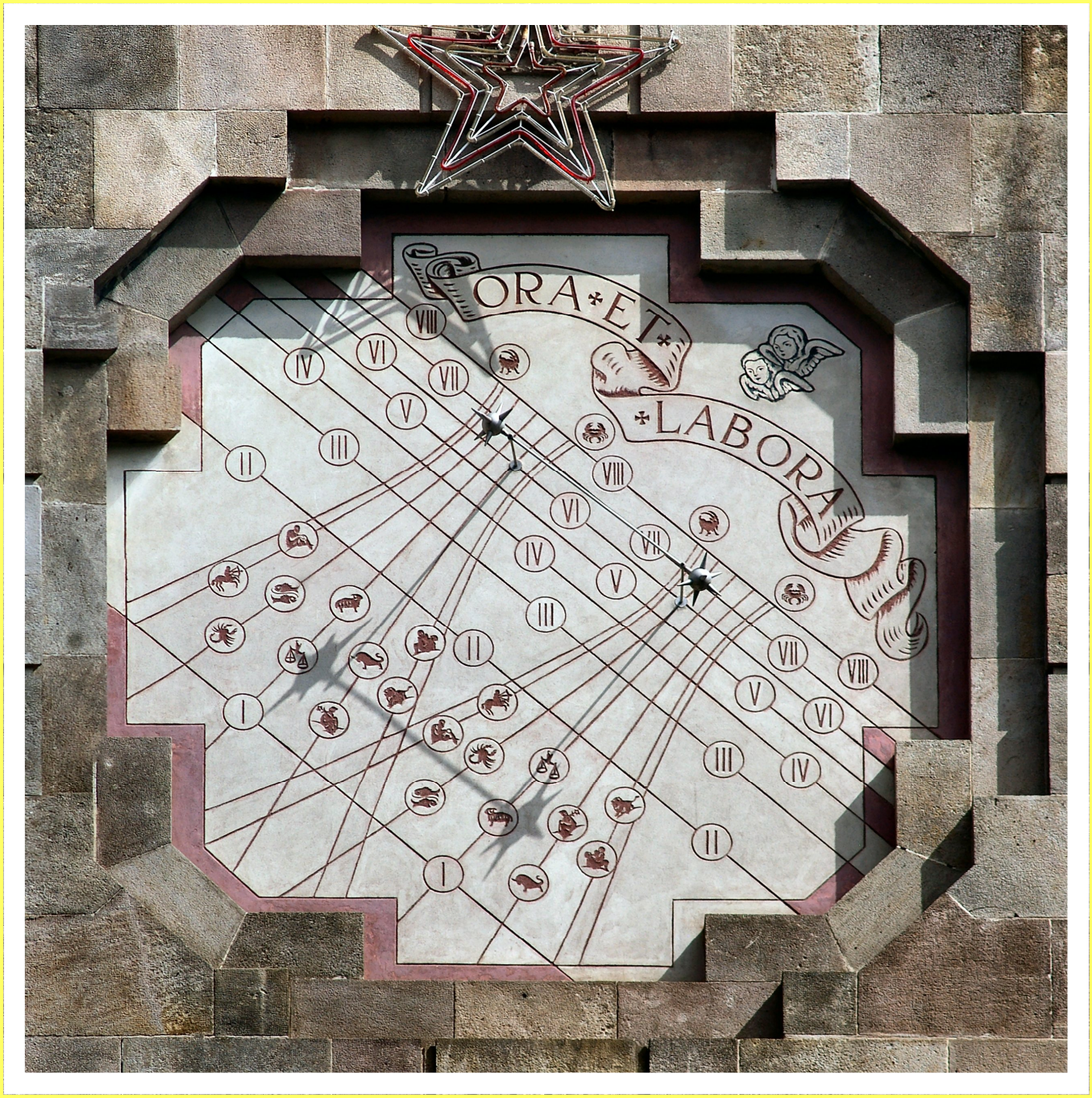
BSS Bulletin 24(iv)

The British Sundial Society

BULLETIN



VOLUME 24(iv)
December 2012

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Front cover: *The direct-West dial (one of a set of four) on the Angel Church in Barcelona, as seen on the BSS Catalan Sundial Safari (see page 36). Note the twin noduses at either end of the gnomon giving rise to two sets of declination lines. Photo: Robert Sylvester.*

Back cover: *A very large and impressive bifilar dial designed by Rafael Soler with a straight horizontal N-S gnomon and a curved E-W one. It is at Platja del Bogatell (the beach at Barcelona). Photos: Robert Sylvester.*

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CONTENTS

EDITORIAL

Most Enjoyed Article Award

A few years ago, we ran an award for the 'best' article by a new author, decided by a small team of judges. That came to an end when we ran out of sufficient new authors (and particularly ones within the membership) to make the award meaningful.

Now, I would like to instigate a new award for the article most enjoyed by the whole membership. Everyone who gets a copy of the *Bulletin* can vote for their favourite article(s) – ones published in any of the four Volume 24 issues for this first award. Just let me know which three articles, in order, you most enjoyed during 2012. Judging is purely subjective and any item with a named author is eligible. I will be pressuring people to vote at the 2013 Edinburgh Conference, where the result should be announced, but if you don't expect to attend send me a message now. It is considered bad form for authors to vote for their own articles!

There are three purposes to the award. One is to reward and acknowledge the authors who have written for us. The second is to encourage new authors to consider writing. And, of particular importance to me, it will show what types of article go down best with the readership and thus allow me to try to tailor future issues.

LOST AND FOUND
The Long Journey Of An Unusual Sundial

PETER KUNATH

As well as Hans Holbein's 'Darmstadt Madonna', the medieval German town of Schwäbisch Hall, situated in Baden-Württemberg, now has a new attraction: a 45-year-old, amazingly accurate sundial, created by the British artist Henry Moore (1898–1986).

History

In 1965, *The Times* newspaper moved to New Printing House Square in Gray's Inn Road (near Fleet Street and Blackfriars Station) in London. In front of the building, aligned towards the south, the architects Richard Llewelyn-Davies and John Weeks planned to construct a sundial. They discussed several forms of sundial with the same basic geometry as that used by Jai Singh for the stone sundial in Jaipur, India.[1]

In a letter to Harry Brooks, president of the New York gallery Wildenstein & Co., Henry Moore wrote:[2]

> "*The sundial idea started this way: I was asked to do a piece of sculpture to put in front of a new building in London where The Times newspaper has its headquarters. I thought about it, but eventually decided that The Times is too much a part of the English Establishment, and that a Henry Moore sculpture would not be right there, but something more recognisable as a Henry Moore sculpture, would be more suitable. In discussing all this with the owner of The Times (Gavin Astor) and the architect of the new building, they agreed with my idea, and that a sundial might be appropriate. Fortunately, the position for the sculpture faced practically dead-south which also made a sundial workable, and being able to tell the time, had a connection with the name The Times. The architect sent me a book on sundials and the principals on which they work… There are innumerable different types of sundial, but the simplest is the bow type and this is the type we chose.*"

In 1965, Moore developed the small-scale model of the sundial with a height of 56 cm and arranged for the firm of Noack, Berlin, the most important bronze-casting foundry in Germany, to produce twenty-one of them. They gave it the name 'Working Model for Sundial' and the number LH 527.

One of these copies was placed at the sculpture grounds, studios and galleries of the Henry Moore Foundation, located at Perry Green, Hertfordshire.[3] The other twenty models are in private collections. One of them was sold in

Fig. 1. The small-scale model, stolen and recovered in 2012, at the Henry Moore Trust. Photo from Zoe Rimmre (UK).

Fig. 2. 1966, Henry Moore in Berlin, in discussion with Hermann Noack, founder of the bronze sundial. Photo courtesy of DPA.

Fig. 3. Photo of the Moore sundial at the Adler Planetarium with a spectacular view of the Chicago skyline.

1998 by auction at Christie's, London, for the sum of £15,000 (ca. €25,000).[4] The Perry Green version was stolen on 13 July 2012. The Reuters report said "The Moore-Sundial 1965 is worth up to £500,000".[5] It was subsequently recovered following an appeal on the BBC *Crimestoppers* programme.

In 1966 Gavin Astor, owner of *The Times,* commissioned Moore to create a larger version for *The Times* building in London. Moore started to cut a wooden sundial with a height of 3.36 m (scale 6:1) in his studio in Much Hadham, Herts. It took him three months. The model was shipped to Noack in Berlin where the production in bronze started. This item had the working number LH 528.

On 23 November, 1967 – 45 years ago – this sundial was shown to the public for the first time on the forecourt of *The Times* in London (latitude 51.5º N, longitude 0.1º W).[6]

In 1974 the building and the sundial were sold. This process is documented in Ref. 6 and rather unkindly in Ref. 7 by Roger Berthoud.[8]

In 1975, IBM Europe bought the sundial, which had been damaged by London's air pollution, from a dealer and transported it first to Noack in Berlin for refurbishment and later to La Hulpe, 20 km south-east from Brussels, Belgium. There, next to 'Le domaine Solvay', IBM owned a beautiful park of 70 hectares with an International Education Center (IEC). The Moore sundial was positioned in front of the main entrance and was the main symbol of the IEC (latitude 50.7º N, longitude 4.4º E).[9]

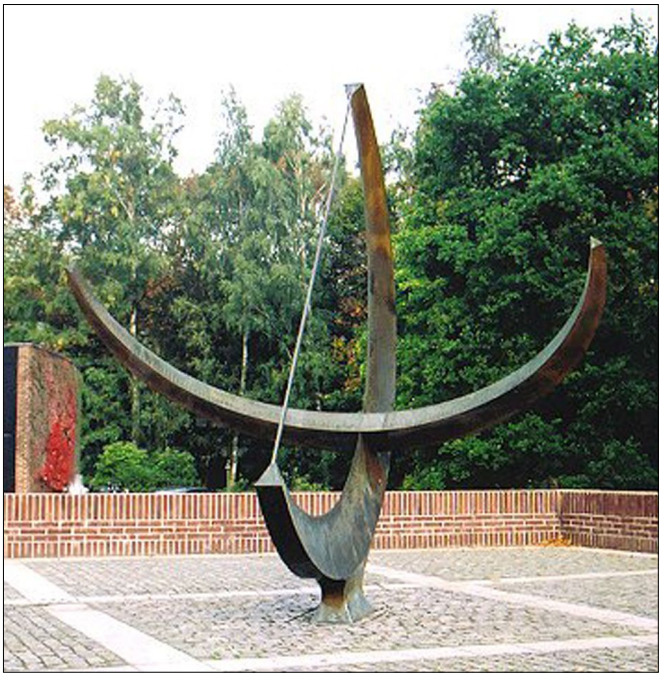

Fig. 4. Photo of the Moore sundial in La Hulpe, after its relocation.

In 1979, the Morris Singer foundry in Braintree, Essex, manufactured a second, identical, copy of LH 528. Henry Moore later sold this copy to Chicago, where it was erected in front of the Adler Planetarium in celebration of its 50th anniversary in 1980.[10-12]

In 1983 I saw the sundial in La Hulpe for the very first time and was fascinated by its clarity and simplicity, though it was much larger than me. I had seen a lot of equatorial sundials before, but this was the most beautiful I ever discovered.

The main difference between other equatorial sundials and the Moore design is the knife-edge form of the vertical bowstring, which gives it elegance. The distance between the 5-minute marks is exactly 4 cm. You are able to observe the shadow cast by the sun moving and you feel time is flying.

Visitors from Britain, who knew the former place in the forecourt of *The Times,* agreed that this place in the woods of La Hulpe was a very suitable place for the sculpture.

Some time later a bus crashed into the sundial. Again it travelled to Noack in Berlin for repair. The IBM management decided to change its position by 100 m to a paved area without access for cars. Unfortunately the alignment was not correct.[10,11]

On 30 September 2002, the IEC was closed and migrated to Dolce Spa Hotel. The Moore sundial was moved to a storage facility in Brussels.

