changed the de Morville chantry into a mortuary chapel in 1688 and at about this time installed a sundial on the bowling green at Knighton Manor. The Dillington line came to an end in 1721 with the death of Sir Tristram, although his sister Hannah survived him and in 1737 presented the silver chalice and paten still in use today.

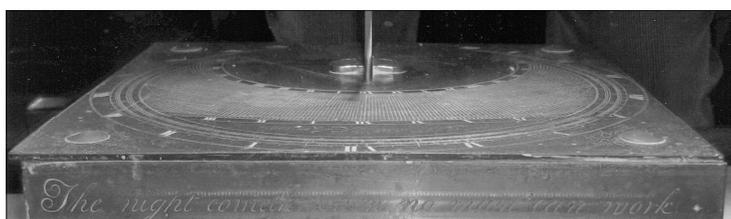


Fig. 2. The inscription on the north edge of the dial plate.

Knighton Manor changed hands and fell into decline, being finally demolished in 1821 by Squire Bissett. Five years before this happened he gave the Dillington dial to the parish of Newchurch and it was set on a pillar in the churchyard, a fact recorded on the south edge of the base of the dial. Fortunately, it was removed from there and is now securely fixed to a N aisle windowsill inside the church where it is protected from weather and possible vandalism. In the 2005 BSS Register it is SRN 2721 and listed merely as a horizontal.

The dial is a rather fine double horizontal, marked for latitude 50° 40' N, that of Newchurch, and the maker "Johannes Marke, London, 1678". The dial plate is approximately 310 mm square, probably bronze, with a brass gnomon which may have been damaged and repaired. There are brass panels on the four sides: figure 1 shows the south side. The sides carry the following inscriptions:

South edge: *This Dial was presented to the Parish of  
NEWCHURCH Nov 1815 by Maurice George  
Bissett Esq.*

East edge: *Ventura est nox qua non potest operari 9th  
Chap. John 4th verse*  
(literally: The night has come when it is impossible to work)

North edge: *The night cometh when no man can work*  
(the biblical version of the above. Figure 2.)

West edge: *ερχεται νυξ οτε ουδεις δυναται ερναζεσθαι*  
(A Greek version of the same quotation)

The inscriptions on the E, N and W edges of the dial plate are partly obscured by the surrounding woodwork and are difficult to read and photograph (a mirror strip would be a useful accessory in any future photography).

The engraving of the dial plate is shown in Figure 3. The name of "Johannes Marke, London, 1678" together with "Latitude 50 40" can just be seen along with an alidade scale in the SE quadrant and traces of a coat of arms below the gnomon. Marke is listed in the BSS *Biographical Index*<sup>4</sup> as working from "1665 to 1673 or probably to 1679".

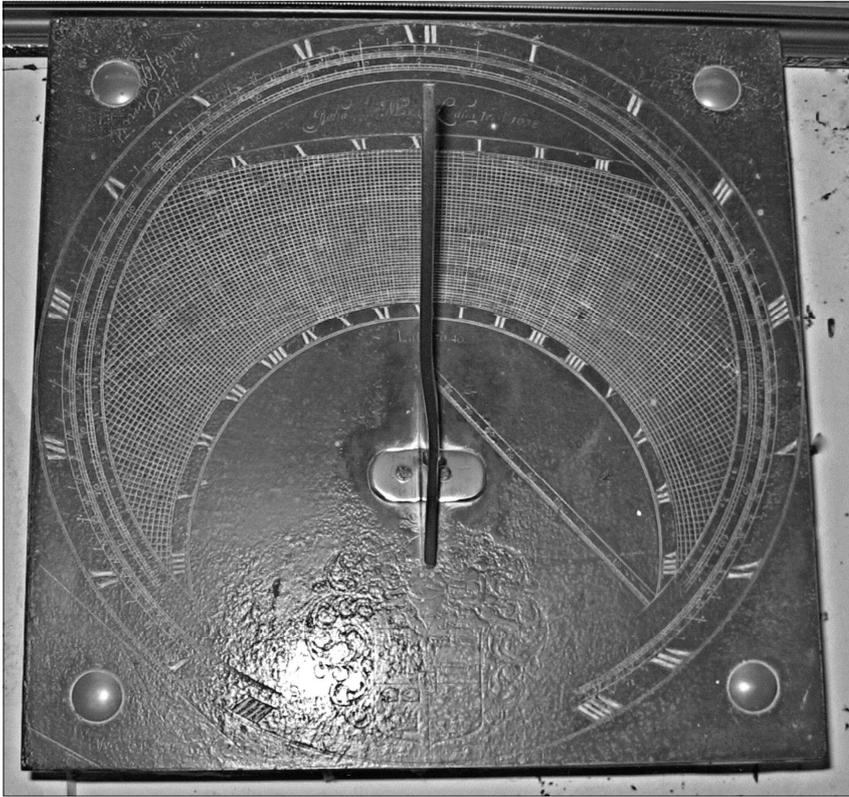


Fig. 3 (above). The engraving of the dial plate.



Fig. 4 (top right). Horizontal dial at Drummond Castle, Crieff, Perthshire.



Fig. 5 (bottom bottom). Horizontal dial at Stobhall, Perth.

Two other horizontal dials are attributed to Marke in the *Biographical Index*. Both are in Scotland - one at Drummond Castle, Crieff in Perthshire, SRN 1517, dated 1679 and shown in fig. 4, and the second at Stobhall, the home of our late patron the Earl of Perth, SRN 1552, dated 16-- and shown in fig. 5. The former is recorded as bronze and has what might be described as a fairly traditional layout, the latter is described as brass with a copper gnomon and shows a more complex layout which could be a sign that Marke was familiar with the design of a double horizontal. It may seem curious that these remaining dials are at opposite ends of the country, but the *Biographical Index* also notes that Marke supplied instruments to St Andrew's Observatory, not a great distance from Crieff and Perth.

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# LIVERPOOL ROAD STATION SUNDIAL, MANCHESTER

ROGER BOWLING

## The Railway

The first inter-city railway was opened in 1830. It ran from Liverpool Road station in Manchester to Crown Street Station in Liverpool. The grand opening by the Duke of Wellington was marred by the death of William Huskisson MP - the first railway fatality - and a politically inspired riot in Manchester. Despite this start the line prospered, traffic exceeded all expectations and it is today one of the main lines between the two cities.

## The Station

The building is the oldest extant railway station in the world and is now part of the Manchester Museum of Science and Industry. From the road there were two entrances, first and second class. These led to the two separate booking halls and up stairs to the waiting rooms at platform level.

In 1844 the Manchester terminus was moved nearer to the town centre to a new station, Hunt's Bank, which eventually became the great Victoria Station. The original station, with an 1830 warehouse, became a goods station and, with declining traffic, finally closed in 1975. In readiness for the 150<sup>th</sup> birthday of the railways in 1980 enthusiasts began clearing the site, so that it was possible in 1980 for a passenger train to enter the station again. Later, the museum moved from a site in an old cinema to its present large site.

## The Sundial

This was situated on the outside window ledge of the first class passengers' waiting room (Fig. 1). Although appearing to be on the first floor it is actually at platform level, thus easily accessible to station staff. It stood



Fig. 1. The station front: the sundial is above the first class entrance.

on a very substantial column which is still in its original position. The dial, now in the museum in a glass case, is about 60 cm diameter. It is brass with a thick, pierced, right-angle gnomon, graduated from 3am to 9pm in Roman numerals and divided into five-minute intervals. Latitude and longitude are included, both slightly wrong. It is inscribed "Railway Station Manchester" and dated 1833.

When the railway moved its passenger operations to Hunt's Bank, the sundial was left behind and due to its position beneath the overhanging head of the window opening has been dripped on by Manchester acid rain for 100 years. The resulting corrosion can be clearly seen, affecting about half the dial. The front of the station faces approximately south but declines about 13° west, which is why the corrosion is more pronounced on the south side of the dial.

The useful life of the dial was thus only eleven years. In the long non-active years it stood outside the office window of Mr Grundy the goods agent from 1917-1931. Thinking it might be a danger or be in danger, Mr Grundy brought it inside in 1929 and hung it on the wall in a place of honour behind his desk (Fig. 2). This was just before the 100<sup>th</sup> birthday of the railways when the staff at the station began, with very commendable foresight, collecting and preserving a few portable antiquities.

The 'sundial' on the column today cannot be called a replica. It can only be described by an architectural term not in the BSS Sundial Glossary, a dummy sundial. The dial plate is just a blank metal disk lacking all markings, a big failure by the museum for surely this large column in an historic site deserves a working dial.

## What Was The Sundial For?

From its opening, the railway had two good clocks, one at each terminus. The museum in its recreation of the first class booking office displays a long-trunk, eight-day, round-dial wall clock, not I suppose the original but similar. Such a clock would be accurate and adequate for the railway's purposes but, of course, it would require checking. The sundial must have been for this purpose but was it suitable for timing departures?

Although the dial is graduated for 18 hours, 3am to 9pm, it is to the south of and partly overhung by the station building. So, like a vertical dial, it can show no more than twelve hours. Usually the



Fig.2. The sundial in about 1930, hanging in the goods agent's office. © Manchester Archives & Local Studies, Central Library.

earliest and latest departures were at 7am and 7pm, but some departures were at 3:15am: at these times the sundial was useless. Considering the Manchester air quality at the height of the industrial revolution, there would have been days when there was less chance of seeing the sun than there was of seeing Salford just across the river. The sundial could never have been of any use in sending off the trains.

### Timekeeping

One of the problems of the railway was timekeeping. Trains were sent off from both ends of the line at half-hour intervals by the clocks. The first class trains stopped only at the halfway point to take on water, but the second class trains called by request at any of the fifteen intermediate stations and time lost by stopping was hoped to be made up when there was a clear run. Arrival time was flexible and not advertised.

If a gentleman was seen hurrying to the station, then departure was held up until he, his servant and the carriage had all been loaded up. Four minutes, the longitude difference in time between Manchester and Liverpool, was insignificant against this laxity. Passengers complained to the company that the clock on St John's church (demolished long ago) visible from the station entrance was unreliable. Rather than buy their own public clock, which would very well have graced the front of the building, they asked the

churchwardens to regulate and illuminate the church clock. This the churchwardens agreed to and requested a contract at £5 per year which the railway paid. Time keeping was a very hit and miss business, but never had anybody been expected to organise their life to the minute.

### Connections

Right from its opening, the railway was a success, soon running ten passenger trains and ten goods trains each day. By 1839 five new companies' lines joined and passengers had to make connections. At this time there also appeared the first timetables, another railway invention originating in Manchester. John Gadsby in 1839 sought permission from the company to print and sell timetables of the Liverpool and Manchester and the Grand Junction Railways and later the same year Mr Bradshaw brought out the first 'Bradshaw': times were given in local sun time. It was the timetable, a concept unknown before the railways, that did just as much as the adoption of railway time to clear the confusion resulting from the use of different time systems. Passengers missing their connection did sometimes turn to litigation and I suggest it was to guard against this threat that the sundial was purchased in 1833, three years after the railway opened. Despite railway time, Greenwich time, Wheatstone's telegraph and timetables, sundial time ruled until 1880.

The sundial was in a prominent position, clearly visible to passengers arriving and to those most likely to complain, the first class passengers. It was really a public relations sundial and I imagine a scene in the first class waiting room, something like the following:-

Two toffs: *Ah my good fellow, can we be assured that we shall arrive in time for our luncheon meeting with His Grace the Bishop of Liverpool?*

The Fat Controller (the world's first): *Certainly Lord and Lady Manchester, we shall do our best and as you can see from our sundial we recognise the old accustomed time, but if by some mischance you miss your lunch and think to complain, you will realise that our sundial carries the weight of the law.*

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# AN ANALYSIS OF THE VERTICAL EQUIANGULAR SUNDIAL

GRAHAM ALDRED and CELIA JAMES

*This paper was written by Graham Aldred to expand the technical details given in the presentation made by Celia James at the BSS Conference 2008.*

## Introduction

Vertical equiangular sundials are very rare. Equiangular sundials were described by Foster in 1654<sup>1</sup> and then independently by Lambert in 1777. Such sundials are now called equatorial projection sundials or Foster Lambert dials which acknowledges the joint discovery. This paper describes a modern vertical equiangular meantime sundial made by James Richard after 1995. I met Celia James at the BSS Conference at Cambridge in 2007 where we discussed the sundials that had been designed and made by her father over a period of 30 years prior to his death in 2004. Most of his designs included features to provide mean time rather than solar time. On his conventional horizontal and vertical sundials the longitude time shift and British Summer Time (BST) were incorporated in the delineation. An artistic EoT reference table was usually provided on the dial face in a graphical form (Fig. 1). James did all the construction, painting and engraving in his own workshop.



*Fig. 1. A conventional vertical declining dial designed and made by James Richard in 1974, delineated for BST and longitude and with an artistic EoT table. Note the month name reversal.*

In later years he set himself a significant challenge. He decided to make a big public vertical, true south, sundial that could be viewed from a distance. It had to resemble a clock with noon at the top of the dial face and with hours advancing clockwise. It would indicate mean time (or BST) and cause the man in the street to 'stand and stare' at a sundial that could actually show the same time as his watch. The design proceeded intermittently over some years in parallel with the many other diverse interests that James enjoyed. Two small plywood prototypes were made leading to the construction of the large sundial which was fixed to the balcony of his home in Bristol, where it functioned well for several years (Fig. 2). After James' death Celia inherited it and kept it in storage.



*Fig. 2. The equiangular vertical meantime sundial mounted on the balcony at Bristol.*

I was intrigued by this impressive sundial with a strange gnomon that inclined upwards against all the rules. I had never encountered a vertical equiangular sundial before and wondered why a sundial with such appeal should be so rare. In James' papers there are letters and sketches about the construction and performance of the dial but there are none that explain how James arrived at the principle. I wanted to analyse it mathematically and this has led to the development of an alternative method for the investigation

of unusual dials that does not require an understanding of Foster Lambert methods for projection sundials. The appeal is that unusual sundials can be analysed by relating them to conventional sundials for which the behaviour of shadows and the associated mathematical formulae are much more familiar to many diallists.

### James Richard's Equiangular Vertical Meantime Sundial

James specification generated several requirements. For meantime readings, the hours must be equally spaced in order to incorporate the adjustments for longitude, EoT and BST. Equal angles in a vertical plane require the gnomon to move daily as a function of solar declination. So this is an analemmatic sundial where the time is indicated by the intersection of the gnomon shadow with a line on the dial face; in this case the line is a semi-circle. The dial had to be large for the numerals to be readable from the street, and strong enough to provide stable support for the gnomon at the extremes of the summer displacement. Despite its size, weight and increasing height of the centre of gravity in summer, the dial assembly had to be very stable and remain vertical and meridian-oriented after the daily adjustments. A fixed frame of wood and ply provided the mounting and bearings for the movable parts and this was clamped to the railings of an upstairs balcony but angled to face true south. Both the gnomon and the hour circle had to be easily accessible for solar declination and EoT adjustments so the balcony mounting provided excellent access to the rear where the scales and clamps could be located without compromising the artistic appearance. Further physical details are given in the appendix.

I never met James but he is remembered by BSS members who joined the early sundial safaris. On one of these Walter Hofmann became very interested in this sundial and he later wrote a description for the Austrian society, *Gnomonicae Societas Austriaca*.<sup>2</sup> This analysis required an existing familiarity with projection sundials and Foster-Lambert theory. In subsequent correspondence James complimented Walter on the article but admitted that he could not follow the details after translation and that Walter seemed "to know more about my sundial than I do!". Apparently James did not recognise the formal Foster Lambert process so perhaps he deduced the principle independently from knowledge of geometry, perspective and graphical sundial delineation. This possibility encouraged me to try to analyse the sundial using conventional dialling principles. After all, if the 'Equinoctial Dial'<sup>3</sup> is the mother of all sundials then the vertical true south equiangular sundial could also be her child, though apparently not her favourite one!

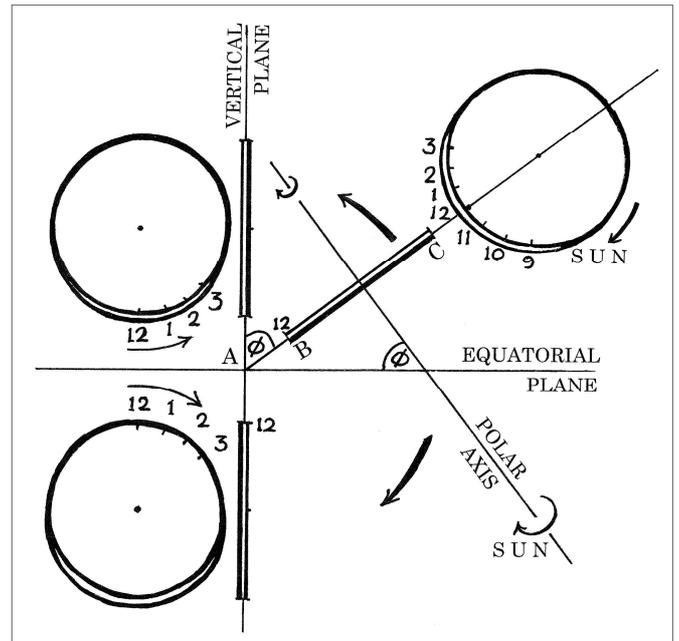


Fig. 3. An equatorial disc BC hinged in two directions into a vertical plane. Two discs with opposite hour rotations are the result: the lower one has noon at the top and clockwise progression.