In 2011 it was sold by the Würth Foundation and again transported to Noack, Berlin for refurbishment. From there it finally found its way to Schwäbisch Hall in Baden-Württemburg, southern Germany, where it was rebuilt in Lange Strasse 35 (latitude 49.1º N, longitude 9.7º E).

In February 2012, the Würth Foundation asked me to correct the alignment. They sent me timed photographs which showed the sundial and the shadow on its time-scale. I calculated that the sundial was not in south-north direction and needed to be turned approximately 7º to the East. The town administration supplied me with a 1:200 scale map, based on aerial photos. In this plan the north direction had a precision of 0.1º.

I called my sundial friend Rolf Wieland, who lives in Satteldorf 30 km away. Armed with a theodolite we met three craftsmen of the Würth company on 14 June.

From a theoretical point of view, alignment of the Moore sundial required three steps:

1. Defining an exact south-north line on the ground.
2. Moving the sundial with both the gnomon and the vertical bowstring in a perpendicular plane to the south-north line.
3. Moving the sundial in this plane to get an angle of 49.1º between the 2.4 cm thick gnomon and the horizontal plane.

The problem with the Moore sundial was its weight of 800 kg. Lacking any sunshine, the sundial was pushed by four people – based on the very precise map – in the eastern direction in the perpendicular plane to the meridian south-north line. After a short shower of rain, the clouds disappeared and the sun came out. We saw that the indicated local apparent time was correct to one minute. After another small move, it could be read to a precision of better than 30 seconds.

With the help of an Ipod electronic 'app' and a real water-level and six wedges we tilted the sundial to 49.1º (point 3).

Helmut Sonderegger's program 'Sonne' has a new function: a table of the sun's culmination times for a specific latitude and year. With the help of that table a new one was built which gives the connection between apparent local time and civil time.

Fig. 5. Closeup of the hour ring. The sundial shows 11:30 h local apparent time and was taken on 14 June 2012. The plaque gives 21:30 m. 11:30 h + 21:30 min = 11:51:30 h MEZ or 12:51:30 h MESZ.

Fig. 6. The author after a hard day's alignment work.

A small plaque will be positioned by the sundial with the following information (in German):

To determine watch time

1. Read time in hours and minutes, where the shadow meets the scale
2. Determine corrections from the table below.

Month	Day 1.	10.	20.
January	24 min	28 min	32 min
February	35 min	35 min	35 min
March	33 min	31 min	28 min
April	25 min	22 min	20 min
May	18 min	18 min	18 min
June	19 min	21 min	22 min
July	25 min	26 min	27 min
August	27 min	26 min	24 min
September	21 min	18 min	14 min
October	11 min	08 min	06 min
November	05 min	05 min	07 min
December	11 min	14 min	19 min

An example is given in Fig. 5.

Viewers are surprised at the precision of better than one minute.

Schwäbisch Hall has at least two things in common with London. Both have a Holbein – London, 'The Ambassadors'; Schwäbisch Hall, 'The Darmstadt Madonna' – and both have been locations for a Henry Moore sundial.

So far, the Moore sundial has had an exciting life: it has travelled more than 7,500 km between England, Belgium and Germany and survived a bus accident.

Form and Function

From my personal point of view, the dial is an extraordinary combination of

- an excellent and beautiful design, which is timeless with an unrivalled elegance and
- an astronomical instrument and timekeeper with an unusual precision of less than one minute.

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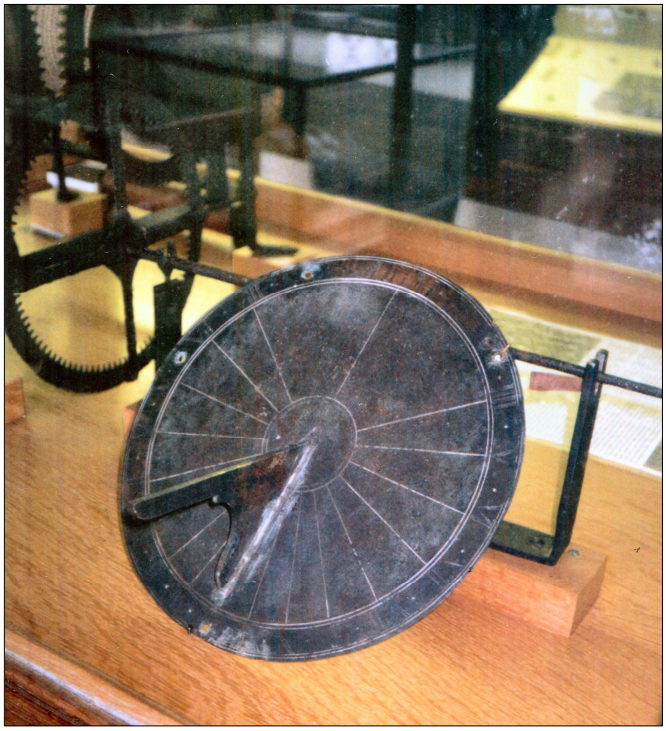
Peter Kunath is a mathematician and former system engineer for mainframe computers who has been making sundials for about 30 years. He has collected more than 2,000 Latin mottos on European sundials, translated them and edited them into a small booklet. He lives in Cologne, Germany, and can be contacted at *peter-jochen.kunath@t-online.de.*

HADDON HALL HORIZONTAL DIAL

TONY WOOD

Haddon Hall is near Bakewell in Derbyshire and is an old stately home which is mentioned in the Domesday Book. There is a clock from the 1920s in the inner courtyard which replaced an earlier single-handed clock of some antiquity. The old clock mechanism is preserved in the Hall Museum and is unusual in having a verge and pendulum escapement with the early pendulum being quite short. The clock would have required frequent resetting and a sundial was positioned on the corner of the upper terrace wall for this purpose. The terracing itself was inspired by Sir John Manners (d.1611) during the late sixteenth century.



The dial (illustrated) is also now in the Hall museum, though the impression cut for it in the stonework of the terrace can still be seen, including fixing holes and relief for the gnomon tenon to match the dial. The date on the dial is clearly given as 1591 making it quite early. It is about 300 mm in diameter (quite large for the time) and shows just the hours and half-hours. There is no maker's name – it is quite likely that it was made by the clockmaker in order to regulate the clock.

The dial features in Gerard Turner's *Elizabethan Instrument Makers* but unfortunately the author's sketch there[1] shows it incorrectly with the centre of the delineation origin offset towards the southern edge of the dial-plate. As can be seen in the photo, it is actually in the centre of the plate as was normal for all English horizontal dials until the very end of the sixteenth century, a natural result of the geometrical delineation methods in common use.

Thanks are due to Janet Blackburn and Jo Walker at Haddon Hall.

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aowood@soft-data.net

IN THE FOOTSTEPS OF THOMAS ROSS

Part 3. The Sundials of James Gifford

DENNIS COWAN

James Gifford was a 17th century stonemason from the village of West Linton, situated about 18 miles south-west of Edinburgh, in what is now the Scottish Borders region. A number of his sundials feature in *The Castellated and Domestic Architecture of Scotland*"[1] although Ross does not actually name Gifford in this work.

Gifford's house in West Linton was demolished in 1864, but a cube sundial (Fig. 1) surmounted with a sphere on four scrolls and attributed to Gifford[2] is on the stone cottage near where his house once stood. This sundial appears to have had dials on all four faces. The south face, which is the only face that can be clearly seen to have hour lines and numerals, has Arabic numerals and the remains of a gnomon. All other gnomons are missing although their positions can be seen. There is damage to the upper left part of the south dial face and the corresponding upper right part of the west face which has been crudely repaired, losing all marks in the process. The sphere has faint lines marked.

Figs. 1 & 2. Two different cube-and-sphere sundials, only 40 yards apart in West Linton.

Also on the gable wall of this house are three elaborately carved stone panels featuring Gifford and his wife and carved by him. These stone panels originally adorned the inside of his own house.[3]

Another cube sundial, again surmounted by a sphere (Fig. 2), is mounted on the south-west corner of a building only 40 yards further up the road and is also presumed to be by Gifford. This dial is similar in design to the previous example but without the four scrolls. It has Roman numerals on the south face with the remains of a gnomon. The east and west faces have Arabic numerals whilst the detail on the north face can not be easily seen. There does appear to be some very faint markings on the sphere.

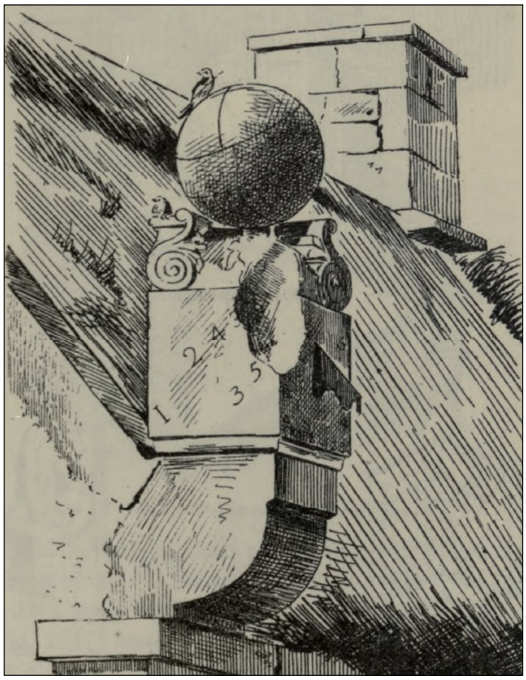


Fig. 3. The sketch by Ross of the dial shown in Fig. 1.

Ross mentions the West Linton dials only briefly by saying *"Dials forming terminations at the eaves or lower ends of gables are of common occurrence, and a good example is shown from a one-storied cottage at West Linton"* (Fig. 3). It can be seen quite clearly that this is the same dial as shown in Fig. 1.

Fig. 4 (far left). Sketch by Ross of the multi-facet dial at Newhall.

Fig. 5 (left). Close-up of the Newhall facet head.

Around four miles north-east of West Linton lies Newhall House and the grounds of this private estate, in which the actor Robert Hardy once lived, contain two sundials. There is not a great deal of opportunity to see these sundials as the grounds are currently open only on one afternoon a year for charity, under Scotland's Garden Scheme.

The first is a large elaborate multi-faceted sundial adjacent to the house. This dial is not by Gifford as it dates from 1810, far too late for him, but as it is described by Ross it is worth mentioning here. He describes it thus: *"This dial, which may be regarded as a monument to Allan Ramsay, stands in front of the mansion-house of Newhall. Its appearance will be easily understood from the sketch"* (Fig. 4).

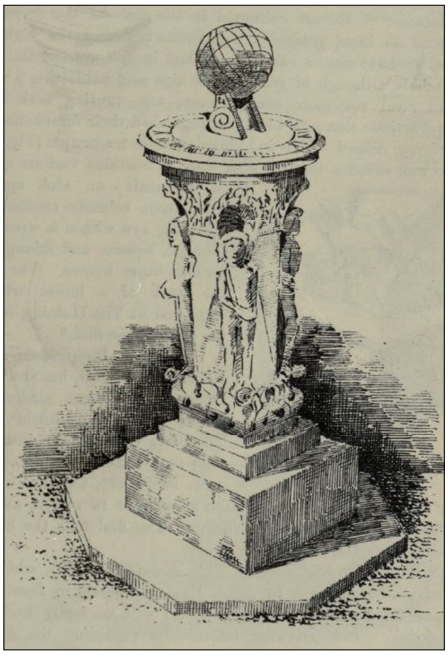
He goes on to recite some of the many inscriptions on the dial which was erected in memory of the poet Allan Ramsay and of his poem *The Gentle Shepherd* in particular, which was based on Newhall. This sundial still stands in its original position, its eight dials having a mixture of Roman and Arabic numerals (Fig. 5). It is in rather good condition despite its dial faces becoming encrusted with moss and lichen.

One of the inscriptions on the sundial reads "*Observe how fast, time hurries past, then use each hour, while in your power, for comes the sun, but time flies on, proceeding ever, returning never.*"

The other sundial at Newhall is in the walled garden (Fig. 6). It consists of a globe sitting on top of a hollow cylinder which acts as the gnomon of the horizontal sundial underneath. It has a late 17th century octagonal shaft with figures of the seasons. This shaft is attributed to Gifford, but there is some discrepancy as to the age of the dial itself, which may or may not be Gifford's work.