### The Analysis

I imagined that a conventional true south dial and an equiangular dial without a meantime adjustment mechanism were mounted on the same wall. Somehow I had to connect the two dials to a common sunbeam. Eventually I realised that my sketches resembled the traditional graphical construction for the delineation of sundials. In the familiar diagram in Figure 4, a circular equatorial dial BC with hour points is mounted on the polar axis at latitude  $\phi^\circ$ . It can be hinged at A either upwards through  $\phi^\circ$  or downwards  $(180-\phi)^\circ$  onto a vertical plane. Two equiangular dial faces will result but they will have opposite hour rotations and noon positions.

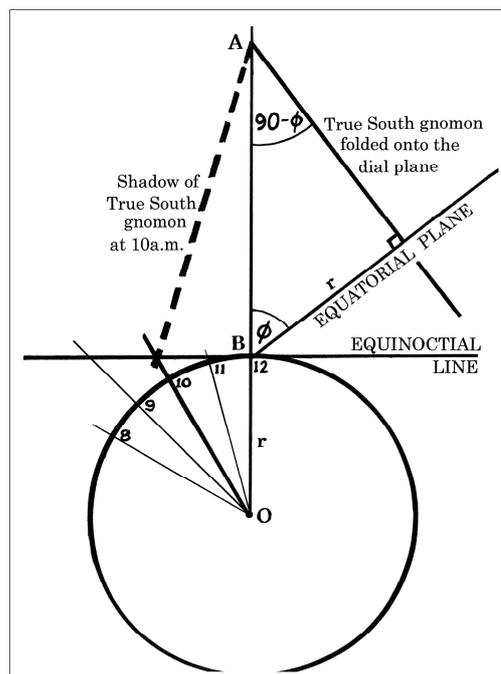


Fig. 4. The standard graphical delineation method showing an equatorial disc generating nodus shadow points at the equinox. These shadow points define the delineation of the true south dial under construction.

In fact this hinging downwards is the fundamental step in the graphical procedure for the delineation of conventional sundials used for the last 350 years. The plan view is shown in Fig. 4: a horizontal line is a tangent to an equatorial circle that has been hinged downwards. There is a nodus at the centre of the equatorial circle on the gnomon. At any time at the equinox the shadow of the nodus must always lie somewhere on the horizontal line, known as the equinoctial line. These nodus shadow points can be found by extending the radial lines from the equatorial circle to intercept the equinoctial line. Connecting these shadow points to the gnomon root provides the desired delineation and shadow angles for a conventional dial face.

I decided that it must be possible to reverse this process by starting with an already delineated true south conventional sundial and guiding it to produce a vertical equiangular sundial. The equiangular dial is mounted vertically beneath the true south sundial (Fig. 5) such that the two gnomons will intersect in the same meridian plane and this common point will provide a nodus that links the shadows from both sundials. Already things were going well: I had a dial face with noon at the top and clockwise hour progression that has always existed as a tool in the graphical construction

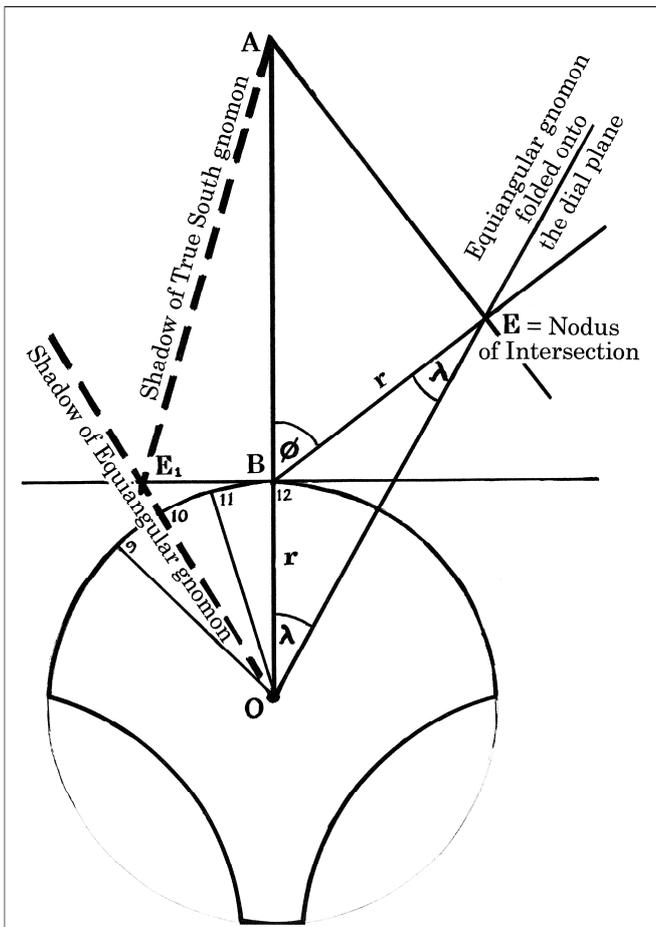


Fig. 5. The construction reversed. The equiangular dial is mounted beneath an already delineated true south sundial. The gnomons will cross to define the nodus of intersection that links the sundials to each other.

for the last 350 years although its potential to become a sundial in its own right does not appear to have been generally recognised. If this approach worked then the true south vertical sundial which is a natural child of the equinoctial dial<sup>3</sup> would become the mother of the vertical equiangular dial thus making the equinoctial dial a proud grandmother. In fact the true south dial would be the mother of twins because there are two potential equiangular dials as shown in Fig. 3. However these are not identical twins so I shall focus on the clockwise dial that James chose.

### Gnomon Geometry

The first feature to consider is the gnomon geometry for which three characteristics are evident.

- For the hours to be equally spaced at the equinox, the gnomon root must be at the dial centre in order to provide radial shadows at  $15^\circ$  intervals.
- In order to cast clockwise shadows on the upper dial plate where the hour labels are inscribed, the gnomon must be elevated or inclined upwards, opposite to a conventional true south dial.
- This elevation of the gnomon from the horizontal must always be greater than the maximum altitude of the sun

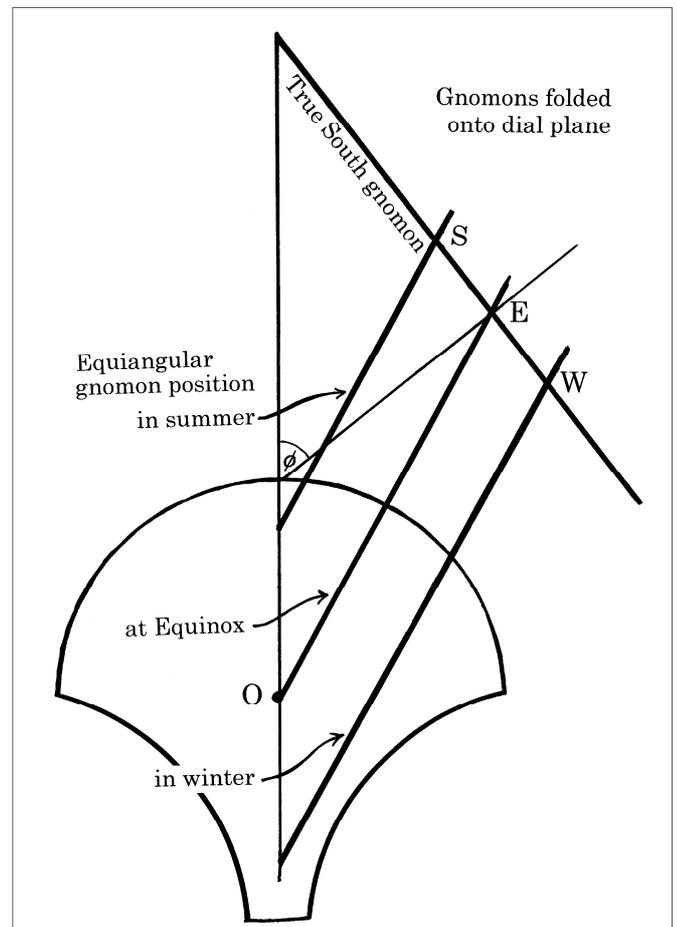


Fig. 6. The effect of the displacement of the equiangular gnomon on the position of the nodus of intersection.

at noon at high summer declinations in order that the gnomon can always cast shadows onto the hour circle.

The angle of elevation can be deduced from the simple geometry in Fig. 5 for the equinox. Suppose the dial is located in latitude  $\phi$  and the gnomon is inclined upwards at an unknown angle  $\lambda$ . By construction  $BE = BO$  so  $OBE$  is an isosceles triangle with the apex angle  $OBE = (180-\phi)^\circ$ , therefore  $\lambda = (\phi/2)^\circ$  and subsequent analysis shows that this angle is viable at all other solar declinations. On James's sundial the gnomon angle is  $26^\circ$  from the vertical dial face. Similar geometry for the anticlockwise version shows gnomon declined downwards by  $(90-\phi/2)^\circ$ .

### Gnomon Displacement

With these gnomon angles there would be radial shadows emanating from the centre so this sundial would function correctly at the equinox. But in order to use an equiangular dial in a vertical plane throughout the year the gnomon root must be displaced in a vertical slot in the meridian plane to compensate for the changing solar declination. It is displaced downwards in winter and upwards in summer consequently the nodus at the intersection point moves accordingly relative to the equinoctial position as shown in Fig. 6. The cover picture shows the gnomon at the winter solstice and Fig. 8 shows the summer solstice for comparison. The true south dial and the equiangular dial are



Fig. 8. The equiangular sundial showing the extent of the gnomon displacement required near the summer solstice.

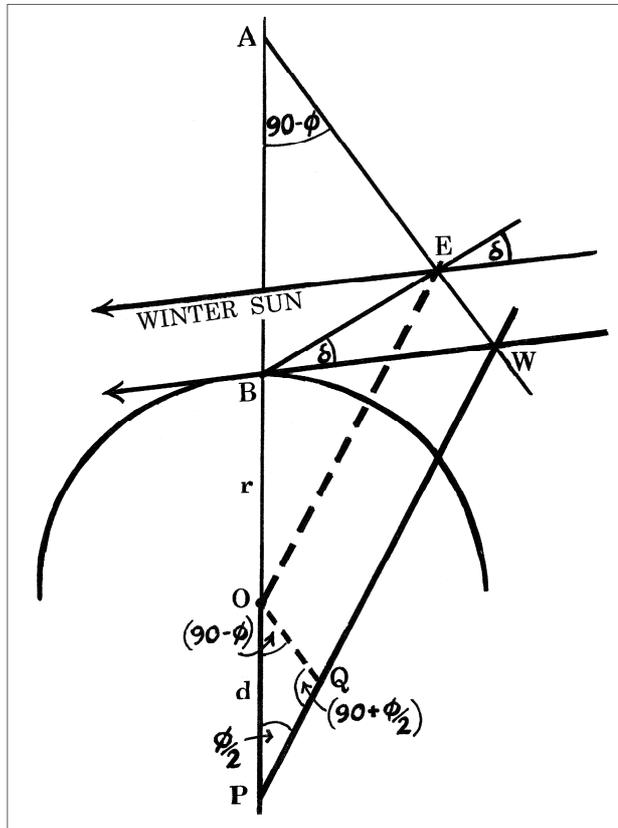


Fig. 7. The gnomon displaced in winter. The displacement required is such that the shadow of nodus of intersection falls on noon on the hour circle at noon. The displacement  $d = r \tan \delta / \tan(\phi/2)$ .

shown in conjunction in Fig. 7. As usual, their gnomons have been swung into the same plane as the dial faces and winter sunbeams are at  $\delta^\circ$  below the equatorial plane. The gnomon must be displaced downwards by a distance such that the noon shadow of the nodus of intersection, now caused by the declined winter sun, falls exactly on the noon point on the equinoctial line. This requirement ensures that all other time readings throughout the year will be indicated on a curve that includes this noon point.

In Fig. 7, triangle  $POQ$  is constructed with  $OQ$  parallel and equal to  $EW$ . The required displacement is  $OP (= d)$ .  $EW = r \tan \delta$ , where  $r$  is the radius of the hour circle and  $\delta$  is the solar declination.

Applying the sine rule in triangle  $POQ$ :

$$\frac{OP}{\sin(90 + \phi/2)} = \frac{OQ}{\sin \phi/2} = \frac{r \tan \delta}{\sin \phi/2}$$

therefore

$$OP = \frac{r \tan \delta \cos \phi/2}{\sin \phi/2}$$

Thus the required displacement is

$$d = \frac{r \tan \delta}{\tan \phi/2}$$

A similar geometrical figure for displacements at summer declinations produces the same formula, thus the displacement is symmetrical about the equinox. Clearly the displacement must not exceed the radius if the shadows are to intersect the hour circle, so  $\delta < (\phi/2)$ .

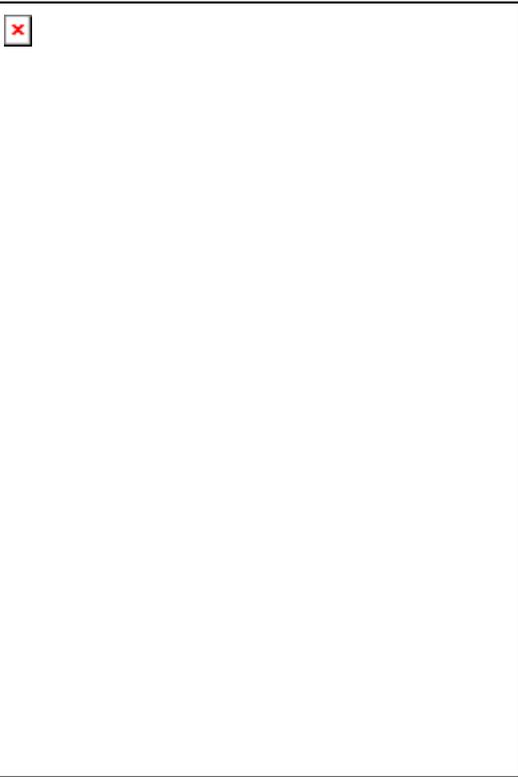
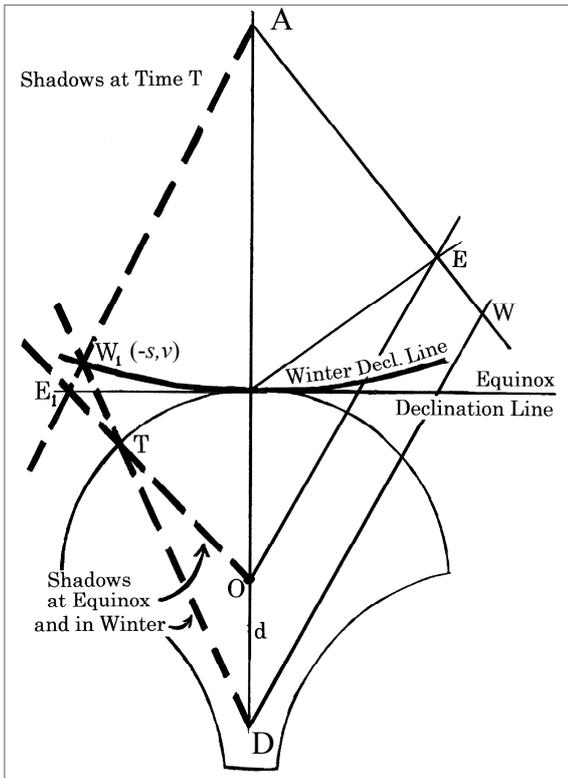


Fig. 9 (far left) The long shadow in winter defined by the point shadow of the common nodus on the winter declination line and the displaced gnomon root. This shadow intersects the equinoctial shadow on the hour circle.

Fig. 10 (left). As in Fig. 9 but showing the equiangular summer shadow with negative gradient but indicating the same time from the high summer gnomon displacement.

Consequently, the clockwise dial will only function every day in summer if it is sited above latitude  $47^\circ (=2\delta)$ . By comparison, the anti-clockwise dial requires a much smaller displacement given by

$$d = r \tan \delta \tan \varphi / 2$$

which is only about 23% of that required by the clockwise dial at  $\varphi=52^\circ$  nor it does have any latitude limitations.

### Shadow Convergence

The final part of the analysis is to show that, at any declination, the shadow of the gnomon will intersect the hour circle at the correct time (AST). In Fig. 9, three shadows at a given time T have to be considered:

- the shadow at a winter declination on the equiangular dial ( $DW_1$ ).
- the shadow on the true south dial ( $AE_1$ ) which is independent of declination, and
- the point shadow  $W_1$  of the nodus on a winter declination line.

The equinox shadow on the equiangular dial ( $OE_1$ ) provides the reference on the hour circle. Co-ordinate geometry with origin at O is used to derive linear equations for the two equiangular shadow lines. The task is to show that the point of intersection of these two shadows is independent of the solar declination at a given time and that the locus of this intersection for all times is a single circle.