There are hour lines on the sphere with the hours marked in Arabic numerals, whilst the half and quarter hours are also marked (Fig. 7). The stone horizontal dial face is badly obscured by moss and lichen, but it appears to have Roman numerals. This is confirmed by Ross's sketch of the dial.

Ross says *"This dial* [Fig. 8] *may be classed with those of the horizontal type, although the globe supported by the hollow cylinder-shaped figure which forms the gnomon is a feature unusual in such dials. The dial is probably the production of a local sculptor, specimens of whose work may*



Figs. 6, 7 & 8. The horizontal and globe sundial at Newhall.

be seen scattered about the village of West Linton. A dial there bears a considerable resemblance to this one, and they are probably by the same hand."

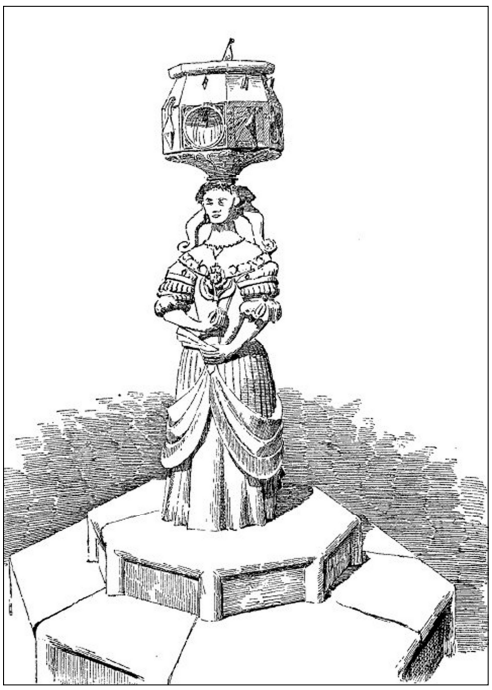
So Ross thought that these dials were by the same hand and there is evidence to support the fact that the hand belonged to Gifford.

But Gifford's crowning glory is surely the multi-faceted dial at Lennoxlove near Haddington in East Lothian. Again, although Ross did not attribute this dial to Gifford in *The Castellated and Domestic Architecture of Scotland*, there is evidence provided by Ross to support the fact that this is Gifford's work.[4] When Ross sketched this dial (Fig. 9) it was at North Barr House in Renfrewshire and he described it as follows:

"This singular and graceful sundial stands in the centre of the old-fashioned, semi-decayed gardens of North Barr, at a distance of a few minutes' walk up the Clyde from Erskine Ferry. There is something extremely droll and quaint in the conception of the lady who supports the dial-stone, with her remarkable headpiece and picturesque seventeenth century costume, as she stands gracefully holding a rose at her breast and smiling on the spectator. The two hair curls standing out in relief very considerably heighten her odd effect, and at the same time give apparent strength to her slender neck to carry the overhanging and weighty dial."

"The dial itself is an octagonal block with seventeen faces. On the perpendicular faces there are cup-hollows alternating with plain face dials. The gnomon of the west hollow is a piece of metal stretched from side to side [Fig. 10]*, with its under edge serrated like a saw. The hollows on one of the east faces* [Fig. 11] *are four heart-shapes, disposed somewhat as they are at Holy rood.*[5] *On the horizontal dial, which is 14 inches wide, there occur the initials of Donald Macgilchrist, with the date 1679.*

Ross's detailed description of the sundial is quite precise and the only thing that can be added is that all the hour lines and numerals, which are in the Arabic style, can still be clearly seen. The heart-shaped hollows to which Ross also refers, whilst quite common on obelisk and lectern dials, are much less so on other types of sundial.



Figs. 9, 10, 11 & 12. The multifaceted dial at Lennoxlove, including details of the scaphe dial and the sunken hearts.

This wonderful sundial, which just has to be my favourite, now stands in the sunken garden to the east of the house of Lennoxlove (Fig. 12) and remains in excellent condition. It dates from 1679 and I wonder how it has managed to survive virtually intact for the last 330-odd years as the dial stone itself is in a very precarious position.

According to Andrew Somerville[6] it was moved from North Barr House to Lennoxlove early in the 20th century. This fits in with the date of 1912 when the sunken garden was designed by the architect Sir Robert Lorimer, who was commissioned by Major William Baird to carry out the restoration of Lennoxlove in that year.

This sundial is a fine testament to the skills of James Gifford and it is said that the young lady supporting the dial stone bears a strong resemblance to his wife. She is certainly dressed in a very similar fashion and strikes a similar pose to Gifford's statue of her in West Linton.

There is another sundial at Lennoxlove identified by Ross, but this sundial is not by James Gifford. This is another example of problems in trying to trace Ross's sundials. Not only do the sundials move from place to place, but houses change their names! It was only recently that I found out that the original name of Lennoxlove was Lethington Castle. Ross identified a two-faced dial on the south-east corner of Lethington Castle as follows:

"On the south-east corner of the latest part of the castle may be seen the dial shown [Fig. 13]. *The date (1644) shows that this portion of the building was erected after Lethington passed from the Maitlands into the possession of the ancestors of the present proprietor, Lord Blantyre."*

I have not yet had the opportunity to return there to see if this dial still exists. Hopefully it does.

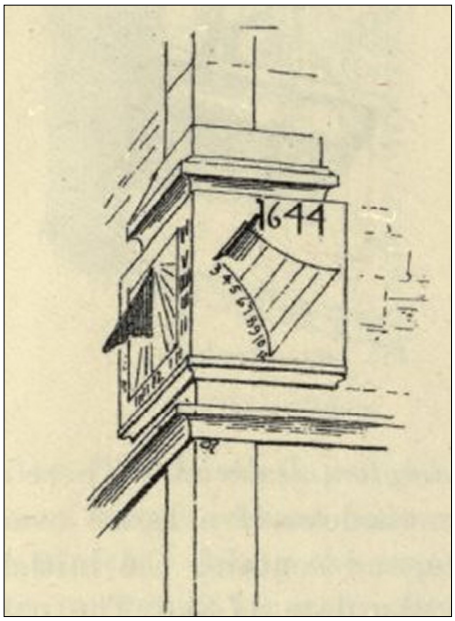


Fig. 13. Ross's sketch of the wall dial at Lennoxlove.

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4. Thomas Ross: *James Gifford and Some of his Works in Tweeddale*, Proceedings of the Society of Antiquaries of Scotland, Edinburgh (1899) p159.
5. Ross refers here to the multi-faceted sundial at the Palace of Holyroodhouse in Edinburgh.
6. Andrew Somerville: *The Ancient Sundials of Scotland*, Rogers Turner, London (1994).

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

BLEMISH OR BLESSING?

JOHN LESTER

A frequent cause of disfigurement of stone sundials is incrustation by lichens. Diallists generally detest them but they are intensely interesting and complex organisms about which a great deal is yet to be learned. Many species are beautiful, especially when viewed with a hand lens, and their presence on an old dial plate can sometimes enhance the impression of picturesque antiquity.

A lichen can be defined as a symbiotic system involving a fungus (the mycobiont) and an alga or a cyanobacterium (the photobiont – so-called because it is capable of photosynthesis). It is really much more complicated than that and closer study will soon open a Pandora's box of technical terms and bewildering examples of lichens which seem to escape the boundaries of a simple definition. It is mainly the fungal element which dictates the shape of the body of

Fig. 2. The dial at Lewannick, Cornwall (SRN 0643).

the organism (the thallus) and forms up to 95% of its volume. The photobiont lives inside it. Fungi normally live by breaking down living or dead organic material and cannot live on an inorganic substrate. When they become lichenized they are able to use the sugars and occasionally nitrogen compounds produced by the photobiont and this enlarges their range of habitats enormously .They are found in arctic conditions, in deserts and even washed by sea water in the intertidal zone.

The fungus clearly gains advantages from the symbiosis but the benefit to the photobiont is less obvious. It is physically protected by the fungus in which it lives and is prevented from drying out. It is also shielded from intense heat and sunlight which might be encountered on a south facing dial. Though it produces food for the fungus it retains enough for its own needs and does not appear to suffer from the arrangement.

The external forms of lichens can conveniently be classified as crustose (forming a crust), foliose (forming a leafy growth) or fruticose (producing a shrubby growth). It is the crustose variety which is of most interest and vexation to diallists. Lichens of this type grow very slowly, the advancing edge of the thallus moving no more than 1 millimetre a year and they may survive for 100 years. The type of rock often dictates the range of species which will grow on it. Basic rocks (limestone, marble) and acidic rocks (granite, slate, sandstone) will each exhibit a different flora; a fact which can easily be observed in any churchyard.

When lichens reproduce it is the fungal element which takes precedence. Fungal spores are distributed but contain no photobiont element. It is thought that they can only survive if they encounter the right alga or cyanobacterium which they can incorporate as they germinate. Failing that they will not survive. A very few species are thought to produce spores with photobiont cells attached to them. If this were the only method of propagation the chances of new lichen formation would seem very small.

Vegetative reproduction also occurs when fragments of a broken thallus are carried by the wind or other means to a fresh site and a new lichen is formed. Even this seems chancey and the likelihood of a lichen gaining a hold on the vertical surface of a sundial by either method seems infinitesimal and yet, as is only too obvious, they frequently succeed. It is interesting to see that some old dials seem to have escaped colonisation by lichens altogether and this may be due to their situation or possibly a very smooth and fine-grained surface which is typical of some slates.

Lichens are very much affected by atmospheric pollution and particularly by sulphur dioxide. Some species are resistant and it is possible by studying the range of species in an area to estimate with fair accuracy the level of atmospheric pollution there.

The city sundial may accrue fewer lichens but suffer from the pollution while the reverse is true of its country cousin.

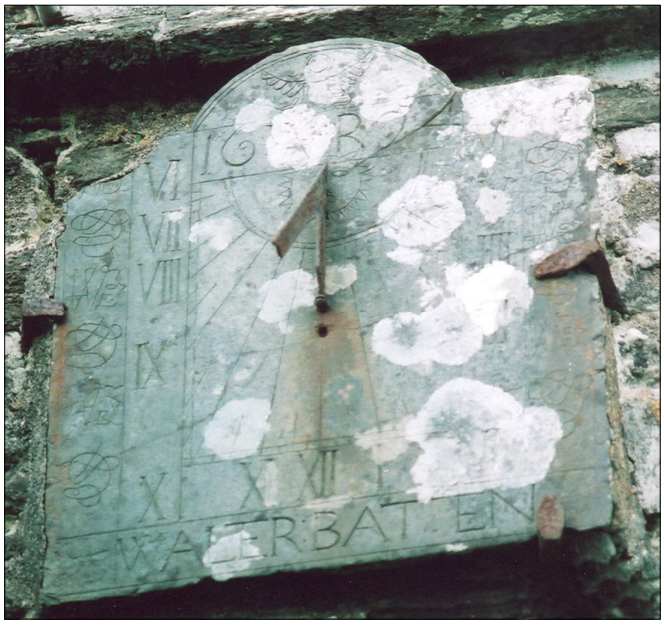

Fig. 1. The dial at Brent Tor, Devon (SRN 0413).

Identification of lichens can be very difficult even if you can get close enough to examine them with a hand lens. When they are coating the surface of a dial on a church tower it almost becomes a matter of guesswork. The Field Studies Council has produced a series of laminated sheets with excellent photographs of common species and the one entitled '*Guide to Common Churchyard Lichens*' would be of most interest to diallists. This was compiled by Frank Dobson whose book, '*Lichens, an Illustrated Guide to the British and Irish Species*' (The Richmond Publishing Co. Ltd, 6th edition, 2011) can be consulted by those who wish to study the subject more deeply.

Though some may consider that lichens improve the appearance of a sundial, restorers will usually want to get rid of them. Crustose lichens are very adherent and attempts at physical removal can easily cause damage. I have no experience in this field and would welcome information from those who have. To me, it seems that the safest plan might be to apply a fungicide which will not damage the underlying stone and hope that the dead lichen will lose its grip and fall off. There is also a very slight danger that a restorer might inadvertently destroy a protected species of lichen without recognising the fact. Since there are nearly 3,000 species in this country we diallists can hardly be expected to know which ones to leave undisturbed.

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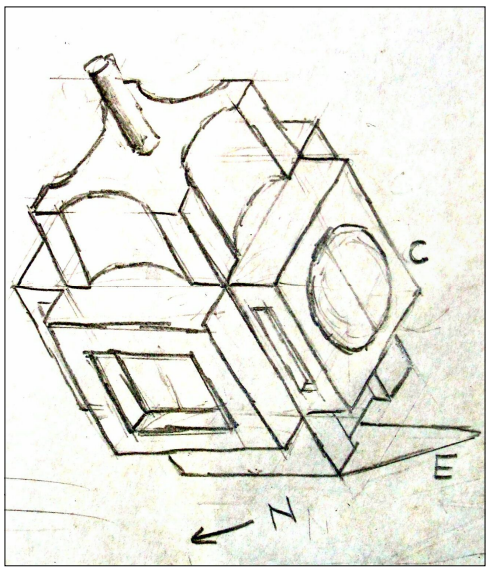
A Diallist's Pub

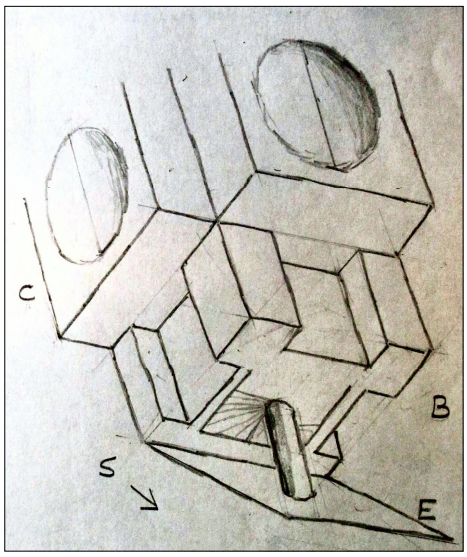
This pub sign was spotted in Drury Lane, London, by Ian Butson. Clearly, a good wateringhole for a diallist, despite the dubious gnomon.

READERS' LETTERS

Dutch Polyhedral Dial Drawing

The September issue of the *BSS Bulletin* came on Friday, and last night I had a chance to focus on the article about the Dutch manuscript (24(iii) pp.23–26). By the time I turned off the light, I had the beginnings of a solution, and by midnight a few other things had fallen into place. Today is the Labor Day holiday, so I don't have access to a copier to construct a cut-and-fold model. But the attached quick sketches are my claim to an independent solution (if perhaps not a priority solution).





The sketches show the dial from the NW, and the base of the dial from the SW. A few observations:

* The key for me were the two equatorial dials "drawn from different centres". They suggested a rod gnomon of non-trivial thickness. I realized that they must be parallel, and facing opposite directions. (At first I thought they should be facing each other, separated by a rod, but that didn't fit with other aspects.)

* This is conceptually an elaboration of one of my favorite dials, the Erickson Memorial dial in Cranmer Park in Denver Colorado.

* The drawing can, in fact, "simply be cut out and folded to make a solid structure" with the exception of a funny bit between the bottom block and the scaphe block.

* In the cut-and-fold, face B remains attached to face E, which is now clearly "the foot or foundation on which the dial has been placed".

* All the 'cut-out' pieces in Fig. 4 are accounted for; for example, the center one is the insert for the north face.

* The polyhedral dial consists entirely of equatorial and polar dials, and thus is not latitude-specific. Build it, and you can install it anywhere in the temperate northern hemisphere. As drawn it accounts for summer hours from 4 am to 8 pm.

* Because it has no horizontal or vertical dials, this polyhedral dial is simpler than the Scottish polyhedral dials which are illustrated in the article and which are latitude-specific. These illustrations may in fact be somewhat of a red herring.

A couple of loose ends:

* The concave dials in the top block require the lunettes on the loose pieces to be pasted onto the lunettes on face A – perhaps a bit of unnecessary duplication. Also, one of the lunettes is missing.

* The folding below the block with the scaphe dials is a bit dodgy and may require some cut-and-paste. But my second sketch shows how they must fit.

* The four loose rectangles in the upper right of Fig. 4 appear to go in the edges of the indented dials on the bottom section. This would imply that a couple may be missing.

* Fig. 3 appears to show cutouts already pasted into the little rectanular north-facing dials adjacent to faces C and D.

* There is a missing piece (perhaps a lost 'cut-out') representing the base of the North inset dial on the scaphe block and the north face of the bottom block. It would be an extension of the left arm in the fold-out drawing. Is there any evidence of glue on the center left of the page?

* The rod gnomon is centered in face A, and does not appear centered in face B. Perhaps it is not intended as a single rod, or perhaps the graphics are off.

Thank you for a delightful mental diversion!

Steven Woodbury
Springfield, VA (USA)

Planispheric Nocturnal

In the September *Bulletin* Mike Cowham describes (24(iii) pp. 20–21) a nocturnal using a projection of the northern sky which can be aligned with the orientation of the stars to find the time at night. There is however a misconception in the construction and description; the two pointer stars in the constellation of the Plough are directly above the pole star on March 8 at midnight, not September 7 as stated. This would introduce an error of twelve hours in the time, but, as the instrument has a complete hour scale in the 2 × 12-hour system the time of night can be read on the *daytime* scale centred on 'Midday'. Alternatively, if the handle is mounted in a position opposite to that shown, (effectively turning the instrument through 180º in use) the time will be shown correctly on the night-time scale.

Michael Lowne
Hailsham, Sussex

THE EQUATORIAL DIALS OF KLOPPENBURGH & CREMER

MIKE COWHAM

Several equatorial dials are known that were made and signed *"Gerhard Kloppenburgh Invenit et Delineavit"* and *"Gerhard Cremer Sculpsit"* and they are all dated around 1714. An example is in Fig. 1. These dials are quite unusual, consisting of a (once gold plated) brass disc of 30 cm diameter. Cremer's engraving is of the highest quality and it also carries some interesting information.

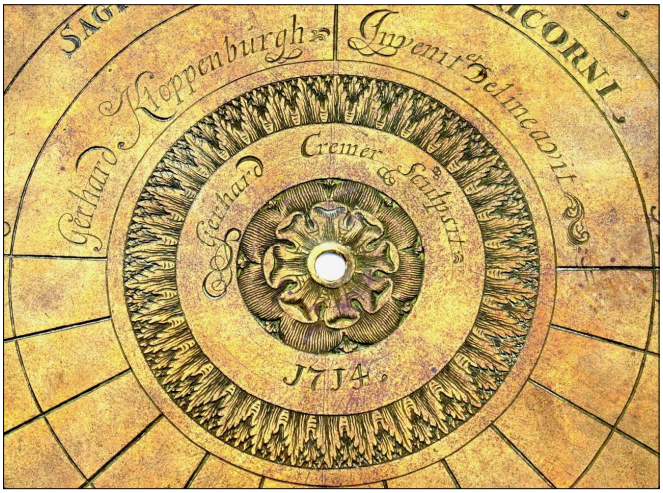


Fig. 1. Signatures of Kloppenburg & Cremer in the centre of the winter disc.

On the upper side of the disc are the hour lines for the summer months *VER* and *ÆSTAS*, and on the underside, those for the winter months *AUTUMNUS* and *HIEMS*.

The information on the upper side is quite detailed and the motto is set into an interesting engraved picture; in the case of the dial illustrated the motto is *SIC TRANSIT GLORIA MUNDI* (Fig. 2). This is surrounded by clouds and ribbons, the whole being flanked by two cherubs. On another dial there is no motto but an armillary sphere and a cross staff are illustrated.[1]

Fig. 2. Motto and cherubs.

The dial is divided into 15° segments from IIII–IIX–IIIV (note the strangely reversed Roman numerals), with each hour subdivided into quarters and half-quarters, with a device like a double fleur-de-lys for the half hours plus a star between the hour numerals. See Figs. 3 & 4.

Fig. 3. Engraving detail showing sunrise times for the start of each Zodiac sign and some of the places where it is noon at each hour indicated by the dial.

For each hour-line the maker has added two distant places to show the time of noon at each, with towns in EUROPA, AMERICA, AFRICA and ASIA (see Table 1). In addition there are concentric rings labelled with the various zodiac sigils and names. Each ring is also labelled with the times of sunrise *SOLUS ORTUS*, sunset *SOLUS OCCASUS* and day length *DIERUM LONGITUDO* at the IV, IIX and IV positions (Table 2).

The winter side of the disc is much simpler and is marked in a similar fashion but without the various places at noon around the Earth.

The specimen in this article is just the dial plate of an equatorial dial having lost its original support but Cousins[1] illustrates another one dated 1716 fitted to a simple stand. It is in the Boerhaave Museum in Leiden. The gnomon is quite short and tapers to its point. The disc itself is supported from behind and is attached at the three fixing holes around its edge. In his example the Roman numerals are not reversed.

Little is known about Kloppenburgh or Cremer. They are briefly listed by Zinner[2] and by Webster[3] but neither show any biographical details. They are thought to be German, and the evidence on this dial shows that it was made for a latitude of about 52°N (from tables of sunrise and sunset given by Waugh[4]) and at a longitude, determined from the

Hour	Angle*	Place	Place	Modern Name & Longitude†	Modern Name & Longitude†
IIII	120°E	*Batavia*	*Bantam*	Batavia = Djakarta, Java 106°E	Bantam, Java 105°E
V	105°E	*Tafata Insla*	*Kithay Lacus*	?	Cathay Lake?
VI	90°E	*Cafra Regio*	*Suratta Indiæ*	?	Surat, India 73°E
VII	75°E	*Oby Fluvius*	*Mexat*	Gulf/River of Ob, N. Russia 73°E	Mexat-Ali, Iraq? 47°E
VIII	60°E	*Tauris Persiæ*	*Aſtracan*	Persia 44°–63°E	Astrakahn, Russia 48°E
IX	45°E	*Medina Arabiæ*	*Aſoff Tartariæ*	Medina, Saudi Arabia 40°E	Azov, Russia 39°E.
X	30°E	*Ambian Cantiva*	*Conſtantinopolis*	Ambiancantiva, Ethiopia? 36°E	Constantinople/Istanbul 28°E
XI	15°E	*Angola Regnum*	*Vienna Austriæ*	Angola 12°–24°E	Vienna 17°E
XII	0°	*Berga Norwegiæ*	*Catonia Agrippin*	Norwegian Mountains 7°–20°E	Catania, Sicily 15°E
I	15°W	*Sierra Lione*	*Lisbona*	Sierra Leone 11°–14°W	Lisbon 9°W
II	30°W	*Heſperides Insulæ*	*Islandia*	Canary Islands 16°W	Iceland 14°–24°W
III	45°W	*Cabo de S. Vincente*	*Cathalin America*	Cape St Vincent, Portugal 9°W	?
IIII	60°W	*Braſilia*	*Gronlandia*	Brasil 36°–74°W	Greenland *c.*45°W
V	75°W	*Buenos Airos*	*Caribana*	Buenos Aires 58°W	Carribean 62°W
VI	90°W	*Virginia*	*Cuba Insula*	Virginia, America 76°–80°W	Cuba 74–85°W
VII	105°W	*Honduras*	*Peru Regnum*	Honduras 85°–90°W	Peru 68°–82°W
VIII	120°W	*Nombre De Dios*	*Nova Mexico*	Nombe de Dios, Panama 80°W	New Mexico 103°–109°W
(XII)	180°	*Zelandia Nova*		New Zealand 167°–178°E	

* *For Longitudes with respect to Greenwich add 15°W* † *Longitudes with respect to Greenwich.*

Table 1. Places marked on the dial with respect to noon at 15°E.