The key is provided by the true south dial. At a time  $h$  hours before noon for a given winter declination, the shadow of the nodus falls at  $W_1$  at the intersection of the

declination line and the true south hour line. The co-ordinates of this point  $(-s, v)$  are well known for true south dials because declination lines can be plotted. They are a function of the azimuth of the sun and nodus height above the dial plane. The equiangular dial shadow must pass through the same point,  $W_1$ , because the nodus is common to both gnomons. The co-ordinates the other end of the shadow line, the equiangular gnomon root at D  $(0, -d)$ , are also known from the displacement formula. With two points known, the equation of the equiangular shadow line  $DW_1$  can be easily derived.

$$y = -\frac{(v+d)x}{s} - d$$

The equation for the radial shadow line at the equinox is a straight line through the origin at gradient  $(90+h)$ . This equation provides the reference at  $h$  hours before noon.

$$y = x \tan(90+h) = -x \cot(h)$$

By standard geometry these lines will intersect at a point  $(X_i, Y_i)$  where

$$X_i = -\frac{s.d}{d+v+s \cot h}, \quad Y_i = -\frac{s.d \cot h}{d+v-s \cot h}$$

where  $s = r \tan(\varphi + \delta) / \cos \delta$

$$v = \frac{r}{\cos \delta} \left( 1 + \cos \varphi - \frac{\tan A \sin(\varphi + \delta)}{\cos \delta \tan h} \right)$$

$$d = \frac{r \tan \delta}{\tan \varphi / 2}$$

in which  $A$  is the azimuth of the sun.

It would be pleasing to state that algebraic substitution of  $(s, v, d)$  at the intersection  $X_i, Y_i$  easily eliminates the declination  $\delta$  for any given time but actually these manipulations are rather long winded and tedious. The solution is to set up an Excel spreadsheet to calculate the numerical values of these formulae discretely across the whole range of possible times and declinations. The numerical results show that at a given time the shadows always intersect in exactly the same point for any solar declination and this point always lies on a circle of radius  $r$ . These results validate this alternative method of analysis based on conventional sundials and show that the formulae given here do exactly describe the behaviour of the equiangular sundial.

The Excel spreadsheet enables the equiangular dial to be modelled using the shadow equations so various characteristics can be investigated. For example, the shadows are partial chords except at the equinox. They get shorter as the gnomon root is displaced towards the top of the dial as the summer solstice approaches (Fig. 8). This means that the rotational speed of the shadow relative to the gnomon root rises dramatically. On the clockwise dial at the summer solstice, in the half hour around noon the shadow rotates about its root at an average rate of  $124^\circ/\text{hour}$  which falls to  $8^\circ/\text{hour}$  at the winter solstice. But this variation in speed does not matter: the passage of the intersection of shadow and hour circle remains utterly constant.

### Closing remarks

The design and construction of this equiangular true south meantime sundial does great credit to James Richard and it deserves much wider recognition. This was not a theoretical exercise in which he just conceived an equiangular vertical sundial on paper, albeit using an unknown method. His task was not only to construct a big analemmatic equiangular sundial but it had to be 'like a clock' so he had to resolve all the additional consequences of the clockwise choice when a less determined man might have resorted to the simpler anti-clockwise version. He produced a rare and unusual working meantime sundial, innovative in its engineering, striking in its size and appearance, shaped like a kite with artistic dial furniture. This dial would have impressed dialling enthusiasts at the time but perhaps James regarded it as his third prototype in which he could see further improvements so he never entered a BSS sundial design competition.

Study of this equiangular sundial has provided a rare opportunity for gnomonic detection and an interesting challenge which has led to an alternative method of analysis. In this unconventional approach I (GA) may have found some accord with James Richard. It has been a

pleasure to work with Celia who provided access to the sundial and helped to interpret James' surviving papers and photographs. She also drew the diagrams for this paper and made the presentation at the 2008 BSS Annual Conference.

Equiangular true south sundials are surprisingly simple and have considerable appeal because they can indicate mean time. The algebraic formulae derived here to prove the principle are not required in order to construct one. The only calculations required are the gnomon displacement as a function of solar declination and latitude. The real difficulty lies in the physical implementation and particularly in the design of an easily accessible gnomon displacement and EoT adjustment system that uses precise scales and that does not compromise the stability and orientation of the instrument. Currently there are no vertical or horizontal equiangular sundials listed in the BSS Register but it is hoped that this paper will stimulate some interest to change this deficiency.

### Appendix - More Details of the Balcony Dial

The radius of the hour circle is 15 inches and this determines the overall size of the dial structure. The aluminium gnomon occupies a central vertical aluminium channel that allows displacement from the equinox position of  $\pm 13.5"$  (for  $\varphi = 52^\circ$ ). Analysis shows that the style at the winter solstice has to be a minimum of 36" long in order for the shadow to reach the hour circle. Physical construction, the size of the hour plate demanded by the numeral size and the convenience of indexing the declination, and EoT scales all contributed to an increase in length and weight of the gnomon, giving an actual style edge 44" (112 cm) long. In contrast, at the summer solstice less than 16.5" is required. Nevertheless, high summer declinations create a problem because the whole gnomon structure must be supported high above the dial with its root only 1.5" below the hour circle. This raises the centre of gravity of the assembly which makes more demands on the mounting and clamping. In fact James even calculated the effect of wind that could twist the dial in summer and considered different gnomon materials for the next construction.

Meantime readings are achieved by innovative and compact methods. The hour circle and numerals are set on a semi circular plywood plate that can be manually rotated through the small arcs necessary for EoT plus BST adjustment. EoT values are provided on the back of the hour plate where dates with the same EoT value are joined by lines radiating from the hour circle centre. The EoT indexing for summer months is arranged to be an hour ahead of winter months. The longitude time adjustment (8 minutes slow) is incorporated into the EoT datum such that when  $\text{EoT} = 0$  the meridian shadow indicates 12:08 ( $2^\circ$  West) in winter and thus this offset is applied throughout the year. There is

no noon gap so the time must be estimated on the centre of the shadow. The hour circle deliberately only carries 11 hour intervals (6am is missing) to make assembly physically easier. The displacement scale is translated into dates on the back of the gnomon main support and indexed against the fixed channel.

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3. "This Equinoctial Dial, though, of all other, he be the simplest, yet is he mother to all the rest, for out of him, as from a root, is derived the projectment of those 24 hour lines on any other great Circle or plane whatsoever." Thomas Stirrup: *Horometria or the Compleat Diallist*, London, (1652).
4. Figs 1,2 by James Richard, Front Cover and Fig. 8 by G Aldred, all other figures by C James.

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## NEW DIALS

### A Painted Sundial in Brighton

This dial on the front of our Brighton house was painted in April this year and shows the hours and half-hours from 5am to 2:30pm plus the solstices and equinoxes. It also marks our wedding anniversary on 1<sup>st</sup> May. The whole painted panel, including the Plough stars, measures 91 cm × 186 cm.

We measured the direction the house front faced by using a plumb line at solar midday and marking its shadow on a horizontal board held against the wall and measuring the angle created which is 37° 30' east.

The gnomon, which is about 55 cm long, was made in a combination of brass and gilding metal with a silver bead

for a nodus. After designing the dial and transferring the plan to heavy tracing paper, we made the holes in the wall for the gnomon to be screwed into. Many Brighton houses were built of a material known as bungarooch, which is a mixture of flint and any other rubble held together with a lime mortar. When drilling into the wall, one has no idea if the drill will go too easily into the mortar or get stuck on a flint. By making the holes first, before marking any lines, we would be able to move the gnomon if the drilling went badly (which fortunately it didn't).

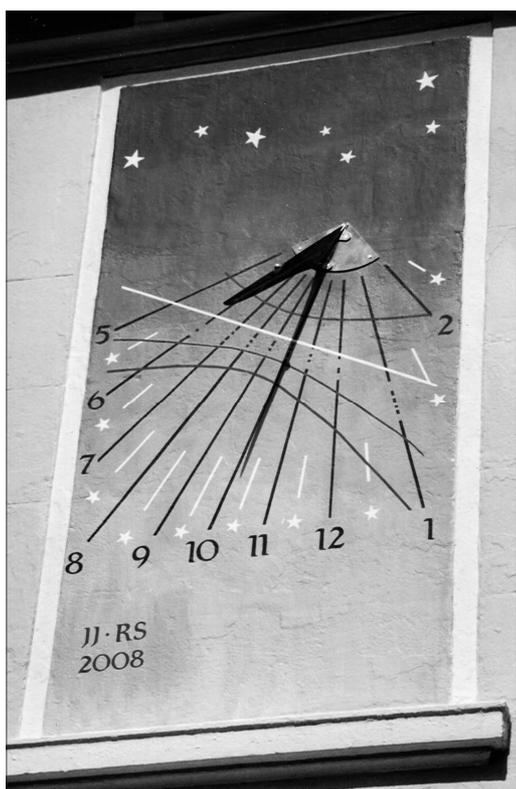
We then transferred the design to the wall by making holes on the lines on the tracing paper with a toothed wheel. The paper was then attached to the wall with masking tape and the lines painted over, leaving a series of dots on the wall. The dial was then painted using artists' quality acrylic paints and finished with a varnish which protects against uv

light. When the painting was finished and the scaffolding platform removed, we screwed on the gnomon and waited for the sun to shine.

Having a dial on the front of a house in a busy road attracts a lot of comments. The best was one man who, after remarking how accurate it was, then asked "How does that copper thing go round? Has it got a motor?" "No" I replied, "the shadow tells the time." "Gosh, that's really clever" he said, walking away in wonderment.

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More on page 143



# ASTROLABES

## Part 5 – Other Astrolabe Related Instruments

TONY ASHMORE

Having explained and discussed, in some detail, the main groups of planispheric astrolabes in Parts 1 to 4 of this series, some related and derived instruments will be considered in this part. As these are outside the main stream of astrolabes, the topic of interest as indicated by the reader survey, a more superficial coverage of this group will be given.

### THE SPHERICAL ASTROLABE

This instrument is largely known through the, mainly Arabic, literature of the 9<sup>th</sup> to the 13<sup>th</sup> centuries. There is only one surviving and essentially complete spherical astrolabe known to exist. This (Fig. 34) is currently on display in the entrance gallery of the Museum of the History of Science, Oxford. It dates from 1480/1 but its provenance prior to 1962, when it was bought, is unknown. The instrument endeavoured to ease the task of visualizing the earth and the celestial sphere.

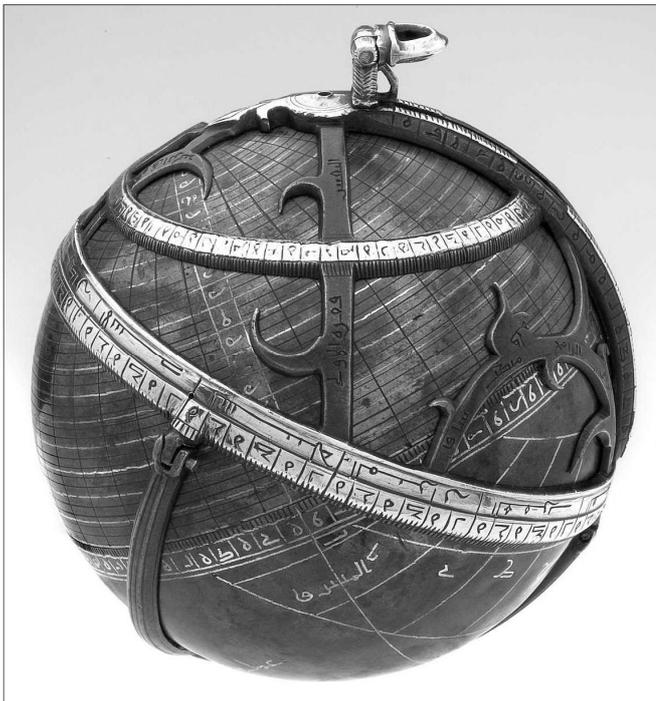


Fig. 34. Spherical astrolabe.

There are reputed to be parts of another, possibly two, spherical astrolabes in existence but there do not appear to be any illustrations of them and their location, if existing, is a well kept secret.

The device consists of a solid sphere representing the earth and this is engraved with lines, for the northern hemisphere,

representing the equator, parallels of latitude, the tropics and meridians, which enable the position of an observer to be located. This is equivalent to the normal plate of the ordinary astrolabe. Below the equator are lines for the unequal hours. Surrounding the sphere is a close-fitting skeletonised and moveable cap, representing the northern sky but including the southern half of the ecliptic. This is equivalent to part of a standard rete with the celestial equator, the zodiac calendar, the ecliptic and 20 star pointers. This pierced cap has a small shackle for suspension and a slot for latitude adjustment.

The spherical astrolabe was small, somewhat fragile and not a very practical instrument, probably accounting for its rarity.



Fig. 35. Linear astrolabe of al-Tusi.

### THE LINEAR ASTROLABE OF al-TUSI

The idea of the linear astrolabe, designed to perform some of the tasks of the standard stereographic astrolabe, is ascribed to one Sharif al-Din al-Tusi (c. 1135-1213). He was a rather obscure Islamic mathematician. There was another al-Tusi (meaning from the town of Tus in present day Iran), Nasir al-Din al-Tusi (1207-1274), a famous astronomer and mathematician who founded an observatory at Maragheh with the patronage of Genghis Khan's grandson.

No original example of the linear instrument is known to exist. A reproduction was made by the Belgian Henri Michel in 1943 which is now also to be found in the Oxford museum. Michel described it and explained some of its uses in his well known work *Traité de l'Astrolabe*.<sup>6</sup>

The instrument, shown in Fig. 35, consists of a simple rod with various graduations along its length. It essentially corresponds to the meridian line of an ordinary astrolabe. In the centre of this meridian line is the projection of the celestial pole and spaced along it are the centres of the almucantar circles including the zero almucantar, the horizon circle. (Fig. 4, Part 1). The sun's position on any day is given by the date, zodiacal or actual, on the ecliptic circle and where this crosses the meridian line gives the sun's declination for that day. The linear astrolabe has a declination scale along part of its length in addition to a few other scales not directly related to points on the standard astrolabe meridian line, such as astrological functions.

Also visible in Fig. 35, the instrument includes three strings. One is fixed in the centre with a weight on the end to act as a plumb line to provide a vertical reference. This string also has a marker, say a knot or a bead on it, to form a reference point. Another string is fixed near the end of the rod and is the *measuring* string or thread. The third string is moveable to various holes in the rod and is held by there by a small peg. Fig. 35 also shows 'sights' near each end but al-Tusi makes no mention of their inclusion.

As one example of the use of the device, Fig. 36 illustrates the method of finding the altitude of the sun or star with the instrument. The plumb line is attached at point C and the marker, say the bead, is at a length R from C at point B. The measuring thread is attached at A, the end of the altitude scale, which is also at distance R from C. This means

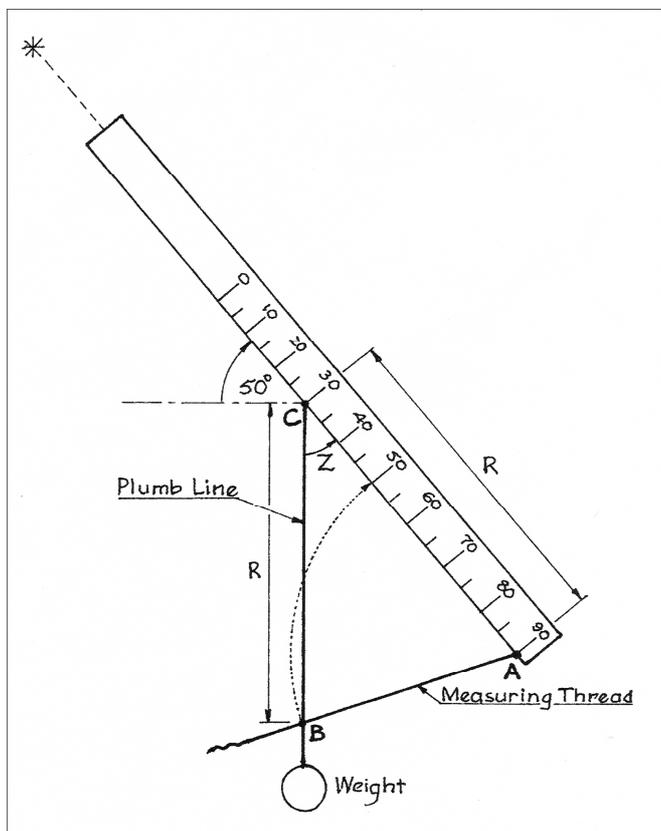


Fig. 36. Altitude finding with the linear astrolabe.

that A and B are points on a circle of radius R with centre at C. Therefore, AB is a chord of that circle and its length is given by the standard formula for the chord of a circle,  $chord=2R\sin\frac{1}{2}Z$ . In the drawing, Fig. 36, Z is the polar distance and the altitude is  $90^\circ - Z$ . The length of the measuring thread can be calculated for a range of angles sufficient to give the accuracy required for marking the scale on the rod.