IIX setting, on a line between *Berga Norwegiæ* (the Norwegian Mountains) and *Catonia Agrippin* (Catania, Sicily), equivalent to about 15° east of Greenwich. These figures would place it in northern Germany, probably somewhere around Frankfurt-on-Oder.

Reversed Numerals

It is rather strange to see the Roman numerals reversed on this dial. It is possible that they wanted the numerals to read in the direction of the movement of the shadow, but then the numerals on the underside are also reversed, so this does not work. (Mechanical clocks, moving in a similar direction, do not have reversed numerals.) Another reason may be that the engraver was more used to engraving in reverse on printing plates; but then he got the rest of the letters and numerals on the dial right!

Note also that the thick legs of numerals V and X are not always in the same direction! Normally the line sloping from upper left to lower right will be broadest, as this is the result of a right handed person writing with a broad nib pen. However, as these numerals have their broad lines in either direction, this is not right and likely to be just an engraving error.

A similar characteristic has been noticed on some of the clocks by Joseph Knibb that use his special 'Roman striking'. Here instead of the usual practice of showing the 4 as IIII (also used on the Kloppenberg & Cremer dial), as with his Roman striking system the clock will strike the 4 on two bells (high/low for IV), he has substituted IV. (I have always understood that the IIII was originally used on clock dials instead of IV so that the apparent 'weight' of the IIII balances that of the VIII on the opposite side.) However, on

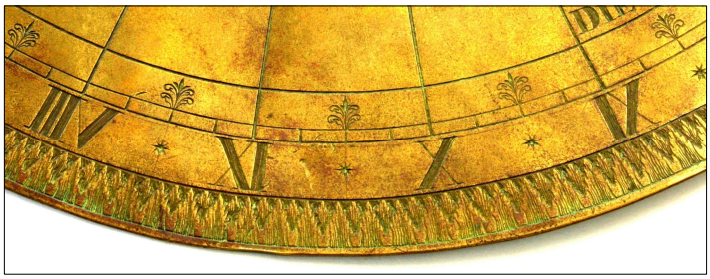


Fig. 4. Detail of half-hour marks and reversed Roman numerals.

				Solus Ortus (Sunrise)	Dierum Longitudo (Day Length)	Solus Occasus (Sunset)
Tropicus Cancri						
Cancer	♋			3.36	16.48	8.24
Leo	♌	Gemini	♊	4	16	8
Virgo	♍	Taurus	♉	5	14	7
Aries	♈	Libra	♎		(Figures for Equinox not stated)	
Pisces	♓	Scorpius	♏	7	10	5
Aquarius	♒	Sagittarius	♐	8	8	4
Capricorni	♑			8.24	7.12	3.50
Tropicus Capricorni						

Table 2. Zodiac signs and day lengths.

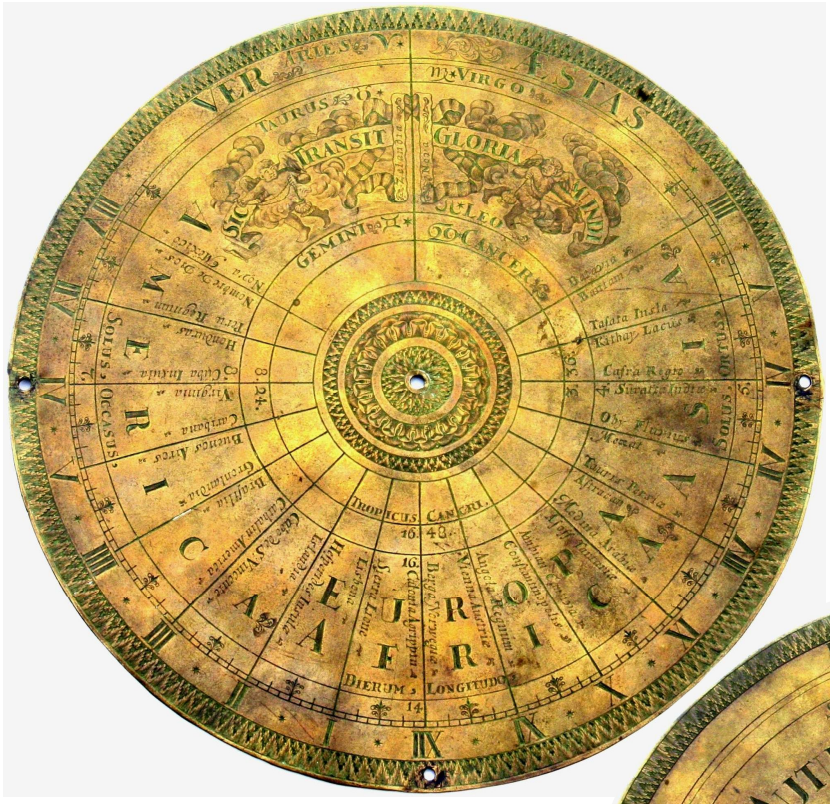


Fig. 5. The upper side or summer disc.

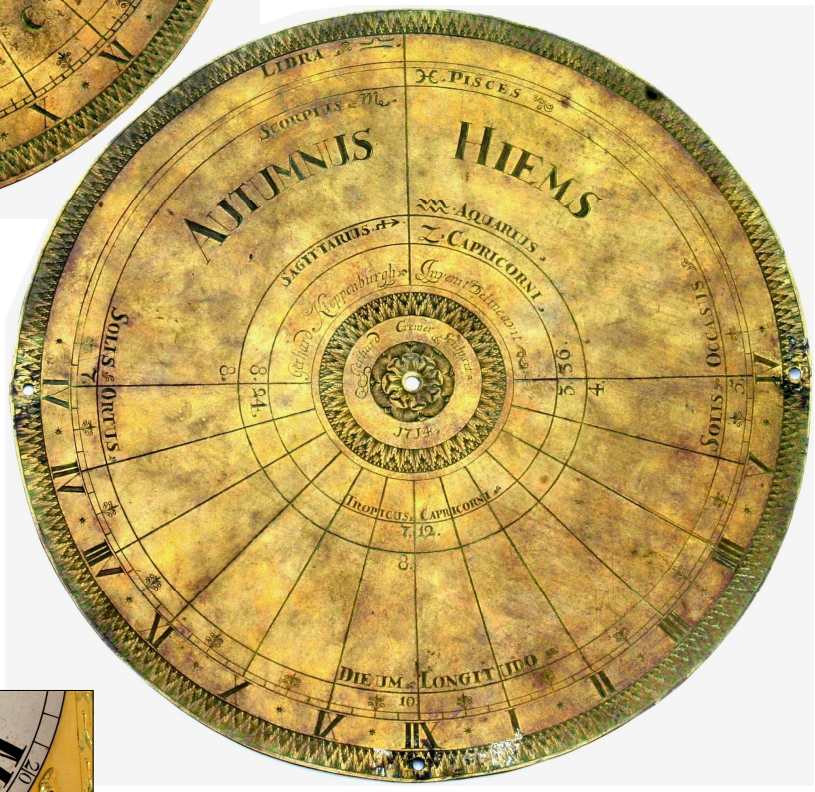


Fig. 6. The lower side or winter disc.

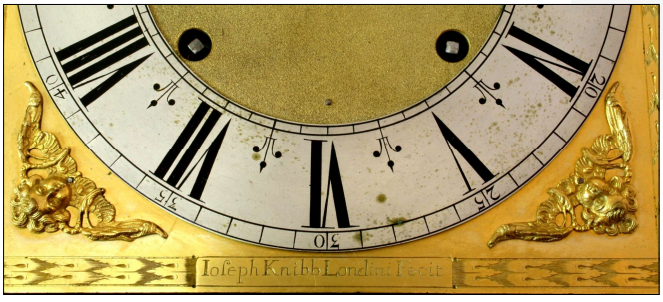


Fig. 7. Part of the chapter ring of a clock by Joseph Knibb, c.1685, with the thick line of the IV *on the 'wrong' side.*

several of his clocks, Knibb has made the broad line of the V on the opposite side to normal. This may be to make it mirror the VIII on the other side of the dial or to give it a bit more weight to balance against the much larger VIII, but he has not done the same with the V and VII.

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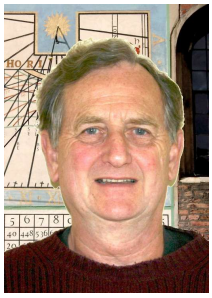
1. F.W. Cousins: *Sundials,* John Baker, London (1969).
2. E. Zinner: *Astronomische Instrumente des 11-18 Jahrhunderts,* C.H. Beck'sche, München (1956).
3. R. & M. Webster: Websters Database of Instrument Makers, *www.historydb.adlerplanetarium.org.*
4. A.E. Waugh: *Sundials, their theory and construction,* Dover, New York (1973).

Mike Cowham was a professional electronic engineer who ran his own company for 25 years making various accessories for scanning electron microscopes. From childhood he had an interest in clocks, from his father, and upon seeing a portable Augsburg dial in an antique shop he realised the close similarity between it and early clocks.



In the last 31 years he has concentrated on sundials, particularly portable dials, and has written a book *A Dial in Your Poke*, now in its second edition, describing these in detail. He has also published *Sundials of the British Isles* and (to date) two BSS monographs. He is also a frequent contributor to this *Bulletin*. He can be contacted at *mike@brownsover.orangehome.co.uk.*

NEW DIALS

Pocklington, Yorkshire

The work of William Watson of Seaton Ross as a surveyor and sundial designer in the 19th cenury was described in *Bulletin* 21(iv). He is little-known even in his native Yorkshire so the Pocklington and District Local History Group decided to organise a tribute in the form of a sundial. A call for bids to make the dial was in the September 2011 *Newsletter* but in the end it was local dialmaker Stephen Holehan who undertook the task. Stephen is from Shirburn in Elmet near Leeds and his website (*www.sunshineandshowers.info/*) describes him as Yorkshire's only professional dialmaker. He offers a wide range of dial types in many materials.

The Pocklington dial is engraved from a material called Corian®, a synthetic material by DuPont™ which is a blend of minerals and acrylic polymer. Although often used for kitchen worktops, it is also specified for exterior cladding and decoration. The engraving was done on a German-made Hiez CNC milling/engraving machine which can handle sheets up to 100 cm × 60 cm.

The dial is designed for the gable end of a butcher's shop in Pocklington's George St, very close to where Watson spent his final years. The actual design is based on one which Watson published in his 1854 booklet *Dialling Diagrams*

and is very much in his style.

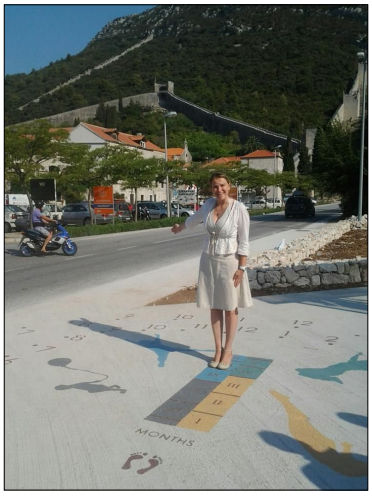
The picture shows Stephen Holehan with his dial immediately prior to installation, with the local Town Crier on hand to give it a good send-off!

The Wirral, Merseyside

'Modern Sunclocks' (*www.sunclocks.com*) is the name of the business set up by Douglas Hunt almost 30 years ago to supply customised layout plans for analemmatic (human gnomon) sundials. Nearly 2000 plans per year are generated for sites all around the world. Although not all of these may result in actual dials being made, it must be one of the most prolific dial designs around. Many of the designs are done for the playgrounds of junior schools which must certainly promote an awareness of the principles of solar time-

keeping in the young generation.

Designs are also produced for prestigious public sites and the recently-made example shown above can be found at 'The Diamond', an area of Port Sunlight near Birkenhead. The building in the background is the famous Lady Lever Art Gallery. The design shows the double ring layout (for



'BST' and 'GMT' times) which is characteristic of Modern Sunclocks and is accurate due to the modified date scale.

The picture above left is of a dial in the Croatian city of Ston, commissioned and installed by the local Tourist Office (and demonstrated here by the Director of Tourism. The fortified wall in the background is claimed to be the longest in Europe at 3.5 miles.

Above right is the date scale from an example made this year by the 'High Peak Community Arts' group. The designs for the tiles were made by local people with learning difficulties and then the manufacture was

SUMMERTIME NOON DIAL

TONY WOOD

Last year I was approached by Adele Christensen (Fig. 1), an artist working in glass, who had been commissioned to create a sundial for a client in Aldsworth, Gloucestershire. Adele had explored the Internet and found some dials for inspiration. I went to meet her for a day and filled in a bit of background about sundials and what kinds were possible. Later she sketched out a design to be made in fused glass, which is her speciality in the world of glass sculpture.

The site was a gently sloping lawn facing substantially south with no obstructions. It was decided that the dial would indicate 'noon' as 12 o'clock BST on 'Midsummer's Day'. 12:00 BST isn't really noon of course as it is 11:00 GMT. Sundial constructor programs don't help for a vertical gnomon, so a little hand calculation was necessary to find where the sun would be at 11:00 GMT on 21 June at Aldsworth (51.79 N, 01.78 W). I also assumed 'Midsummer's Day' to be the summer solstice. The correction incorporated longitude and the equation of time. Other 'times' are also indicated by markers with varying accuracy throughout the year but were set for summer use.

Two panels with a narrow slit between them create a noon line of sunlight and the panel edges cast a shadow onto the other hour markers. Fig. 2 shows the dial under construction, the panels being set in a concrete base and an elliptical area is laid with gravel to hold the glass hour markers. The

Fig. 1. Adele Christensen with her noon dial.

'12:00 BST' sunlight line points to the marker nicely and lies along it between the autumn and spring equinoxes (Figs 3 & 4). This light line is quite limited in operation, less than half an hour either side. Checking out at the summer solstice this year was tricky as both 20 and 21 June claimed to be *the* day and it was raining anyway. So 23 June it had to be and the line of light was truly close at 12:00 BST.

Adele's design rang a bell with me and I remembered coming across a similar arrangement at Lockinge Ring, in Oxfordshire, almost identical in concept and construction to

Fig. 2. The dial under construction with a sub-surface concrete base.

Fig. 3. The midsummer 'noon' line.

Fig. 4. The line of light at 12:00 BST on the Spring(?) equinox.

Fig. 4. The Dedication Stone of the Lockinge Ring Millennium dial at Ardington, Oxfordshire.

Fig. 5. The Noon Reflector of the Lockinge Ring.

her dial. The Lockinge Ring doesn't seem to have appeared in the *Bulletin* previously although it is a Millennium design by David Harber. It is situated at Ardington village near Wantage. Fig. 4 shows one of the markers in the Ring and is one of thirteen such pairs in a semi-circle on a hillside just outside the village, and it is identical in concept to Adele's design.

The sunlight lines appear through the slot at each hour, and noon is marked specially by means of a mirror mounted on a single marker stone due north of the 'observation stone' at the centre of the semi-circle (Fig. 5). The hill slopes down to the south; at the bottom is the observer's stone with a dedication plaque and equation of time. The marker pairs are around 50 metres away up the hillside. It may be David's biggest 'dial'. Recently a 'planetarium' has been added depicting the planets.

Like Adele's dial the hour indication will vary somewhat throughout the year as the sun tracks round from east to west. In winter the early and late hour markers will not receive any sunlight and other 'times for a line of light' from individual marker pairs will vary from winter to summer. Noon, however, at the Ring is true noon and occurs at around 12:00 GMT, allowing a bit of variation for longitude and the equation of time.

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Postcard Potpourri 24
St Peter's, Bexhill, East Sussex

Peter Ransom

The *Register* records a Dolland dial in this churchyard, but minus its gnomon (recorded by Michael Lowne in 1994, SRN 2502). Now if this IS that dial we have a picture of the gnomon together with an extra puzzle! Is that arc above it supporting the gnomon, or is a pierced ring that acts as another dial? Perhaps it was just used to help raise the stone on which the dial stands onto the top of the funerary monument. The stone appears to have some old letters and numbers on it, so a nice bit of recycling! Any observations are most welcome.

The postcard is undated, but there is a stamp (not a postage stamp) on the reverse that says 'Photo by A. D. Hellier, Bexhill'. It appears that this was Archibald Douglas Hellier (who started trading in 1909 and the business seemed to stop trading in 1938). There is an interesting account of Hellier and his work at *www.sussexpostcards.info/publishers.php?PubID=137*

pransom@btinternet.com

AN EXCAVATED LEAD SUNDIAL

JOHN DAVIS

Excavated sundials are an under-used resource in researching the development of horology.[1] They offer a different perspective on the development of everyday time-keeping to the carefully preserved sundials found in museums, on churches, and in aristocratic residences and gardens. A good example is the small lead sundial reported here.

The Find

The object shown in Figs 1 & 2 was found in July 2012 by the metal detectorist David Beaumont while searching for a lost wedding ring. It was located a few inches under the topsoil of a small uninhabited island in the middle of the River Avon as it passes through the village of Barford, just outside Warwick (see Fig. 3). After the find was shown to the local representative of the Portable Antiquities Scheme,[2] I was quickly able to identify it as a sundial.

The Sundial Details

The sundial is evidently made of lead and is 51.5 ± 0.5 mm in diameter (a nominal 2 inches) and 3.5 ± 0.2 mm (a nominal one-eighth inch) thick. With a weight of 76 g, it is quite robust. A scribed line around the perimeter, partly cut away, shows that it was marked out and cut from a sheet. The edge has a slight slope of a few degrees (smaller diameter at the top) which suggests that it was cut with shears rather than a chisel. A small hole penetrates the centre, slightly less than 1 mm in diameter though it is far from truly circular.

Fig. 1. Photograph of the Barford lead sundial.

The back of the dial is blank. On the front surface, there are two concentric circles and the 'hour-lines' indicated in the figures. Most of these lines terminate in a small pock on the inner circle which indicates how they have been set out, though one or two lines miss their pocks slightly. In the annulus between the circles, the lines are numbered 6, 7, 8, 9, 10, 11, 12, 1, 2, 3, 4, 5, 6 running *anticlockwise* and starting at the right in Figs 1 & 2. Due to corrosion and mechanical damage, not all of these numerals, which are orientated towards the inside of the circle, are clearly visible. It is apparent that the straight line elements of the numerals were engraved rather deeper than the curves.

The angles of the hour-lines, measured from the central diameter (the noon line) are shown in Table 1. Although they are not precisely symmetrical about noon and there is significant variation in the spacings, the strong impression

Time am (*hours*)	**Hour-line angle** (*degrees*)	**Hour-line angle** (*degrees*)	**Time pm** (*hours*)
6	–91	89	6
7	–76.5	75	5
8	–61.5	61	4
9	–47	46	3
10	–28	33	2
11	–14	18	1
	0		

Table 1. Measured hour-line angles, with respect to noon.

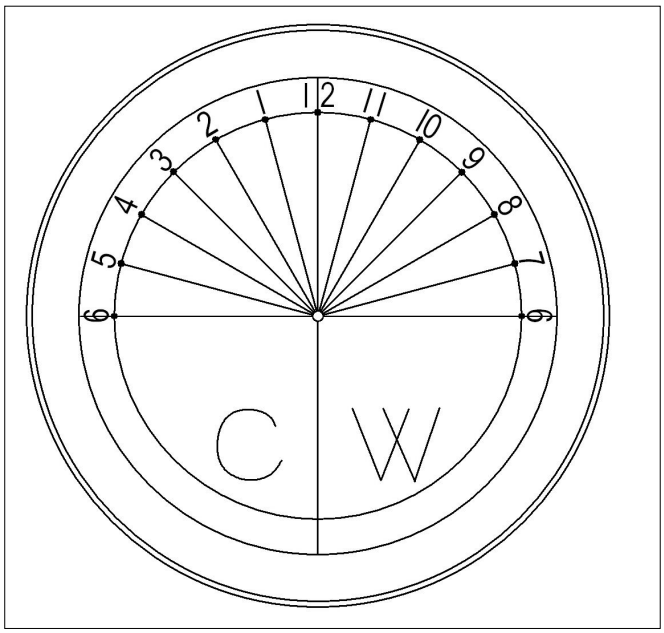

Fig. 2. Idealised drawing of the Barford sundial.

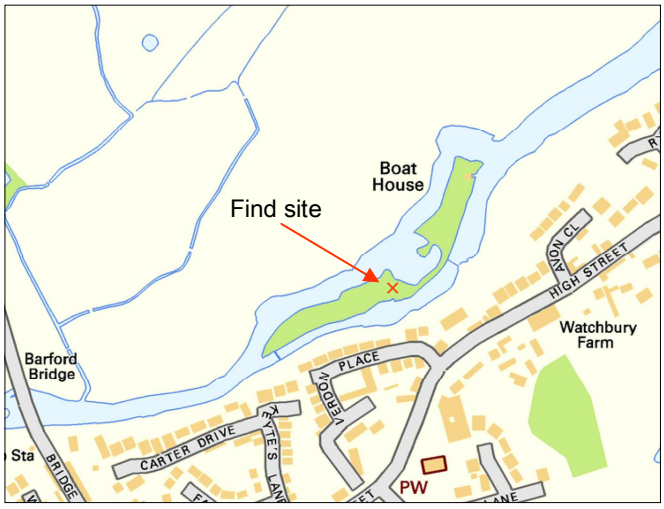

Fig. 3. Map of the find location on the R. Avon at Barford.

which is gained is that the maker was attempting to space the lines at regular 15° intervals, *i.e.* it is an equi-angular dial, not a 'scientific' one.

To the bottom (as shown in Fig 1 & 2) of the dial, large but shallow engravings give initials thought to be "C W", presumed to be for the maker.

History

There was a watermill in Barford, associated with the island, since at least 1086 – it was valued in Domesday at 2 shillings and 3 sticks of eels.[3] By the 13th century the mill, known as "La Lee", had been granted to the priory of Thelsford. After the dissolution of the monasteries the mill, and another at Barford, were granted to John Dudley, Earl of Warwick and Duke of Northumberland. For much of the 17th century it was in the hands of several generations of the Ward family. In 1692, a Charles Ward of that family 'quitclaimed' (renounced) the mill to a William Price. The fact that Charles Ward's initials match those on the dial could be purely coincidental and any connection would be very difficult to prove but it provides for some interesting speculations.

In more recent times, the island where the dial was found continued to have a mill for grinding corn until the end of the 19th century. It was then not used regularly until 1914 when an electric generator was installed.

Discussion

The overall appearance of the sundial initially tempts one to describe it as a 'portable mass dial', even though such things are not reported in the literature. It does, though, need rather more careful consideration.

The choice of lead as a material for the dial suggests that it was not made by a professional mathematical instrument maker or perhaps even a full-time metalworker. Lead has been available as a roofing material for a very long period, it is easy to both cut and engrave, and it is resilient against weathering or light wear. It would thus be an obvious choice for a provincial artisan wanting to produce a dial cheaply for his own use.

Delineating the dial would require just a pair of compasses (which masons, blacksmiths or carpenters would have had access to), a straightedge and a simple scriber. Angles may be bisected exactly with compasses alone (*e.g.* to form the right angle and 45° lines) and although there is no exact construction to trisect one – to form the 15° lines – it is a trivial task to achieve this by trial-and-error, stepping-out an estimated spacing. Any practical workman could have achieved this.

The anticlockwise numbering of the hour-lines indicates that this would be a vertical, rather than horizontal, dial. This is discarding as highly improbable any thoughts of a southern hemisphere dial. The small central hole could only have held a very thin rod gnomon prependicular to the dial surface (*i.e.* horizontal, like a mass dial) unless it was bent downwards (something which is unlikely and for which there is very little evidence). Combined with the equi-angular hour-lines, these would mean that the dial could not show modern equal-hours with any accuracy.

Vertical equi-angular dials were also sometimes used to try to show unequal (temporary) hours though again the accuracy is rather poor.[4] Even in the medieval period, rules for spacing the lines non-uniformly to achieve a passable approximation to unequal hours existed (the 'Erfurt formula') and the hours were counted from sunrise, putting noon as 6 hours, not 12 as engraved on the dial.