In use, while sighting the object, the measuring thread is held taut across the plumb line and to coincide with the bead and then the 'intersection position' on this thread is retained while moving it to lie tightly along the rod to show the observed altitude, this being shown by the position of the intersection position against the scale on the rod. Care must be taken not to disturb the verticality of the plumb line in determining the correct position on the measuring thread. In the figure, angle Z is  $40^\circ$  corresponding to the  $50^\circ$  true altitude angle but the scale numbering is such to read the true altitude. If the altitude had been, say,  $65^\circ$  then Z would actually be  $90^\circ - 65^\circ = 25^\circ$  and the measuring thread would lie along the rod only '25° length' from point A but this is labelled as  $65^\circ$ , the true altitude, and so on.

The linear astrolabe can be used for several other purposes depending on the scales incorporated on the rod and using the moveable thread. A number of these functions are astrological which were very important in the Islamic world. With the sun's altitude known, the moveable thread can be brought into use to find day length or approximate time, hour angles and approximate declinations. Some of these involve reasonably simple calculations involving trigonometrical functions, not a problem in the twelfth and thirteenth century Islamic world for those likely to possess and use the instrument.

### ASTROLABE CLOCKS

Clocks that include an astrolabe type of dial are of two classes, monumental and domestic. Monumental versions were public clocks erected for the benefit of the town's community, more elaborate than the clocks we are used to seeing these days installed on the exterior of town halls or church towers. The monumental astrolabe clocks usually had a recognisable but simplified version of the rete of the ordinary astrolabe with its eccentric ecliptic circle, complete with zodiac signs and subdivisions showing a sun device indicating the place of the sun in the zodiac, and frequently unequal hour arcs under this 'rete' and a conventional 24 hour chapter ring with its hand. How much of their indications were meaningful to the general public is open to question but they must have been impressed with what the town council or local benefactor had provided for them.

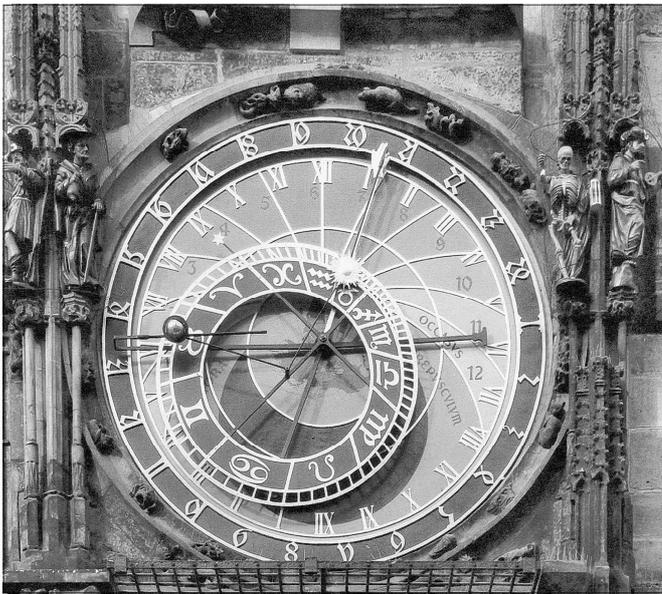


Fig. 37. Monumental astrolabe clock.

A well known example of this type of clock is shown in Fig. 37, installed on the southern wall of the Town Hall in Prague. The original clock was installed in 1410 but it has undergone a number of modifications and restorations since then, one of the more recent being in 1945 following war damage.

The projection for this dial is taken from the north celestial pole, unlike the standard astrolabe which uses the south celestial pole as the projection position, see Figs. 3 and 4 in Part 1 of this series. In consequence the horizon line is curved upwards from IV on the left to VIII on the right. The time of day is shown by the hand-shaped indicator against the 2× XII scale of Roman numerals, which rotates in 24 hours, and is showing about 1:10pm in the picture. The ecliptic circle, which rotates once in a sidereal day of approximately 23h 56m, is very prominent with its depiction of the zodiac divided every 5°. The sun face shows the position of the sun in the ecliptic giving the zodiacal date. The dark globe on the left, roughly in the middle of Taurus, shows the approximate position of the moon relative to the sun. The moon globe is painted half light and half dark and rotates about its own axis to indicate the phase of the moon. The ‘clock members’ of the Society will recognise this as a Halifax Moon. The curved white lines in the upper part show the unequal hours, labelled 1–12 in our common Arabic numerals and are also read from the hour hand. The area below the horizon is night time, the dark circle being total darkness whilst the lighter part around ‘darkness’ is the area of astronomical twilight, in this case when the sun is less than 18° below the horizon.

The outermost circle, numbered 1 to 24 in early European notation, gives the time in ‘Bohemian’ hours which, like Italian hours, start and end at sunset. This circle also moves to keep the 24 hour mark in line with sunset for the day.

Note: Authorities vary in their definition of Bohemian hours. Some give the above definition but others give them as starting and ending at sunrise, the same definition as Babylonian hours.

Domestic astrolabe clocks range from small, drum shaped table clocks, which have a normal astrolabe-type dial surrounded by the usual 12 hour chapter ring, through table or mantel clocks, having an astrolabe in the main dial or in a separate dial, to long case clocks. Some rather large multi-dial brass astrolabe clocks, standing 2 to 3 feet high, were made mainly in 16<sup>th</sup> century Germany for very high status homes and palaces. These latter items now tend to be mainly found in museums. The displays in the domestic type of clock vary more widely than in monumental versions.

The movements of astrolabe clocks, monumental and domestic, are quite complicated since different parts of the display must rotate at different rates. The ecliptic circle and the equal hours have nearly 4 minutes difference per day whilst the lunar indications of position and phase require yet other rates, for example.

Distinction should be made between ‘astrolabe clocks’, where a rete and plate type arrangement is incorporated, and public and private ‘astronomical clocks’, such as the well known clocks at Hampton Court Palace and at Wells Cathedral, where multiple dials, hands and pointers may show time, date, ecliptic position and so on but not in any form of display similar to an astrolabe.

### MARINER’S ASTROLABE

The instrument commonly referred to as a Mariner’s astrolabe is included here simply because of its name but it is not an astrolabe. Fig. 38 shows that it is a circular instrument with an alidade, with two plain sights, similar to the alidade on the back of an ordinary astrolabe and used for measuring altitudes. The circular edge is graduated 0–90° in

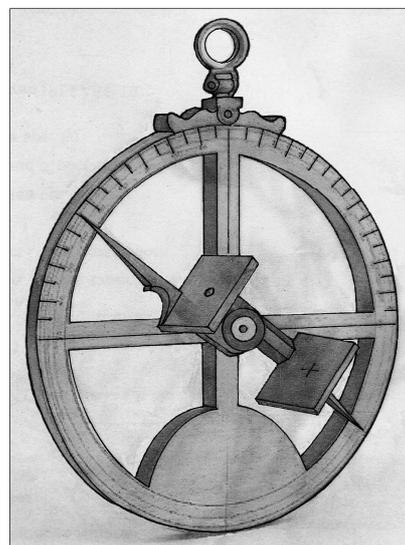


Fig. 38. Sketch of a mariner’s astrolabe.

the upper two quadrants, sometimes in all four quadrants. It is suspended, usually by a cord, from its ring and just measures the sun's altitude by rotation of the alidade until the image of the sun through the upper sight coincides with the hole, or mark, in the lower sight. It is thus not necessary to view the sun directly.

As its name implies it was an instrument for use at sea. It is very heavy with a significant weight at the bottom and most of the disc cut away, both features designed to reduce the effect of wind on it. The ordinary astrolabe with its comparative lightness and considerable area subject to wind forces was essentially of little use at sea. Manuscripts depicting an astrolabe in use at sea are largely fanciful.

The mariner's astrolabe was superseded by the cross-staff and back-staff and finally by the octant and sextant.

### QUADRANTS

As the name implies, a quadrant is an instrument in the shape of a 90° sector of a circle. There are a number of different types and designs of quadrant, some based directly on the astrolabe and using a stereographic projection and others, using various projections, were developed for such purposes as astronomy, surveying, navigation, construction and artillery use. Quadrants vary in size, small ones normally hand held, and large ones, mainly for astronomical use, were attached to solid walls and these are referred to as *Mural Quadrants*.

As this series is about astrolabes, only two quadrants very closely related to the astrolabe will be described.

### HORARY QUADRANT

This instrument is essentially half of the unequal hour scale usually found in the upper half of the back of the ordinary astrolabe. Fig. 39 shows the layout of the instrument. The pole, P, is the centre point of the astrolabe from which the

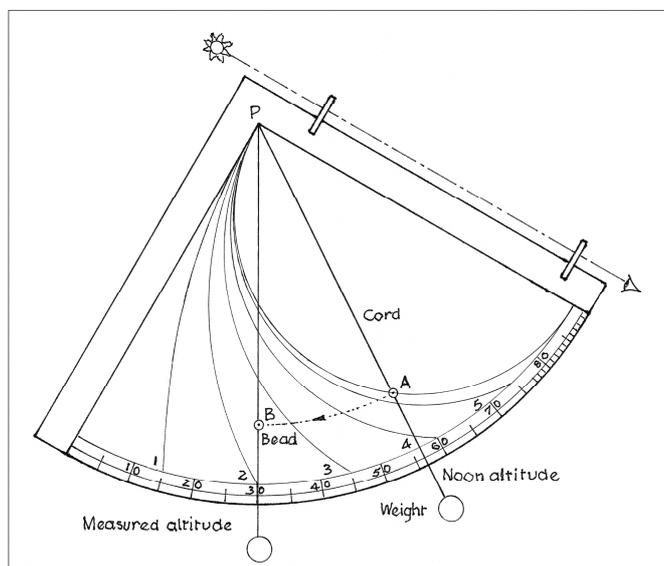


Fig. 39. Horary quadrant.

unequal hour arcs originate and the 0–90° graduations are the same as found on the outer edge of astrolabe's top right quadrant. On the meridian edge are two sights for viewing the sun and a weighted cord, with a moveable bead on it, is fixed at the pole, P. To measure the sun's altitude it is sighted using the two sights and the cord hanging vertically shows the altitude against the circular scale. To position the bead for the day, one of two methods may be used. If the declination of the sun for the day is known, perhaps from tables, the noon altitude can easily be determined using the simple calculation

$$\text{Noon altitude} = 90^\circ - \text{latitude} + \text{declination},$$

declination being positive if north or negative if south. The cord is placed at this calculated noon altitude angle and the bead slid along the cord until it coincides with the sixth unequal hour arc, point A. A sighting of the sun is taken and the cord retained at the observed position and the bead then shows the unequal hour, point B (half way between the 2<sup>nd</sup> and 3<sup>rd</sup> unequal hours). Alternatively, the quadrant may have a declination scale engraved along the other edge to the sights. In this case, the cord is placed along this scale and the bead moved to the day's declination and then the altitude measured, as above, to give the unequal hour.

This quadrant is also sometimes called the *quadrans vetus* or Old Quadrant. It is of Arabic origin dating, from manuscript sources, from the 10<sup>th</sup> or 11<sup>th</sup> century.

### ASTROLABE QUADRANT

This quadrant, being derived from the complete astrolabe by a process of *folding* the front view of the instrument twice to a quadrant, is capable of many of the tasks of the ordinary astrolabe. Fig. 40 indicates the method of achieving this design. Fig. 40(i) shows the rete outline but without any stars. It does include two horizon curves as they would appear on two different plates, one for 40° latitude and one for 51½°. Several more horizons for other latitudes could be included as desired by the maker or his client. If the diagram is folded along the east-west line, EW, the result is Fig. 40(ii). The second fold, of the semicircle, is along the meridian line, P-NS, giving the quadrant in Fig. 40(iii). The labelling of points on this quadrant is the same as on the unfolded diagram Fig. 40(i). The path of the sun during the year, starting at the vernal equinox, point A – the *First Point of Aries* – can be followed on this quadrant. The declination increases until the point B, coincident with the Tropic of Cancer at the summer solstice, is reached from where the sun apparently retraces its path to point C, the autumnal equinox. From point C the ecliptic progresses to point NS, coincident with the Tropic of Capricorn at the winter solstice, and then back to AC, the starting point and vernal equinox. Each section of the ecliptic between the tics

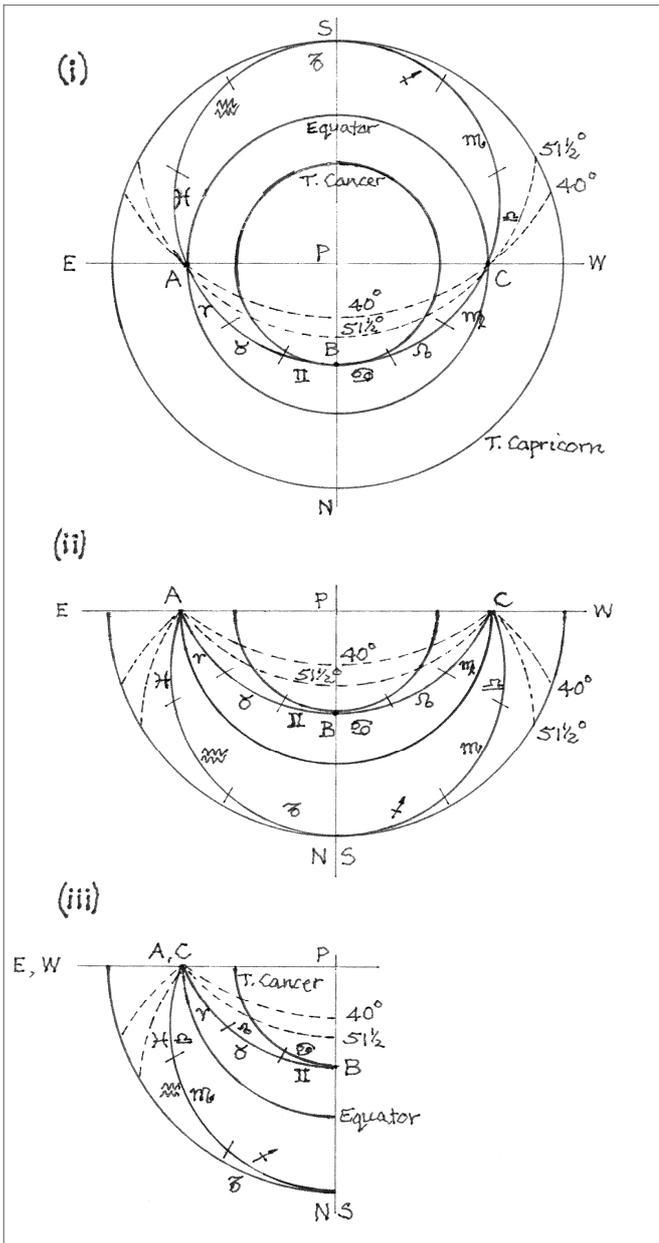


Fig. 40. Derivation of the astrolabic quadrant.

represents two signs of the zodiac. Referring back to Fig. 40(i) this progression should be quite clear.

The basic design of this quadrant is often given the name *quadrans novus* meaning new quadrant, and seems to date from the 13<sup>th</sup> century. Like the *quadrans vetus*, it has a weighted cord attached at the pole with a sliding bead along it. It also has the two sights along the meridian side. Like its progenitor it is capable of many functions and the multiplicity of overlapping scales provided for these purposes can make it look rather complicated. To help reduce the complication, the group of horizon lines springing from points A & C in Fig. 40(iii) is transferred along the equator to the opposite side of the quadrant on the line P-NS. To provide for measuring angles from both edges, the scale along the curved edge is labelled from both ends.

A simplified diagram of the astrolabe quadrant is given in Fig. 41. It is drawn as though the sun at an altitude of 30° is

being sighted. The origins of the 40° and 51½° horizon curves have been transferred to the opposite end of the equator as described above and the two 90° scales running in opposite directions are included. The arc for the Tropic of Cancer has been omitted as it normally serves little purpose in this instrument. Two semicircles have been added, noted as Noon/Sine and Cosine, one centred on each side. The one labelled Noon/Sine provides the 6 hour line for the unequal hour scale, as in the horary quadrant, and the unequal hour arcs 1 to 5 are usually included as that was the most used time stating method when these instruments were in greatest use. For clarity, the extra hour arcs have been omitted in this drawing. With the inclusion of the unequal hour arcs, this use of the astrolabe quadrant is identical to the use of the horary instrument described in the previous section. The sine and cosine applications will be described later, as will the scales marked Sine and Versine on the side with the sights. On the east-west line, on the left hand side in the drawing, a declination scale has been included. If, as is to be found on some astrolabic quadrants, a few prominent stars are plotted, the north declination scale is extended to 70° or 80° to cover these.

Unlike the full astrolabe, the equal hour time of day cannot be found directly but requires a simple calculation. However, the values needed for the calculation can be found from the quadrant. The calculation needed is

$$\text{versine } h = \text{versine } B (1 - \sin a / \sin a_N)$$

$h$  is the sun's hour angle,  $B$  is the day's semi-diurnal arc (the angle between the sun's rising and reaching the meridian, at noon, and also between noon and sunset),  $a$  is the sun's observed altitude and  $a_N$  is the noon altitude of the sun. The versine of an angle is little used today but was popular in earlier times and is equal to  $1 - \cos$ ine of an angle.

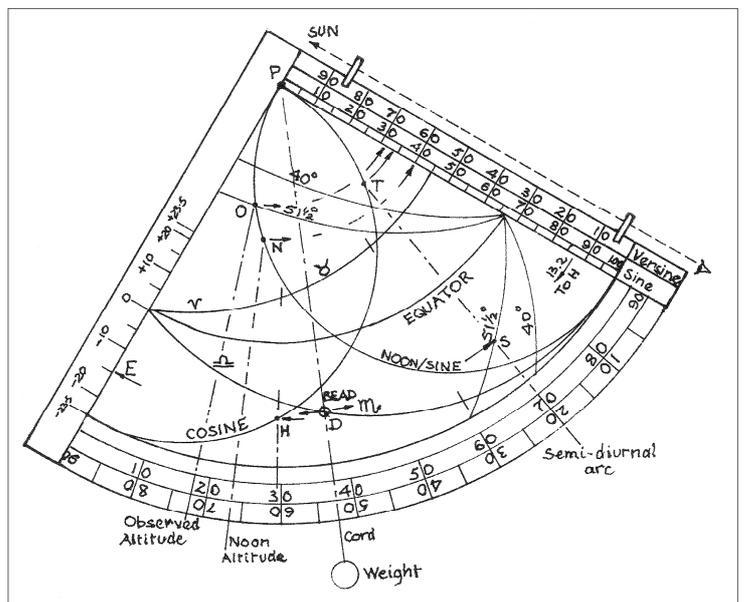


Fig. 41. Time finding with the astrolabic quadrant.

Example: To find the (equal) hour time of day when the sun's altitude is measured at  $18^\circ$  on November 2 in London, latitude  $51\frac{1}{2}^\circ$  N.

Shown in Fig. 41, the steps required are:

1. If the sun's declination isn't known from elsewhere it is determined by setting the cord across the zodiacal date, here Scorpio  $9^\circ$ , and adjusting the bead to lie on the ecliptic curve, point D. The cord is then moved to the declination scale for the bead position to give the declination,  $-15^\circ$ , point E. If the declination is already known the bead can be set directly at point E.

2. The noon altitude is calculated as for the horary quadrant, here

$$a_N = 90^\circ - 51\frac{1}{2}^\circ - 15^\circ = 23\frac{1}{2}^\circ$$

3. To find the semi-diurnal arc the cord, with the bead still at the declination position, is moved until the bead lies on the  $51\frac{1}{2}^\circ$  horizon arc, point S. Here the semi-diurnal arc is  $70^\circ$ .

4. The values of angles  $B$  ( $70^\circ$ ),  $h$  ( $18^\circ$ ) and  $a_N$  ( $23\frac{1}{2}^\circ$ ) have been found. The *sine* curve is used to find both  $\sin h$  and  $\sin a_N$ . To avoid working in decimal values, the sine and versine scales are expressed in parts of 100. The cord is placed over the observed altitude,  $18^\circ$ , and the bead adjusted onto the sine curve, point O, and then rotated to the sine scale giving  $\sin 18^\circ = 32$  (true value familiar today  $32/100 = 0.32$ ). Similarly, for the noon altitude the cord is placed on  $23\frac{1}{2}^\circ$ , the bead moved to the sine arc, point N, and then to the sine scale to give  $\sin 23\frac{1}{2}^\circ = 40$ .

5. The determination of versine  $B$ ,  $(1 - \cos B)$ , is similar to step 4 except the cord is placed over the semi-diurnal arc of  $70^\circ$  but the bead is placed on the cosine curve, point T, and moved to the versine scale – above the sine scale – to provide versine  $B$  directly as 66 (real value 0.66).

6. The calculation to be made is

$$\text{versine } h = 66 \times (1 - 32/40) = 66 \times 0.2 = 13.2$$

7. To find  $h$ , step 5 is reversed. With the cord on the versine scale the bead is adjusted to the 13.2 mark (or as close as seems right), the cord rotated for the bead to lie on the cosine arc and the hour angle  $h$  read as just under  $30^\circ$ .

8. The hour angle is converted to time by the relation that the sun moves  $15^\circ$  per hour. Therefore the angle must be divided by 15 to give the time in hours, say  $30/15 = 2$  hours for this exercise. The versine formula is based on the hour angle  $h$  being relative to noon. If the observation was taken in the morning the sun time was about 2 hours before noon, about 10am, or for an afternoon observation the time was about 2pm.

Like many techniques it is far quicker, at least with some experience, to do it than to describe it. The accuracy

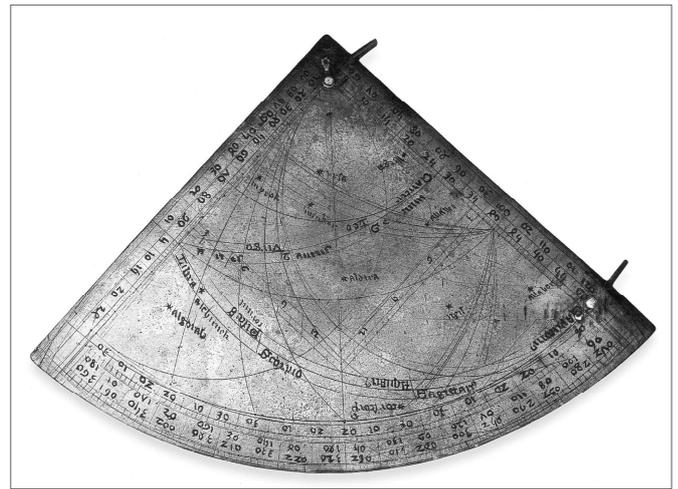


Fig. 42. The astrolabe quadrant.

achievable, even with the sine and versine values limited to two significant figures and using  $30^\circ$  instead of slightly less at step 7, was more than adequate for the age in which the instrument was in use. Subsequent developments of quadrants, particularly in England, improved the time finding capabilities to reduce or eliminate the small amount of calculation needed. Fig. 42 shows an astrolabe quadrant of the type described dating from the very early 14<sup>th</sup> century. It is nearly  $5\frac{1}{2}$  inches radius.

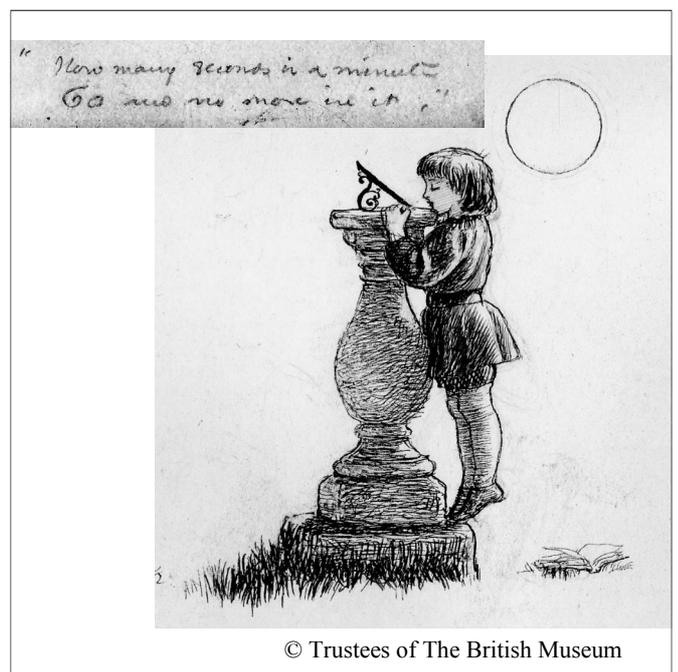
#### ACKNOWLEDGEMENTS

Figures 34 and 35 are reproduced with the kind permission of The Museum of the History of Science, Oxford. Fig. 42 is © Trustees of the British Museum. Fig. 37 is taken, with permission, from a photograph supplied to the author.

#### REFERENCE

6. Henri Michel; *Traité de l'Astrolabe*; Libraire Alain Brioux, Paris, (1947). Reprinted 1976, translated, edited and revised, as *Treatise on the Astrolabe*, by James E. Morrison, (1992).

*To be continued*



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# SOME HERTFORDSHIRE SUNDIALS

IAN R BUTSON

A previous article<sup>1</sup> in the *Bulletin* reported on the ‘Sundials of Buckinghamshire’ using references obtained from the Buckinghamshire volume of the King’s England<sup>2</sup> series of books by Arthur Mee. My researches into the sundials of Hertfordshire would likewise use Mee’s Hertfordshire volume<sup>3</sup> as the initial source of information but locations which noted mass dials as detailed in T.W. Cole’s ‘Origin and Use of Church Scratch Dials’<sup>4</sup> would also be investigated. Again, the opportunity would also be taken to visit and report on the dials recorded in the *Sundial Register 2005*.<sup>5</sup> All churches and cemeteries as indicated on the current OS maps of Hertfordshire would also be visited as past experience had shown that previously unreported dials were to be found at these locations.

Bordering onto the northern outskirts of Greater London, Hertfordshire remains essentially an agricultural county. In size, its population is sixth among the 39 non-metropolitan counties in England, whilst in area it ranks 34<sup>th</sup>. The county adjoins Buckinghamshire to the west, reaching almost to Aylesbury, with Bishops Stortford being its most easterly town close to its border with Essex: the town of Royston is situated at its northern boundary with Cambridgeshire.

## Mee’s and Cole’s Listings

Across Hertfordshire, Mee noted six fixed dials and seven mass dials at a series of locations. Five fixed dials were found still to be visible with that in the churchyard at Albury having possibly been replaced with a recent commemorative dial. The dial noted as being in the paved garden of the church at Ware was not found. Mass dials were found at six of the seven locations noted by Mee; but at Redbourn much stonework had been recently replaced at the church, perhaps causing the scratch dial noted here to be lost. Cole noted mass dials at ten locations; all being found except for the missing Redbourn one.

## Overall Findings

In total, 56 fixed dials were recorded during my researches. The dials were largely found on churches, in church graveyards and cemeteries, and also in locations open to the public or publicly viewable. Where a dial was seen on private premises, permission was sought to record it. In addition, 24 pedestals for horizontal dials were unfortunately found on graves but with their dials missing.

Mass dials were located at 27 separate church locations with a total of 68 inscribed dials being recorded. Addition-

ally, at the ‘new church’ of St Mary Magdalene in Flaunden a mass dial inscribed onto a ‘free’ block of stone was found within the church as an item of interest. This had been rescued from the nearby (old) church at Latimer in Buckinghamshire when it was demolished some years ago. At four churches, a large number of mass dials were found: Bengoe (8), Little Hornead (7), Old Knebworth (6) and Radwell (9).

By combining both Mee’s and Cole’s listings, mass dials were indicated at 10 locations. Once again, it was found that by adopting a systematic search of all the churches within a county a worthwhile result could be achieved whereby many more dials could be found than using the individual publications.

## Some Particular Dials

Scattered across the county, a good selection of old dials, and also some more recent ones, were found with most being in fairly good condition. Being of varied types, no attempt has been made to place them in any particular category or to suggest a path of travel through the county in which to see them.

In the churchyard at Albury, a simple horizontal dial on a stone pedestal (Fig. 1) commemorates a couple’s 60 years of marriage in 1998. Perhaps this dial replaces that which was noted by Mee as “placed in the churchyard 300 years ago”?

The National Trust estate at Ashridge, Little Gaddesden, affords wonderful woodland walks and on the Old Park

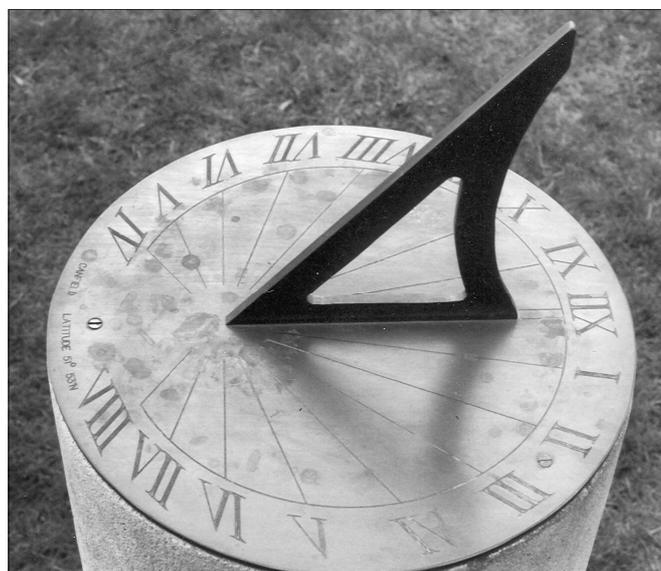


Fig. 1. Churchyard dial at Albury.

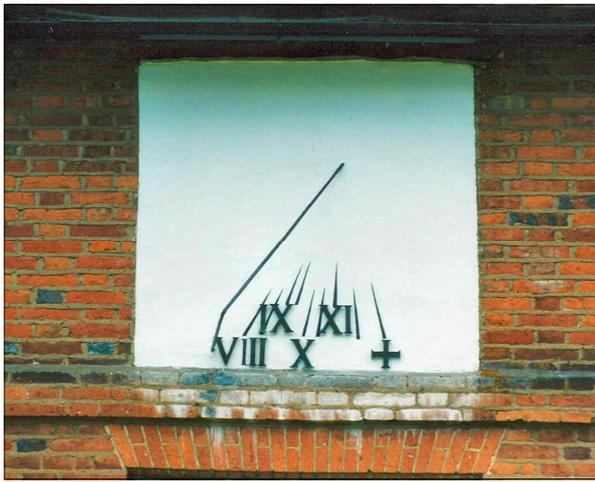


Fig. 2 & 3 (left and right). Two simple dials at Ashridge, on the Old Park Lodge.



Fig. 4 (below left). Sundial Cottage at Boxmore.

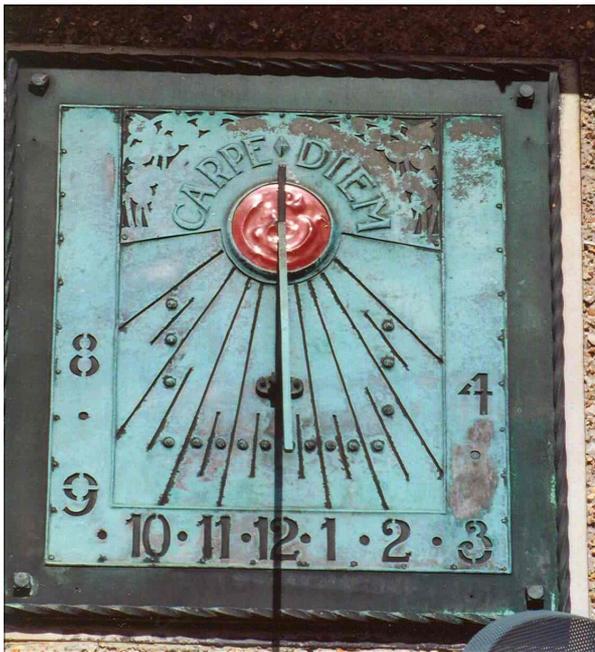


Fig. 5 (bottom left). Slate dial at Bucks Hill, Chipperfield.



‘Sundial Cottage’ at Boxmoor overlooks the Grand Union canal and displays a vertical dial (Fig. 4) with pierced characters proclaiming ‘Carpe Diem’.

A simple modern vertical slate dial (Fig. 5) is visible on the front of a cottage at Bucks Hill, Chipperfield.

On the grave of Sir George Alexander and his wife at Christchurch, Chorleywood, a simple horizontal dial (Fig. 6) can be found, the gift of a descendant in 2002.

Dials of interest can be found on two graves in the cemetery at West Watford. A bulbous ovoid-shaped pedestal carries sentimental symbols and commemorates George H Newton and his wife. The dial (Fig. 7) surmounting the pedestal is

Fig. 6 (right). Horizontal dial at Chorleywood.



Fig. 7 (below right). Dial commemorating George Newton at West Watford.



Lodge two simple vertical dials (Figs. 2 & 3) set into the brickwork may be found. However, beware of flying objects since a golf course also shares this part of the park. At the other end of the glade of trees, The Bridgewater Monument (1832) commemorates the ‘Canal Duke’ and may be climbed for panoramic views of the area on summer afternoons.



Fig. 8 (left). Equatorial dial at West Watford.

Fig. 9 & 10 (above & right). Fine horizontal dial by John Crosthwaite at Hatfield House.

engraved “Maker – Geo. A. Newton, Watford AD 1923” with latitude, longitude and height above sea level 240 ft also indicated. The dial plate engraving is relatively unworn and the mellow patina most pleasing. A shaped letter ‘N’ supports the gnomon. Nearby, an equatorial dial (Fig. 8) is to be found on the Steabben family grave. It is dated 1931-1943 and although the gnomon rod is missing and some attention to the dial’s mounting is required, it is an unusual example of dial to be found in this environment.