It might be suggested that the dial could operate as an equi-noctial one showing equal hours for the winter half of the year by positioning it at an angle to the horizontal equal to the co-latitude, with the face downwards, and with a polar-aligned gnomon. The fact that the back of the dial, which would need to be engraved to form the face for the summer half of the year, is blank is one strong reason why this arrangement is rejected as improbable. A small corpus of stand-alone stone sundials with equi-spaced hour-lines does exist though these too have an uncertain basis to their time-keeping principles.[5]

There are, though, difficulties with the suggested vertical arrangement. The first of these is that it would place the numbers, and the 'CW' inscription, upside down. Perhaps the maker did not realize this until too late.

A second difficulty for a portable mass dial is that it would need to be aligned facing true south. There is absolutely no evidence that the dial was associated with a magnetic compass so one possible solution is that it was held, or fixed, to a south-facing wall, either on a church or another building. This might have been a permanent set-up with a nail through the centre both fixing the dial and acting as the gnomon. The small size of the central hole would only have allowed a pin, rather than a nail, to have been used. Microscopic examination of the hole shows it to have an approximate elliptical shape with a sharp 90° corner at one end. This suggests that it was formed by the tip of a cut-nail, rather than a round pin.

Dating the Dial

The dial could have been lost on the island at almost any date in the second millennium. There are very few clues in its appearance as to when it was made. The form of the numerals does not look to be medieval in style (though unfortunately the most characteristic numerals of 4, 5 and 7 are no longer visible) which would place the dial as later than about 1500. Perhaps the strongest clue, other than the form of timekeeping, is the 'W' of the 'CW' inscription, which is engraved as two overlapping Vs (*i.e.*, a double-u). In printed books and also on some dials this form is at its most common from the second half of the 16th century to the end of the 17th. Considering that this is a provincial piece and not one made in the workshop of a London mathematical instrument maker, this period could even be extended and it would certainly be within the ownership of the mill by Charles Ward.

By the end of the 17th century, the only form of timekeeping in common use would have been modern equal hours. Together with the 6–12–6 numbering, this suggests that the dialmaker was attempting to make an equal-hour dial but lacked the knowledge to design one scientifically, drawing instead on experience with mass dials on churches. Its very existence does show the interest in practical timekeeping at that period.

Acknowledgements

It is a pleasure to thank Matthew MacFadyen and Kirsty Healy, the landowners and owners of the dial, for allowing me to examine it in detail and to report it here. David Beaumont is to be congratulated for finding the dial and I am also grateful to Angie Bolton, PAS Representative for Warks. & Worcs., for alerting me to the find.

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WINDOW REFLECTIONS

MICHAEL LOWNE

In *Bulletin* 24(i) of March 2012 (p.48), John Moir mentions the possibility of using the reflection of the sun from a window as a sundial and draws attention to the shape of reflections from double-glazed windows. These have the form of crosses with bright diagonal arms and concentrations of light in the centre. Fig. 1 is the reflection on a brick wall from a 400 mm square window at a distance of about five metres.

Fig. 1. Reflection from a square double-glazed window.

An optical investigation shows that both panes of a double-glazing unit are concave as seen from their exteriors and that the reflected pattern can be explained by the departure of a surface from a plane. Radial slope profiles of the glass were derived and two examples are shown in Fig. 2, one for a radius from the centre perpendicular to an edge and the other for a diagonal. That of the perpendicular is almost a straight line, indicating that the section conforms quite closely to a parabola, the theoretical shape for a surface subjected to a uniform pressure. The diagonal profile shows an increase of the slope to a maximum at about 150 mm

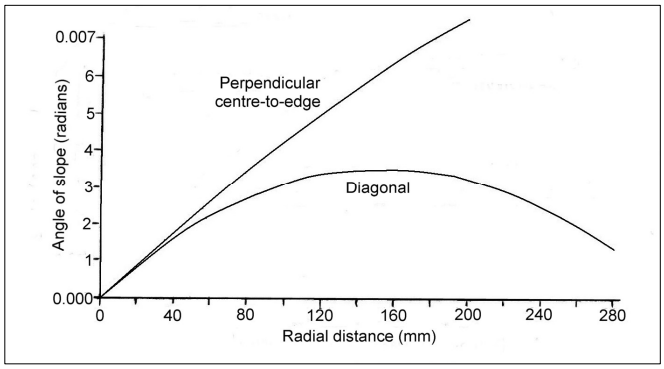


Fig. 2. Radial slope angles.

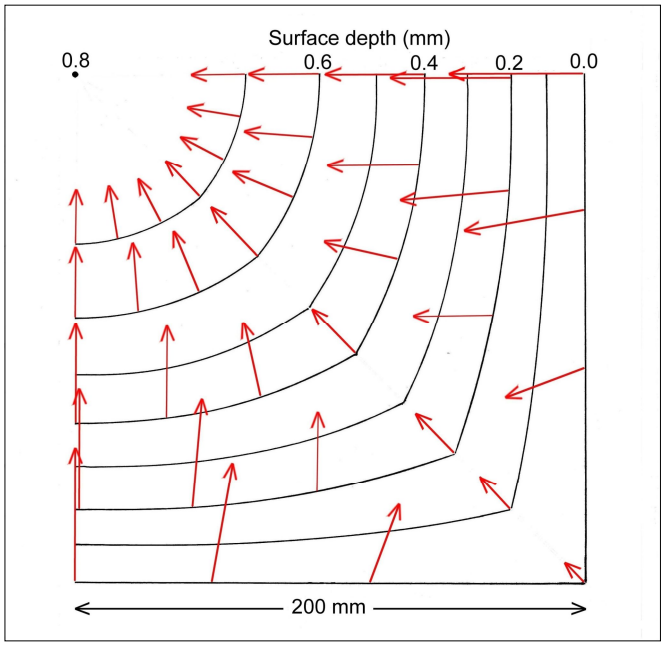
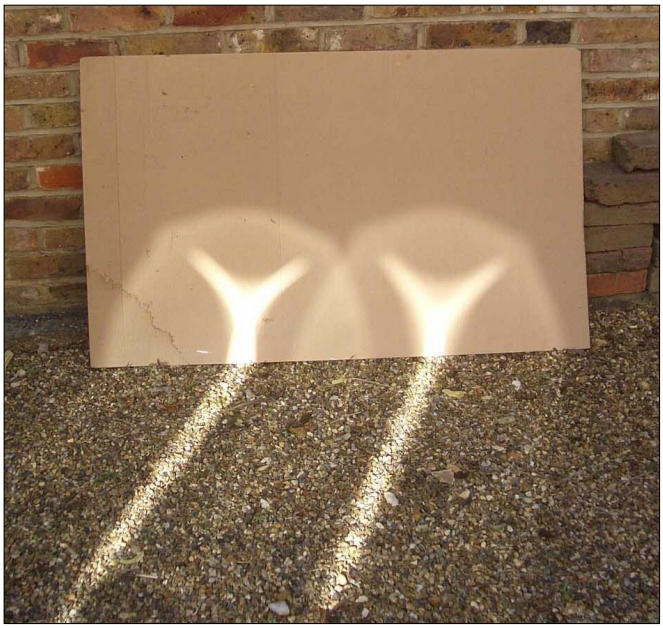


Fig. 3. Contours and ray deflections.

radius and then a decrease to the corner. Fig. 3 is a contour map of one quadrant of the window derived from these and intermediate radii, with contour lines drawn at 0.1 mm intervals, numbered from edge to centre. The depression at the centre is quite small, only 0.8 mm. At the edge, since the edge separators are plane-parallel, the contour is square. Following inwards, the corners become progressively less acute until near the centre the contours are practically circular. A ray of incoming light is reflected through twice the angle of slope at the point of reflection, and in a direction which makes an angle with the perpendicular to the contour equal to the angle the perpendicular makes with the radial direction. Rays from the radii perpendicular to the edge and from the diagonals are reflected towards the centre. Rays from intermediate positions are reflected towards the diagonals at angles which are large in the outer parts, but become more nearly radial near the centre. The red arrows show the direction and relative amounts of the reflection from various points, appropriate to a window-to-image distance about half that of the image in Fig. 1. It is easy to see how the reflection pattern can be formed at the greater distance of Fig. 1, but the simple picture is complicated by the finite angular diameter of the sun which will spread individual images into overlapping discs about 50 mm in diameter.

The bright circle surrounding the main pattern in Fig. 1 is formed by the other glass surface, which is convex to the incoming light and therefore reflects outwards.

David Young has kindly supplied a photograph (Fig. 4) of the reflections from two windows with height-to-width ratios of about 3:1. V-shaped patterns are formed from the upper parts (and presumably inverted Vs from the lower parts, which are shaded by a roof) and are similar to half the pattern from a square window. The bright line joining the top and bottom shows that the section in between is bent into a cylinder with a vertical axis. From the width of a window and its distance from the screen it is possible to



David Young

Fig. 4. Reflection from a pair of narrow windows.

calculate that the central depression of the glass is about 1.1mm, not significantly different from that found for the square window.

The reason for the concavity of the glasses is uncertain. It seems unlikely that individual panes (of varying sizes for different windows) are made with curvature or that the heat-sealing of the edges distorts the glass. One possible explanation is that the units are made with a partial vacuum inside and the excess atmospheric pressure bends the glass inwards. Enquiries to several manufacturers have produced no response.

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The Strangest Place for a Sundial?

This 6ft high red sandstone cubic sundial sits on top of an 8ft high standing stone just north of Luncarty in Perth & Kinross. It is situated in a field next to Over Benchil farm which was unfortunately full of cows at the time of my visit. It made me a little wary of going closer to the sundial, so the photo was taken with a telephoto lens from the edge of the field. I couldn't see any numerals or hour lines, but the gnomon holes can be seen. The stone itself is of quartzose schist and a group of smaller standing stones a mile away at Gellybanks are so lined as to point directly towards this larger, eight foot high stone. It is thought that the sundial has been in this position for at least 100 years, but who put it there and why?

Dennis Cowan

NORTH-FACING MASS DIALS

JACKIE JONES

Some years ago, Tony Wood asked me to assist a National Association of Decorative and Fine Arts Societies group based nearby in their church recording. They were looking at Litlington church in East Sussex and were a bit puzzled about the dials.

The church has three dials; one on the south side by the door which they assumed was a mass dial and two others on the north, also mass dials. The south one is on the cover of Cole's book of scratch dials.[1] It is about four feet above the ground right next to the door – it has no gnomon or numbers and looks at first very much like a scratch dial. Then you look closer and see that it is, in fact, an early scientific dial. All the hour lines are in the correct place for a dial of 51° N and the positioning of it would guarantee that the gnomon would get knocked off when people walked by to enter the church. In Christopher Daniel's book *Sundials*[2] it is described as "one of the earliest so-called scientific sundials, probably dating from the late 15th or early 16th century, showing the equal-hours system, which we use today."

But go round the back to the north side of the church and about 2–3 feet above the ground, amongst the nettles, are two real mass dials (Fig. 1). They are on a 14th-century wall jutting out from the tower, at right angles to each other, facing north-west and north-east. We were puzzled as to why they were placed there so low down on the shady side of the church. Was the stone from another building or did the builder get it wrong and it was supposed to be on the south side? We will never know for sure.

Fig. 1. The buttress on the north side of Litlington church, showing the dial positions.

Fig. 2. Makeshift gnomon for the north-west mass dial at Litlington. Photo at 6pm BST, 26 July 2012.

Much later, one summer day, my husband and I were walking in the area so I thought we would pass by Litlington so I could show him the dials. To our surprise, the sun was shining on the NW one. We put a stick in the central hole and took a photograph (Fig. 2). It was 6pm BST on 26 July and the dial was working perfectly. So maybe they were placed there intentionally for morning and evening use in the summer months. There is another north-facing mass dial at Firle church, about five miles from Litlington (Fig. 3). It is about 8 cm in diameter and the absence of a noon line indicates that it was always intended for this position. Thus north-facing dials could be more common than I first thought. Does anyone know of others or if they are specific to this region?