The gardens of Hatfield House (open daily) contain a fine horizontal dial by John Crosthwaite, dated 1793 (Figs. 9 & 10). Mounted on a spiral fluted pedestal, the dial plate carries an Equation of Time scale and indicates noon in 28 locations.



Fig. 11 (above left). A pair of declining dials at St Mary's, Hitchin.

Fig. 12 (left). The very unusual dial in the Paynes Park Physic Garden.

Figs. 14 & 15 (above right). A horizontal dial on the stump of a cross in St Faith's, Kelshall, churchyard.

Fig. 13. The dial on a house at Hitchin Hill.

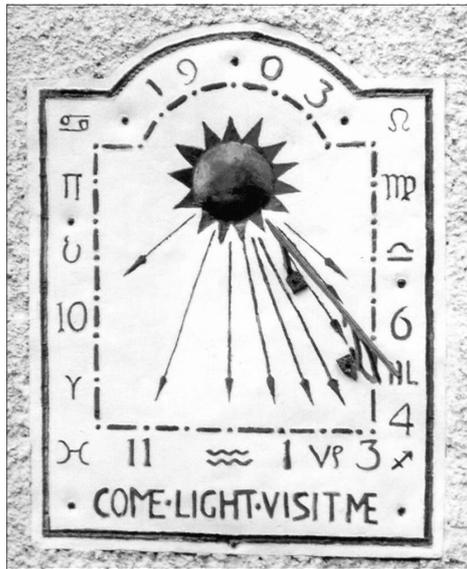
The town of Hitchin is well-endowed with sundials. The town centre church of St Mary's has two declining stone dials (Fig. 11) set in the tower brickwork. The dials face approximately south and that aligned southeast has the motto 'Anno Salutis' and is dated 1660. Visitors here may also be surprised to see black squirrels, a locally occurring melanic variant of the common grey squirrel.

Close by in the Physic Garden of Paynes Park, an unusual modern dial (Fig. 12) in the form of a pestle and mortar forms a central feature of the garden. The pestle acts as the gnomon of the scaphe dial with the motto within the bowl of the mortar inscribed "Disease doth oft rise above medicine. Wm. Drage. Hitchin Apothecary. 1632-1668".

Just to the south of the town, a vertical dial (Fig. 13 and shown on the cover of *Bulletin 18(ii)*) on the side of a house overlooking Hitchin Hill invites "Come Light Visit Me". Dated 1903 and with a sunburst at the origin of the gnomon, time is indicated from 10am to 6pm with signs of the zodiac also being used to show and sub-divide other hours.

In the churchyard of St Faith's, Kelshall, the stump of an old preaching cross supports a bronze (?) octagonal dial plate with the remains of a rusty iron gnomon (Figs. 14 & 15). It is inscribed "Latitude 52 00" and the engraving remains reasonably clear.

On the southeast facing buttress to the entrance porch of St Mary's church, Walkern, a newly inscribed stone dial (Fig. 16) records the hours from 8am to 2pm. Mottoes are also



inscribed in Latin and Greek. A dial is recorded here in Mrs Gatty's 1889 book of sundials with similar mottoes.<sup>6</sup> In 1878 it was noted that "the inscription is nearly obliterated but certainly ought to be preserved". Perhaps today's dial is honouring this request?

A newly provided vertical dial (Fig. 17) mounted over the south entrance porch of St Mary's, Braughing, replaces an earlier dial of 1848 which fell down in 1970. With bold engravings in gold, this slate dial has the motto 'Mox Nox'.

A vertical declining stone dial (Fig. 18) mounted on the wall of the south nave of St Michael's church, Bishops Stortford, is dated 1798. With two sets of initials, perhaps those of churchwardens of the day, the engraving is still very legible.

Carved into the brickwork of the south facing gable end of 'Sundial House' in Dunmow Road, Bishops Stortford, a



Fig. 17 (above). St Mary's, Braughing.

Fig. 18 (below) St. Michael's, Bishops Stortford.

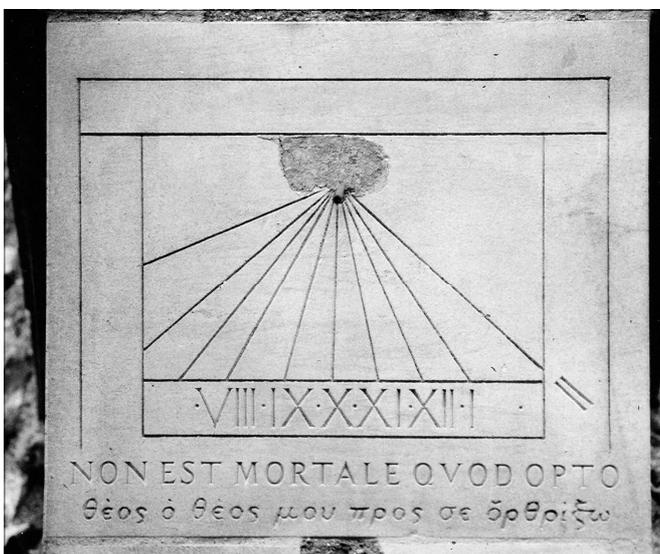
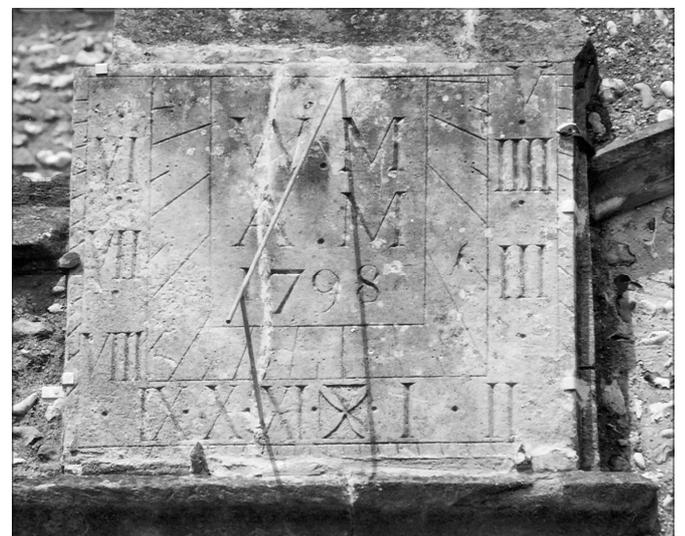


Fig. 16. A new stone dial at St Mary's, Walkern.



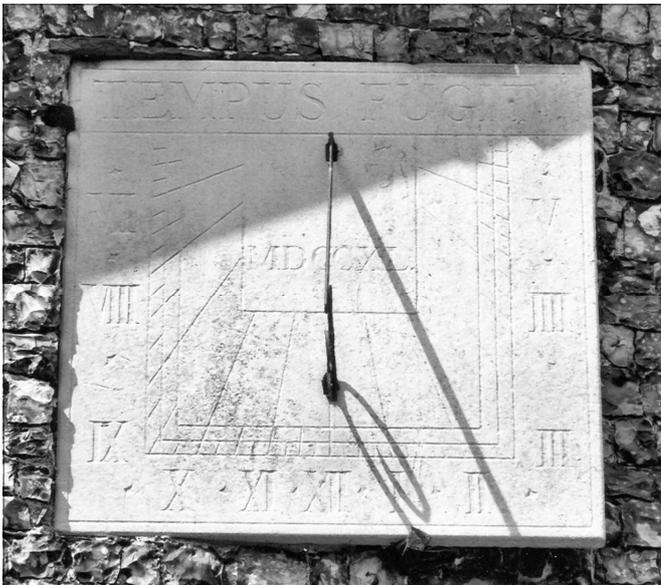
Fig. 19 & 20 (left and right). Vertical brick dial in Dunmow Road, Bishops Stortford.



Fig. 23 (below right). A rare reclining slate dial at Stapleford.

vertical dial (Figs. 19 & 20) has the common motto 'Let others tell of storms and showers, I'll only count your sunny hours' surrounding it.

At St Botolph's church, Shenleybury, a simply marked vertical stone dial plate (Fig. 21), dated 1740 and with the



motto 'Tempus Fugit' is set into the knapped flintwork of the south wall of the building. Although the church itself is now a private house, the dial may be seen from the still-used adjacent graveyard.

The worn markings of a mass or transitional dial (Fig. 22) are still to be found on a quoinstone of the chancel at St Peter's, Tewin.

An interesting concept has been used at St Mary the Virgin church, Stapleford, to record past members of its congregation. Small named and dated metal disks are set into the sloping surface around the gnomon of this large slate reclin-



Fig. 21 (top). St Botolph's, Shenleybury.

Fig. 22. (bottom). A transitional dial at St Peter's, Tewin.

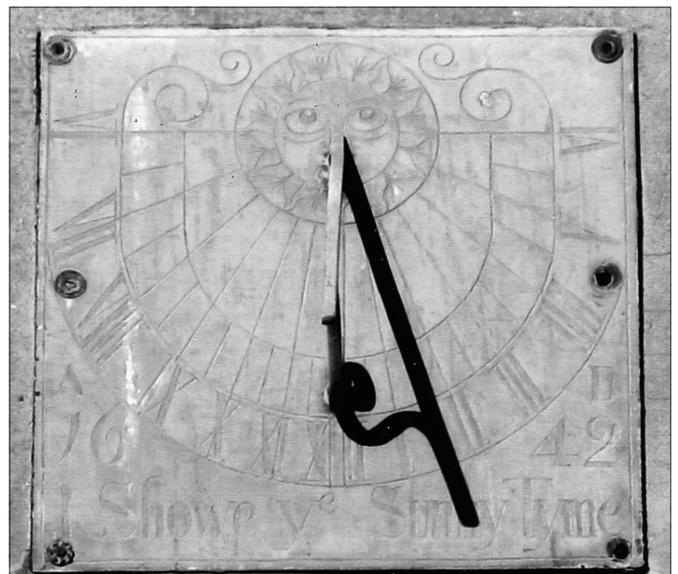


Fig. 24. Weir Cottage, Hertford.

ing dial (Fig. 23). Hours are indicated from 4am to 8pm with an engraved image of Jesus Christ with upturned palms indicating the alpha and omega symbols. A verse from Matthew 28 is also inscribed around the surface of the dial.

Overlooking the river and gardens at Hertford, the vertical dial on the gable of Weir Cottage (Fig. 24) has roman numerals, a flaming sunface and tells us that "I showe ye Sunny Tyme".

### Conclusions

A number of other interesting dials may be seen within this county and the latest edition of the BSS Sundial Register published in 2005 provides details and descriptions of them. Once again, the use of Mee's King's England series of books has proved to be of considerable use in acting as a source of information whilst researching in this county. It is also very pleasing to find that the majority of the dials noted there are still in existence today. Although Mee's

books were published many years ago, they may still be regarded as a useful source of information for those seeking sundials within their own local counties.

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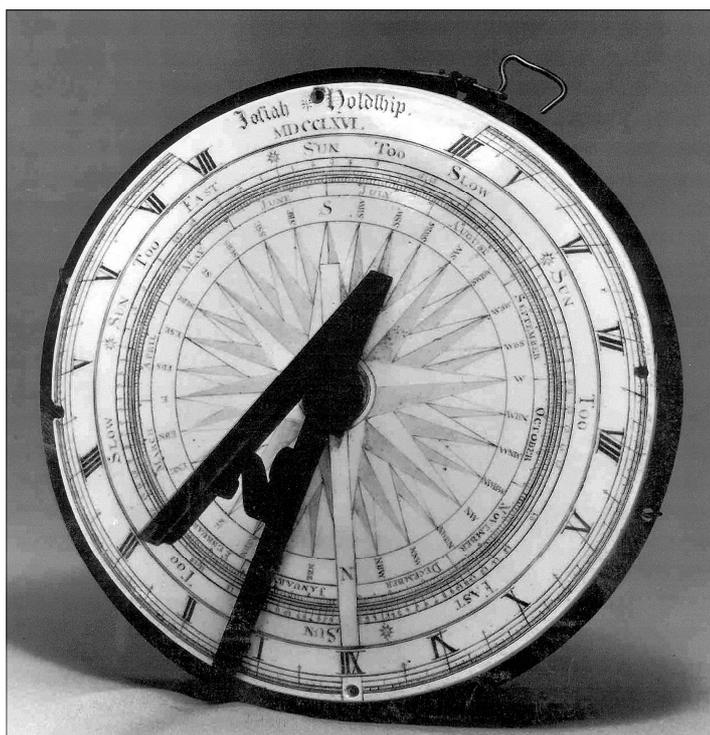
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Colchester  
Essex, CO4 3EY

## READERS' LETTERS (continued)

### Porcelain Dial

The recent article about ceramic sundial production in Russia asked if other examples were known. Probably the granddaddy of them all – and possibly never to be surpassed – is the one exhibited at the Royal Worcester Porcelain Museum in Worcester. It was made in 1766 at John Wall's Worcester porcelain factory for Josiah Holdship who was a partner when the company was founded.

The dial is made from a circular slab of soft paste porcelain,



*hand painted!* and inscribed in black enamel. It has been in the Museum these last 130 years. The dial is made for the latitude of Worcester or a little to the north and presumably meant for the garden of the Holdship house or mansion. It features delineation down to minutes, an Equation of Time ring and a 32-point compass rose; a triumph of draughtsmanship.

Many thanks and due acknowledgement to Wendy Cook of the Museum for allowing inspection and providing the photograph.

*Tony Wood, Churchdown, Glos.*  
*Jill Wilson, Chipping Campden, Glos.*

### Mass Dials and Geology

I found Chris Williams' article (*Bulletin* **20**(ii), pp. 75-8) on the geographic location of recorded mass dials of great interest. The map appeared somewhat familiar so I compared it with the IGS Geological survey 'Ten Mile' Map Sheet 2 that shows the geology of England and Wales. The diagonal bands of counties with various proportions of mass dials coincides roughly with the SW/NE trend of rock formations. This leads to further aspects that might be helpful if recorded.

Like Chris, I regret that there is no full record of churches surveyed but found to have no extant mass dials. Until that is built up the statistical analysis of finds lacks an important ingredient. It would also be helpful to know something of

continued on page 151

# BRITISH SUNDIAL SOCIETY - Accounts for 2007

## Income and Expenditure

|                             | INCOME            |                   | EXPENSES                    |                   |                   |
|-----------------------------|-------------------|-------------------|-----------------------------|-------------------|-------------------|
|                             | 2006              | 2007              | 2006                        | 2007              |                   |
| General                     |                   |                   |                             |                   |                   |
| Subscriptions (1)           | £12,715.89        | £12,789.59        | Subscriptions               | £107.00           | £73.00            |
| Gift Aid (2)                | £1,802.74         | £0.00             | Bulletin (5)                | £7,892.88         | £7,921.97         |
|                             |                   |                   | Publications (6)            | £399.45           | £787.00           |
|                             |                   |                   | Officers (7)                | £3,049.46         | £3,499.07         |
| Events                      |                   |                   |                             |                   |                   |
| Durham 2006                 | £12,546.09        | £0.00             | Durham 2006                 | £12,147.72        | £0.00             |
| Nurnberg 2006               | £12,670.00        | £0.00             | Nurnberg 2006               | £11,787.14        | £0.00             |
| Cambridge 2007              | £7,212.00         | £12,065.10        | Cambridge 2007              | £1,248.00         | £15,473.80        |
| Latimer 2008 (8)            | £0.00             | £380.00           | Latimer 2008 (8)            | £0.00             | £150.00           |
| Sales etc                   |                   |                   |                             |                   |                   |
| Sales (9)                   | £2,083.80         | £2,335.70         | Sales (9)                   | £366.52           | £154.17           |
| Auction (13)                | £1,082.00         | £0.00             | Auction (13)                | £27.50            | £0.00             |
| Advertising (3)             | £50.00            | £10.00            | Advertising (3)             | £70.00            | £0.00             |
| Donations (Somerville) (13) | £777.86           | £190.00           | Donations (Somerville) (13) | £0.00             | £500.00           |
|                             |                   |                   | Library (10)                | £100.00           | £236.16           |
|                             |                   |                   | Internet (11)               | £193.88           | £0.00             |
| Finance                     |                   |                   |                             |                   |                   |
| Interest                    | £2,138.94         | £3,153.93         | Banking/Insurance (12)      | £817.74           | £712.46           |
| Special                     |                   |                   |                             |                   |                   |
| Design Competition          | £0.00             | £0.00             | Design Awards               | £0.00             | £0.00             |
|                             |                   |                   | Photo competition           | £126.51           | £0.00             |
| Other                       |                   |                   |                             |                   |                   |
| Offprints                   | £0.00             | £0.00             | Offprints                   | £790.00           | £0.00             |
| Misc                        | £137.83           | £0.00             | Misc                        | £129.70           | £0.00             |
| St. Katherine Cree Fund (4) | £0.00             | £0.00             | St. Katherine Cree Fund (4) | £0.00             | £0.00             |
| <b>TOTALS</b>               | <b>£53,217.15</b> | <b>£30,924.32</b> |                             | <b>£39,253.50</b> | <b>£29,507.63</b> |
| <b>Net income</b>           | <b>£13,963.65</b> | <b>£1,416.69</b>  |                             |                   |                   |

### Notes for 2007

- Balance held in the U.S.A. Amounts paid in US dollars have been converted to sterling at the exchange rate in force: on 31/12/2006, when notified of balance, or when sums were repatriated.
- Gift Aid for this year has been received, but will appear in the 2008 accounts (= £1796.53)
- Advertising income for adverts in the Bulletin & Newsletter, expenses for Society publicity in other journals etc.
- These donations, held on behalf of the St. Katherine Cree Sundial Restoration Fund, are **not** part of the BSS assets.
- Four editions paid for in the year. Includes postage costs.
- Printing of the publication(s): Biographical Index.
- Includes postage, leaflets, travel, computing sundries, meeting room costs etc.
- Advance deposit for the 2008 Conference and early payments from members.
- Sales of booklets, sweatshirts, slides, ties etc by Peter Lane, Jane Walker.
- Subscription to the Bromley House Library (Nottingham) and purchase of books.
- Hosting of the BSS website and domain name costs.
- Bank costs (inc international), credit card costs, Society liability insurance.
- Proceeds of Conference auctions are automatically added to the Somerville Fund.
- The Andrew Somerville Memorial Fund contains all donations to the BSS and its reserves are part of the general BSS Assets. Expenses include the annual Somerville Lecture and grants.
- The BSS Library valuation is based on the 2003 value by Rogers Turner Books with allowances for inflation and new purchases.

**General Notes.**

- A. The accounts are prepared on a payments and receipts basis. That is, money is booked when it is received or spent (i.e. when cheques are written, not presented). This is in line with the Charity Commission's guidance.
- B. The year-end funds are held mainly in approved investment accounts as well as current accounts.
- C. Events are priced not to make a loss, with contingencies plus a gross margin of 10%.
- D. Stocks are valued at nil as they are unlikely to have any value if the Society were to be wound up. This does not impact our cash flow.

|   | 2006              | 2007              |
|---|-------------------|-------------------|
| Current account balance                       | £3,559.18         | £823.75           |
| Deposit account balance                       | £16.59            | £4,539.22         |
| BSS USA current account balance (approx) (1)  | £1,904.76         | £1,075.13         |
| Charities Office Investment Fund              | £52,840.25        | £56,761.55        |
| <b>TOTALS</b>                                 | <b>£58,320.78</b> | <b>£63,199.65</b> |
| <br>  |                   |                   |
| Change in funds during the year               | £13,738.74        | £4,878.87         |
| Income received during the year               | £53,138.15        | £30,924.32        |
| Expenses incurred during the year             | £40,296.36        | £29,507.63        |
| Excess of income over expenditure             | <b>£12,841.79</b> | <b>£1,416.69</b>  |
| <br>  |                   |                   |
| <b>Andrew Somerville Memorial Fund</b>        | £3,182.15         | £2,872.15         |
| <b>St Katherine Cree Restoration Fund (4)</b> | £1,148.42         | £1,148.42         |
| <b>Library Valuation (15)</b>                 | £16,635.00        | £16,635.00        |

**Auditor's Comments**

- a. The treasurer has made every effort to maintain accurate records and balance the account but further work is need to resolve an accounting error.
- b. The Society Funds and Accounts was checked against the statements on 15 Mar 08 and the total credit confirmed as £63,037.33.
- c. It is recommended that future accounts be closed at the end of the calendar year.
- d. It is recommended that separate accounts be maintained for the current and deposit bank accounts.
- e. Mixed payments and multiply cheques paid into the bank account on the same day are difficult to reconcile against the bank statements.
- f. It is recommended that a separate record showing the breakdown of the individual bank payments is maintained.
- g. It is recommended that quarterly checks of the accounts are undertaken.

| NAME        | POST      | SIGNATURE   | DATE      |
|-------------|-----------|---|-----------|
| G Stapleton | Treasurer |  | 22 VI '08 |
| G Parsons   | Auditor   |  | 25/6/08   |
| C Daniel    | Chairman  |  | 02/07/08. |

**NEW DIALS (continued)**

**Australian Analemmatic Dial**

A new analemmatic dial was inaugurated in April 2008 in Cecil Plains, Queensland, Australia. The mosaic design was made by local artist Alain Colfs based on layout plans from *Modern Sunclocks* in Scotland. Funding for the project came from several Commonwealth and regional arts organisations.

Notice how the hour-markers run in the anti-clockwise direction. Because the location is not far from the tropics (latitude 27.53° South, longitude 151.20° East) the summer end of its centre date-scale – the months of December and January in the Southern Hemisphere – is close to the hour-markers.

*Douglas Hunt*



# A HAPPY ENDING: THE PRESTON GUBBALS SUNDIAL

ANDREW JAMES

## Three Encounters

I first saw the sundial from St Martin's church, Preston Gubbals, Shropshire (OS reference SJ492196, about four miles from Shrewsbury), *in situ* when I visited the churchyard on 30<sup>th</sup> May 2000, while on holiday in the area. I knew that it had been recorded by John Lester in 1996 and was SRN 3433, and as usual I took photographs and measurements and later sent in a report form to Patrick Powers, then BSS Registrar.

St Martin's had ceased to be in regular use and is in the care of the Churches Conservation Trust (CCT). The pedestal, in the churchyard south of the church, has an old two-step plinth. On this stands a massive octagonal stone and above this a square shaft, wider and grooved in the middle. The square top stone above was broken at the south side, so the dial's fixing was precarious, with only two screws left holding it. The broken-off piece of stone was still lying at the base of the shaft and can just be seen arrowed in Figure 1.

Years later, in October 2006, I chanced to visit the Scientific Instruments Fair in London and saw a sundial for sale that caught my eye. After a minute I realised where I had seen it before and felt sufficiently confident of my identification to ask the dealer to remove it from display, as I was sure it must have been stolen from Preston Gubbals.

That evening I telephoned the acting Field Officer for the CCT. He confirmed that the dial had been stolen from St



Fig. 1. The dial and plinth at Preston Gubbals in 2002. The broken piece referred to in the text is arrowed.

Martin's four years earlier – in November 2002 while restoration work was being done in the churchyard and in fact on the plinth – so the next morning (police stations don't seem to open on Sunday evening any more) I gave a statement to a local CID officer. I stressed that I was not accusing the dealer of wrongdoing, as it seemed likely that after so long the dial had passed through several hands before his (this proved to be the case). Copies of my original dial report, which provided a detailed and illustrated description, supplied to the CCT, the police, and the dealer, supported my claim.

The theft had been reported at the time by the local BBC, but apparently with no mention of identifying features, calling it a "faded brass 18<sup>th</sup>-century sundial face"!

To cut a very long story short, although the thief has not been found, Gabriella Misuriello of the CCT recovered the dial from Ludlow in Shropshire in November 2007 and kindly allowed John Davis and me to visit her and study it in detail in February 2008.



Fig. 2. The dial at Preston Gubbals in 2002. The precarious fastening is clear.

## The Dial

The dial is made of copper alloy – it is difficult to say whether nearer to a bronze or brass without metallurgical tests. The dial plate is 124 mm square and – at 3 mm – surprisingly thick. The date 1638 and initials WG are south of the gnomon. The hour numerals from IIII to VIII lie between two double circles centred in the square and the centre is also the origin of the hour lines which terminate on the innermost circle in bold dots. Further bold dots between the Roman numerals indicate half hours. Some of the hour lines show double marking as if correcting an inaccuracy. A



Fig. 3. General view of dial. Talcum powder has been used to enhance the lines for photography.

fainter border line is marked about 3 mm in from the edge and there is a fastening hole at each corner.

This centred arrangement is an early form<sup>1,2</sup> and by the time this dial was made it was already out of fashion in London.<sup>3</sup> A dial by Humphrey Cole dated 1582 in the National Maritime Museum (inventory no. AST0390) looks very similar. SRN 4717 at Bodrhyddan, dated 1632, and SRN 0636 at Dale Bottom, Cumbria, dated 1635, provide nearly contemporary provincial examples of this layout; and the undated dial plate SRN 0405 at Sydenham is probably of similar or earlier date.

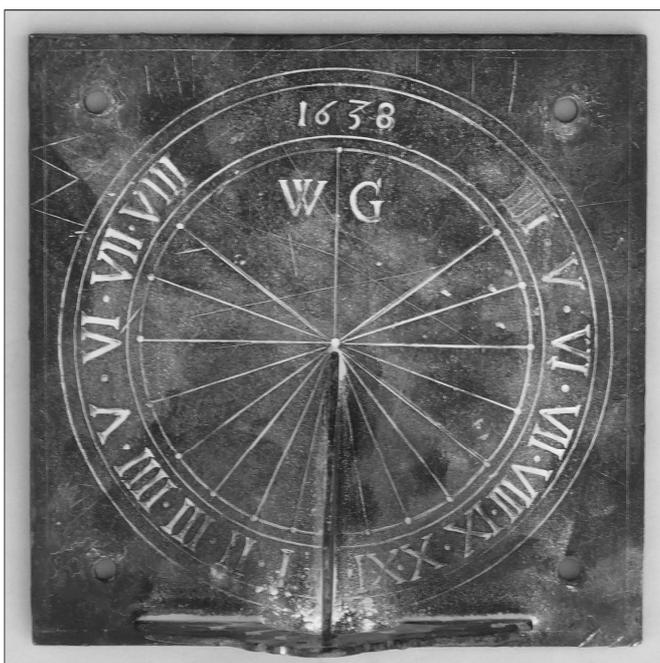


Fig. 4. View of the dial from above, showing the centred arrangement.

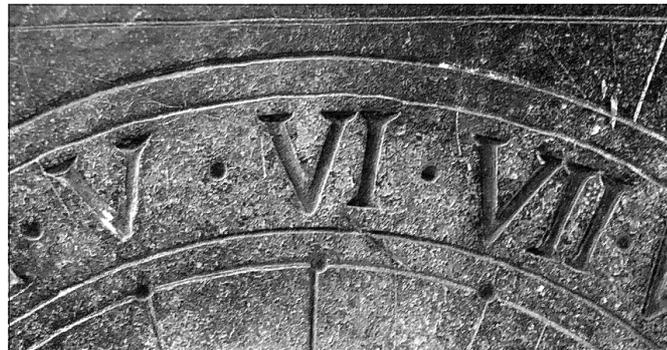


Fig. 5. (top) Detail of numerals.

Fig. 6. (above) Detail of initials and date.

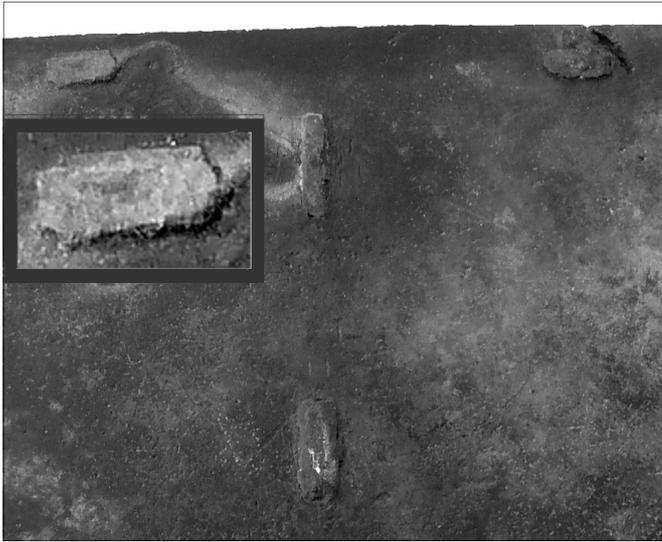
Although the numerals have a form suggestive of punching, traces of graver marks on the flat bottoms of the largest strokes, the absence of visible distortion, and slight inconsistencies lead me to conclude that they are engraved.

John's analysis of the hour angles shows that the dial is fairly accurately laid out, with 80% of the marks within half a degree of correct position – but not for Shropshire, for  $49\frac{1}{2}^\circ$  North! He suggests that the delineation was probably copied from a manuscript or book originating from the Nuremburg area, or that the Kratzer graphical method was used to draw the lines but with the wrong 'climate' version. However, the measured style angle of  $52.2^\circ$  agrees quite well with the actual latitude of Preston Gubbals at  $52^\circ 46'$  North.

The significance of 'WG' is not certain. Hind<sup>4</sup> lists a William Grent as an engraver working c.1625 which is within the bounds of possibility, but gives no other details about him. I can find no record of any English instrument maker or clockmaker with these initials around this time. The prominence of the letters suggests to me that they might refer to a donor rather than a maker.

#### The Gnomon and Supporter

The gnomon is of much thinner (1.5 mm) metal and basically triangular, 55 mm base and 44 mm high, with a part missing from the tip, clearly a very old break. The



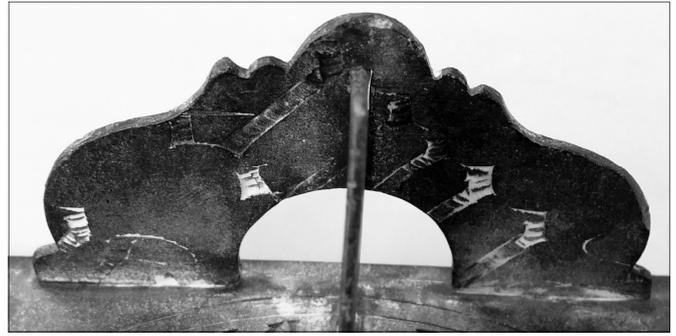
*Fig. 7. Underside showing undisturbed rivets for the gnomon and supporter (one shown enlarged in the inset).*

North edge is rather loosely tenoned near the present top into an arched supporter running East-West; this is 80 mm along the base and 44 mm high, also 1.5 mm thick, and has a decoratively curved upper edge and approximately semicircular under edge.

Of course, the larger gnomons on vertical dials very often have side stays for stability, but supporters – other than bracing blocks lying along the gnomon root – feature on only a very few horizontal dials and were once thought to be 19<sup>th</sup> century additions. Examples were known in Kent at Headcorn (the dial, dated 1763, is now missing), Chilham (SRN 0302, gnomon and supporter now missing) and Smeeth (SRN 0299, dial now missing, perhaps 1826 – the date being on the oak plinth).<sup>5-7</sup> The BSS Sundial Register (2005) records slate examples at Helmsley (SRN 5944) and



*Fig. 8. Side view of the gnomon showing memorial brass engraving.*



*Fig. 9 (top) . Gnomon and supporter showing the memorial brass engraving.*

*Fig. 10 (above). Outside of supporter showing the loose tenon fixing of the gnomon.*

on Jersey (SRN 4636); in both cases gnomon and supporter are missing. The fine 18<sup>th</sup> century SRN 2430 at Castle Howard has a single supporter and the dial at Lower Peover, SRN 0155, was apparently dated 1691 (though this is not now legible) and has a horseshoe-shaped supporter that appears contemporary.

I am convinced that the Preston Gubbals supporter is original to the dial. Now, detached from its pedestal, it is possible to examine the underside of the dial plate. The riveting of the feet of the gnomon and supporter shows no sign of disturbance or replacement. What is particularly interesting and significant is the positive evidence, probably unique, that the gnomon and the supporter were definitely made together, for both are cut from a monumental brass and bear fragments of earlier black-letter engraving, the supporter to the inside (South) and the gnomon to its East face.

In the 17<sup>th</sup> century and earlier, brass was very scarce and expensive<sup>8</sup> and, especially after the Dissolution of the Monasteries in 1537-9 and further destruction by Edward VI's commissioners, many memorial brasses were melted down or re-used as palimpsests by engraving the other side. (The British Museum has two brass discs apparently cut from monuments to priests with instruments engraved on the reverse, but I am unsure of their authenticity.<sup>9</sup>) Here the maker was evidently not concerned to hide the origins of

the brass he used. Even after 370 years out of doors there appear to be traces of wax still in the engraving – a remarkable display of tenacity! The lettering and thinness suggest to me a mid-15<sup>th</sup> to early 16<sup>th</sup> century date; if so, the metal would have been imported from the Continent, as brass was not made in England until later in the 16<sup>th</sup> century. Experts at the Monumental Brass Society have been contacted but have so far not responded with any opinion on the origins or date of the brass.

### Conclusion

This sundial therefore provides proof that gnomon supporters were used at this early date and is a remarkable survival. Only a few horizontal dials dated from before the Civil War have come down to us, and I am aware of only one other example (SRN 0155) with a supporter apparently dating from before 1700.

The Preston Gubbals dial is presently in a secure location: I would like to see a replica made and placed back on the original pedestal, as sadly these days it seems much too risky to replace such a rare – if all too often little-regarded – item in the churchyard. It is very fortunate, and very satisfying, that it has proved possible to rediscover and recover it and return it to its rightful custodians; far too many dials stolen from churchyards (and elsewhere) disappear altogether. Once stolen, twice shy could be the watchword here.

### ACKNOWLEDGMENTS

Thanks to John Davis for access to his analysis of the hour lines and for other measurements and comments on the dial, including the suggestion of William Grent; to John Foad for Warrington Hogg's references to Kent dials in *The Strand Magazine*; and to David Thompson and Silke Ackermann regarding the items at the British Museum.

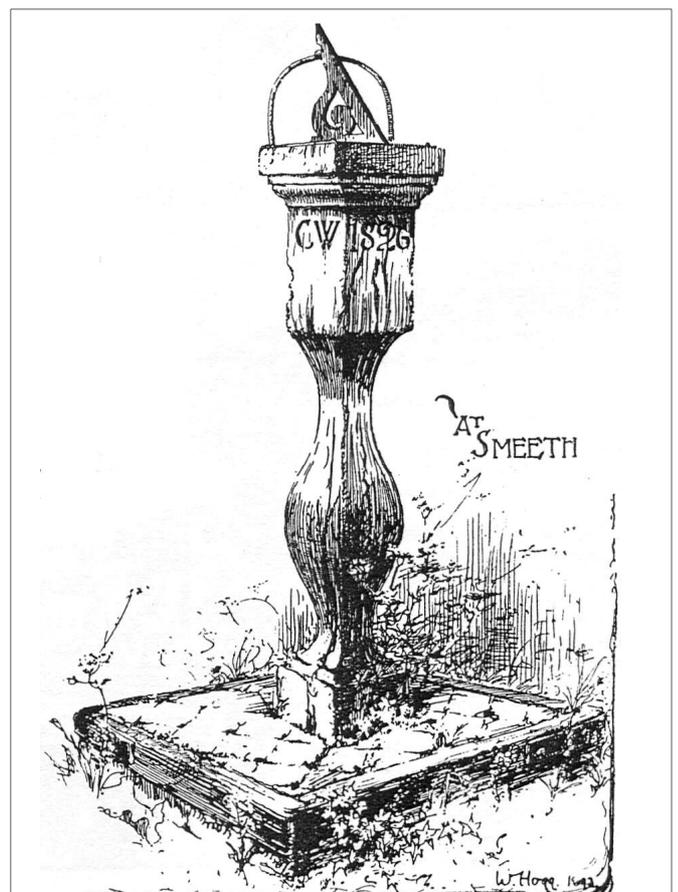
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2. C. St J.H. Daniel: 'The Sundial Page: In character', *Clocks*, 26.2 (March 2003): discusses the centred arrangement's predominance in dials from 1520 to 1620.
3. See SRN 5847 made by William Bowyer in 1630, and SRN 3101 at Ashurst, made by Elias Allen in 1634, for earlier London examples where the dial origin is south of the centre.
4. A.M. Hind: *Engraving in England in the Sixteenth and Seventeenth Centuries, part I – the Tudor Period*, Cambridge University Press, Cambridge, (1952).
5. T. Geoffrey W. Henslow: *Ye Sundial Booke*, W. & G. Foyle Ltd, London (1935): illustrates Chilham and Smeeth on pp 285 and 289 but in neither case is the supporter shown in the somewhat approximate woodcut. On p.45 the illustration just might show a supporter on a

dial dated 1862 at Ecclesfield churchyard, Yorkshire, but I have no details of this.

6. Warrington Hogg: *The Book of Old Sundials*, T. N. Foulis Ltd, Edinburgh and London (1922): illustrates the Chilham (facing p.62) and Smeeth (before p.27) dials clearly, with supporters in the form of an inverted horseshoe or semicircle. It also shows (facing p.6) the Headcorn dial, with the gnomon elongated into a long curving supporter twisted and bifurcated ending some way down the pedestal.
7. Warrington Hogg's articles in *The Strand* in 1892 and 1893 give more textual information and tell us that the Chilham dial was by Stedman (18<sup>th</sup> century) and that the copper supporter was an addition. The Smeeth supporter is described as copper and similar to that at Chilham, and the Headcorn supporter, of wrought iron, is also described as an addition.
8. The metal for Duncan Liddel's memorial brass in Aberdeen, supplied from Antwerp in 1613, cost almost £2 per square foot (£31/-/6 for 5' 5" × 2' 11").
9. Item OA7113 has a pair of dividers depicted and item 1875-1-20.4 has a triangle divided into eight sectors with the numerals 1 to 8, reading from right to left.

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Warrington Hogg's 1892 drawing of the dial at Smeeth, Kent. Note the hoop supporting the gnomon, probably a later addition. Contrast with the gnomon supporter shown in Andrew James's article on this page.

# SUNDIALS IN ARMENIA

JULIAN LUSH

**AR-ME-NI(A)** ..... The 'Land of the Sons of AR'. Ar was the ancient deity of .... yes, the Sun and of Light and Fire. Ar came into the known world of antiquity with the Aryan races from central Asia who split into Indo and Iranian branches. Amongst those who settled in the southern Caucasus highlands from the 10<sup>th</sup> century BC were the Armani. Another people, the Uartians settled in eastern Anatolia and established a kingdom 900-600 BC from Lake Van eastward into Armenia and northern Iran, melding later into one linguistic Armenian people. The dominating, snowy peak of Mt Ararat (5165 m, seen in Fig. 1) and the massif in their heartland, Mt Aragats (4095m) became their symbols. Wherever the syllables



Fig. 1. Mt Ararat looming over Yerevan.

'ar' or 'ur' appear, it is a tribute to the Sun deity.

Armenia was trampled over successively by warlords and superpowers, principally in Persia's interminable conflicts with Greeks (Xenophon's 10,000 passed through, to and fro), Romans and above all, Byzantium. Before Constantine's adoption of Christianity for the Roman Empire, Armenia had already been visited by Sts Thaddeus and Bartholomew. Then in the year 300 AD, the pagan king of Armenia, Tiridates, being cured of illness by St Gregory the Illuminator, promptly converted to his religion. Thus Armenia claims to be the first kingdom to adopt Christianity. Its subsequent history was no less troubled by Seljuk and Ottoman Turks competing with Russians. Eventually in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries Armenia lost half her historic heartland to Turkey and today Mt Ararat looms inaccessibly beyond her border.

With Ar in the nation's heritage, it is no surprise that the Sun-god's symbol was, and still is, prevalent as dials on

the walls of the churches and monasteries built through the centuries of Armenia's pros-perity, put to use in recording the passage of the Sun throughout the day. The latest appears above the south transept door of the modern cathedral in Yerevan, the capital, completed in 2001 (Fig. 2). In a two-week trip, some forty of the principal old churches were visited, over half of which carried sundials, and there are certainly as many more.



Fig. 2. St Gregory's Cathedral, Yerevan, 2001.

The common form originated as a full sun's disc with the lower half distinct as a semicircular sun dial with horizontal gnomon at the centre and a radial series of equal segments, usually with scalloped ends. The earliest church in Armenia with a dial of this form is the 5<sup>th</sup> century basilica at Yereryuk (Fig. 3), but was the dial contemporary? A fine dial is on St Gayenne of 630 AD at Ejmiatsin (Fig. 4). But



Fig. 3. Scalloped dial on the 5<sup>th</sup> century Basilica at Yereryuk. Note the swastika.





Fig. 4. Incised dial on S. Gayenne 630 AD at Ejmiatsin. The dial predates the 13<sup>th</sup> century porch structure to its left.

Fig. 5 (below). South entrance to the Roman-style church at Zvarnots, built 641-662 AD. It is a replica of the dial originally placed above archway.



the earliest example that can be positively dated was incorporated into the structure of the Roman-style, round church at Zvarnots built 641-662 AD, shown in Fig. 5. Felled by an earthquake, the complete dial was recovered and today lies in the museum by the partly-restored church; a complete replica lies outside. This was no prototype; it appears as an already well-established form. The same form became common throughout Christendom, especially in medieval times. Today it is referred to as the shell or scallop dial (nothing to do with that of St James of Compostela, a symbol of fertility or death). For articles on French and Greek shell dials see references 1 and 2.

Whether the dials were contemporary with the churches has usually to be conjectured but the majority do seem to be. There is no hard rule about the number of segments, always equal sized. They vary between 10, 11 and 12, most commonly 12. Decoration varies considerably from simple inscribed lines to full and florid sculpture, with or without



Fig. 6. Talin's 7<sup>th</sup> century cathedral with a sculpted dial (possibly contemporary).



an outside band or boundary. The unique feature of most Armenian dials is the numbering of the hours in the Armenian alphanumeric script, invented by the monk Meshrop Mashtots in 405 AD.

The 6<sup>th</sup> and 7<sup>th</sup> centuries saw a flourishing of church building and monastery foundation in Armenia. Clearly it was a time of prosperity but one wonders whether religious fervour was engendered by the appalling decimation of populations caused by the first pandemic of history, the outbreak of plague in Justinian's reign. The 7<sup>th</sup> century cathedral at Talin carries a dial which is probably contemporary and replaced during restoration (Fig. 6). Odzun church, also 7<sup>th</sup> century, carries a scratch dial which was evidently in use later when, uniquely, European numerals were boldly added (Fig. 7).



Fig. 7. A scratch dial with European numerals (a later addition) on Odzun's 7<sup>th</sup> century church.

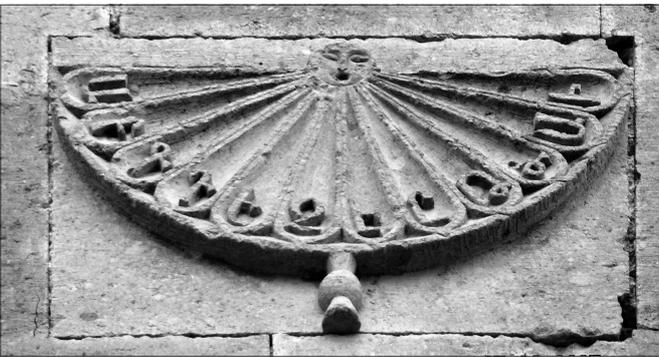
Churches followed in the 10<sup>th</sup> to 12<sup>th</sup> centuries but a second major phase of religious patronage took place in the 13<sup>th</sup> century. The churches and monasteries extant in Armenia today, as ruins or active, are more or less equally divided between the earlier and later phases. Sundials appear on just over half of them, perhaps the greatest profusion anywhere. In the light of the historic veneration of the sun-god Ar, is this surprising? The monasteries at Haghartsin (1281 AD) and Goshavank (12<sup>th</sup> century) are examples of dials with associated sun discs (Figs. 8 and 9).



Fig. 8. Haghartsin monastery, 1281 AD; a dial with a full sun disc above.



Fig. 9 (below). An ornate dial at the 12<sup>th</sup> century Goshavank monastery, with sun's face at the origin.



Armenian church architecture began with the basilica in the 5<sup>th</sup> century but it soon developed the cruciform plan as at Haghartsin monastery (Fig. 8) that became the hallmark of the Armenian style throughout the region, including what is now eastern Turkey and in Georgia, Nagorno-Karabagh, Azerbaijan and northern Iran. Monasteries were founded with religious and domestic quarters and frequently grew with multiple churches into monastic complexes, often located in remote and inaccessible spots; some developed into great centres of learning. The monastery at Haghpat of



Fig. 10. The dial on the refectory wall at Haghpat monastery, 1250 AD.



Fig. 11. (left) A scalloped dial with two doves on St Stephanos, Tanahati 1273-9 AD. (below) a dial with one dove on the 1295 AD obelisk at Tatev monastery.



Fig. 12. A sculpted dial on St Stephanos, Aghjots, monastery, 1220 AD.

991 AD carries a dial above the south door of one church for prayer times (not illustrated) and another very ornate dial (Fig. 10) added in the 13<sup>th</sup> century on the wall of the refectory to ensure punctuality for meals. Emblem decoration occurs, as in the dials portraying doves on the two dials at Tanahati and Tatev monasteries seen in Fig. 11.



Fig. 13. The 12<sup>th</sup> century khachkar at Mastara and its ornate sun/eternity disc.





Fig. 14 (far left). Marmashen monastery; khachkar memorial to the war over Nagorno-Karabagh in 1992; note the sun/eternity disc.

Fig. 15 (left). The modern khachjkar at Saghmosavank; an Armenian cross with a sun/eternity disc.

Sundials are not the only case of the appearance of the sun disc emblem in later imagery. Traditionally, Armenians have carved khachkars as tombstones or as memorials to notable persons or events. A khachkar, ‘stone-cross’, is an upright slab of most intricately carved stone, bearing a large Armenian cross as the emblem of Christianity and very often beneath it a full disc, now attributed to Eternity but in

truth, the ancient sun emblem. Erected since the earliest times, a particularly fine example from the 12<sup>th</sup> century still stands prominently above the church at Mastara (Fig. 13) while a forest of them stands in the cemetery at Noraduz. Khachkars, many with sun discs, are ubiquitous and carved frequently to this day (Figs. 14 and 15).

A full list and photographs of the churches and dials visited in June 2007 is available on request.

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## READERS’ LETTERS

(continued from page 141)

the type of building material used for the body of the church and whether such dials as are found are on this or on building stone more suitable for carving, elsewhere in the fabric, say, on doorways or windows.

In medieval times local stone would be used where possible for building parish churches. Should the local stone be unsuitable for the fine decorative carving often needed for doorways, windows or statues then, if it could be afforded, better stone would be brought from a distance for that purpose. Thus the questions are raised, on what type of stone is the mass dial carved and where is it located? If no mass dial is found – would the building material used for the church be any good for the carving of such a dial? It was regular practice to plaster walls, outside as well as in, where a good surface could not be produced from the local stone. This could and frequently was used for paintings, no doubt including mass dials in the same way that later some scientific dials were painted.

Returning to the two maps, Chris marks a watershed and another with less than 30% can be discerned enclosing Cambs., Herts., Middx., Surrey plus Essex. This led me to consult *The Geology of Building Stones*, by John Allen Howe, first published in 1910, and this confirmed my first

thought, that most of the areas with low numbers or no recorded mass dials are also poor in suitable stone.

Further thoughts that have also occurred to Chris and are hinted at in his final paragraph, suggest that apart from the lack of researchers, events over the centuries, ordinary weathering, rebuilding, Victorian restoration and so on, may well have removed dials that were once there. So to obtain a final picture the history of each church without a mass dial may have to be studied. At least with my own interest, the makers of scientific dials, I have signatures, local history and other written records to help. Mass dial recorders have no such luck!

Jill Wilson, Chipping Camden



A fridge magnet from Briançon in the Hautes-Alpes department of France.

Peter Ransom

# A VISIT TO BELGIUM BY TWO INNOCENTS ABROAD

JACK BROMILEY AND JAMES MARGINSON

“Jim”, I said, “You know that Marion is going to America for ten days early in October. I’ve been thinking of going to a Sundial Park in Belgium. I think it’s at a place called Ghent. Do you fancy going?”

“Yes. What’s a Sundial Park? Where is Ghent? How would we get there? How long would it take?” said Jim. So began a trip to Belgium. Phone calls to society members soon told me:

1. That the park was in Genk, not Ghent (both places in Belgium),
2. That someone from the Dutch Sundial Society would probably be able to take us round the park.
3. That if we stayed in Liège we could go to a certain Museum and possibly find out some information about a certain portable dial for a fellow-member of the Society.

Two visits to a local travel agent convinced me that we should travel by train throughout. Numerous e-mails enlisted the assistance of a member of the Dutch Sundial Society, Willie Leenders. He advised us on the best train to catch to get to Hasselt where he lives.

Apart from a bomb scare at Waterloo Station and consequential delays, travel was easy. We met our guide in Hasselt, by arrangement, had a walk round the historic city centre, saw two public dials designed by him and then went by car to Genk (a town of 40,000 inhabitants where Mondeo cars are made).

The dials are tastefully located in a linear public park and suit their environment well. The Sundial Park was opened in 2000 and was the idea of the Director of the local Astronomical Museum. As a bonus, we were taken to the Astronomical Museum and given a demonstration at the recently refurbished planetarium.

Next day we spent in Liège and visited (by arrangement) *La Musée de la Vie Wallonne*. We met the Conservatrice in charge of sundials and found the museum to have a notable collection of over 150 portable dials. The museum is presently under “restauration” and closed to the public but we were allowed to examine the data on the dials. We were un-

able to find the dial we were looking for but did find the sheet for a Pilkington and Gibbs helio-chronometer, an unexpected bonus.

The purpose of the visit was pleasure, hopefully combined with education. Our guide and mentor Willie Leenders and our other contacts were most helpful. Numerous other serendipitous happenings enlivened our trip. For example we visited a marionette theatre and went ‘backstage’ and met a Belgian who is an honorary Punch and Judy Professor.



*Willy Leenders with his sundial and meridian line in Genk.*

Mention your interest and you usually find a ready audience. Ask a question and you get help. We came home wishing there was a similar Park in Britain. We were given copies of a booklet about the Park but our Dutch is non-existent. However, the website by Frans Maes explains the dials so well that any efforts on our parts would be superfluous.

Our thanks go to our host, Willy Leenders without whom this would not have been possible. We commend the idea of such outings to other Members. Our question now is “Where shall we go next?”.

There are over 120 dials in Limburg and Willy Leenders our host suggested we visit [www.wijzerweb.be](http://www.wijzerweb.be) where the dials are displayed for each department and by type. The Genk Sundial Park is shown in [www.fransmaes.nl/genk/welcome-e](http://www.fransmaes.nl/genk/welcome-e).

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