Fig. 3. The mass dial beside the north door of Firle church.

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MAPPING GRECO-ROMAN SUNDIALS USING GIS

SHAUL ADAM and JÉRÔME BONNIN

The aim of this article is to document a project of mapping of all the Greco-Roman sundials that had been excavated and found around the entire Roman Empire.

The sources which were used were:

1. The doctorate studies of Jérôme Bonnin, from the University of Lille, France.
2. Mapping of ancient sundials of Israel – Shaul Adam, Israel.
3. Mapping Software – ArcView, ArcGis (by ESRI[1]).

One day in the Spring of 2009 the first author (SA) received an email from an unknown person in France – Jérôme Bonnin – asking if I could help him with the mapping of Greco-Roman sundials which he was studying for his PhD. The contact was made at second-remove through friends in the BSS. It was clear that it would be a big task (though it turned out to be a huge task), but as sundial enthusiasts we loved the challenge.

GIS (Geographic Information Systems, *i.e.* computerized mapping) is based on the idea of multi-layer mapping, where each subject or geographic sector consists of a different layer (imagine a transparency of a series of feature maps over a background map – physical map, an aerial photo or satellite imagery, *etc.).* Each such layer has an attribute table 'behind' the scene, with the data for each displayed feature.

Subject layers can be anything from provinces, county and country boundaries *etc.*, cities and settlements, through water bodies and systems, to land parcels, transportation, communication, energy and other infra-structure feature, to forestry, geology, oceanography, agriculture, land and natural resources, wildlife, and, of course, archeology**.** Anything!

The first step was to find a GIS layer of the Roman Empire – the Roman province boundaries and the main cities. JB looked in France and maybe in other places in Europe, and SA looked in Israel and also sent a question to one of the most popular forums of GIS, but we both failed to produce any results.

The next approach was to find a background map with the Roman Empire boundaries which could be input and projected on to the world coordinate system in the GIS, upon which any other required layer could be produced. At this point JB produced two jpg pictures of maps of the Roman Empire with the province boundaries. These maps were small (scanned A4 sheets) but since that is what we had, we tried to input them.

The input method was to indentify many base points both in Google Earth and on the 'maps', finding the points' coordinates in Google Earth and using these coordinates to project the points in the 'map' until reasonable registration accuracy was obtained.

However, the resulting registration accuracy was poor and not satisfactory, so the work so far was discarded and we looked further for a better – more detailed – map of the Roman Empire.

Finally, a very good and detailed map (probably a scanned wall map) was found. SA downloaded this map and began the registration from the beginning, this time with many more base points and with a better accuracy in identifying and correlating the proper locations, both in Google Earth and on the map.

The outcome this time was quite satisfactory, with good accuracy and small tolerances (equal to the accuracy of the country layer supplied by ESRI) for the entire extent of the Roman Empire (and actually just beyond it), considering the actual geographic region registered. To clarify, the region is: the Atlantic Ocean to the west; Central Asia (and Hindu-Kush) to the east; the Sahara and Arabia to the south; and Scandinavia, the Baltic countries and Russia to the north. It is really a vast area.

Now we were ready to begin with the producing of the Roman Empire provinces. This was a huge task.

Working on the 'background' of the scanned map a new 'polygon' layer was produced. The boundary of each province was digitized according to the province boundaries. This was done for all the countries/provinces in Europe, North Africa and the Middle-East. The next stage was to produce each region as a different layer, out of its relevant provinces.

The final step of this stage was to produce a layer of the major cities in the Roman Empire, based on the scanned map of the Empire.

We were now ready to begin treating the sundials themselves. This chapter began with a long correspondence between us, starting with how to prepare JB's basic table (database) so that it could be imported to the GIS and produce a sundial layer for the map. It required organizing the database according to few rules, without which it could not be turned into a layer and displayed in true map, the aim being to display each sundial in the proper location where it had been found.

That is the first step. The second step was to meet the main aim of analyzing the sundials according to their types,

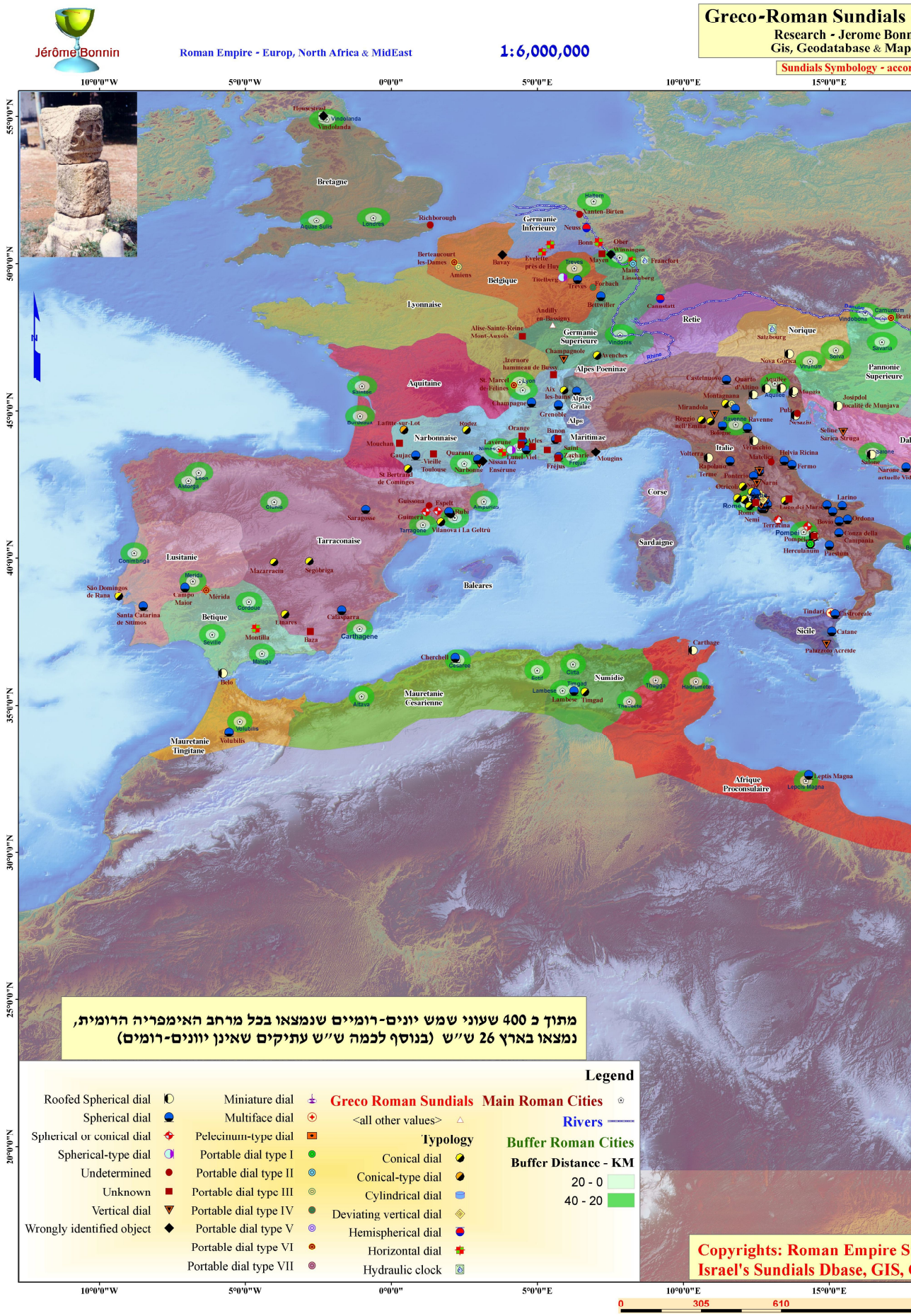
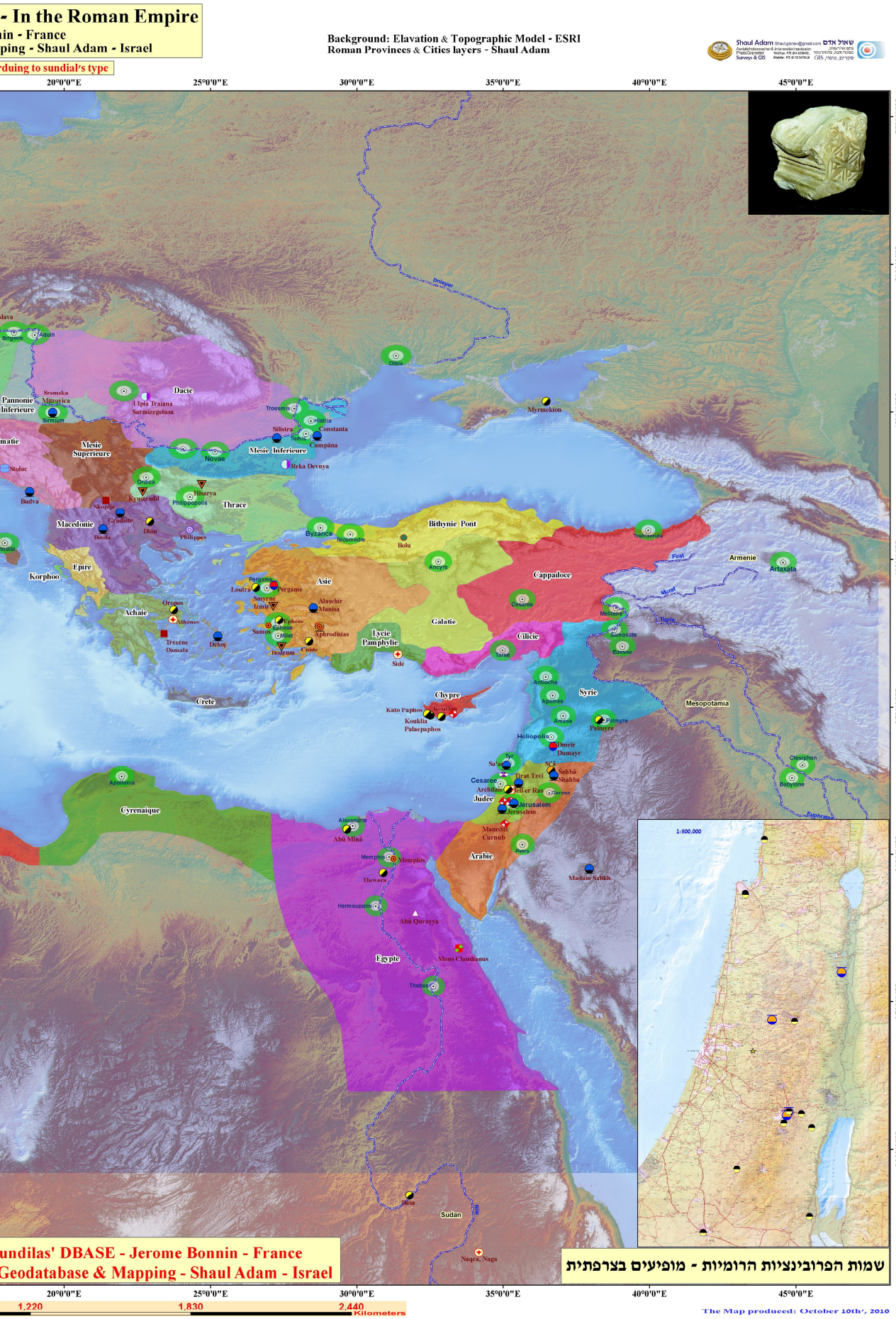


Fig. 1. The map which won the first prize in the Israeli ArcGis Users' Conference, 2010.
The labels in Hebrew are intended for the Israeli audience in the competition and are not very important to the map itself. They indicate that from more than 400 or so sundials (on the later version there are 563 sundials and 102 epigraphic references to sundials) 26 were



found in Israel. From these 10 were found within the old City of Jerusalem, most of them around the Temple mount.
The smaller remark explains that the province names are in French.

shape, periods and other characteristic criteria, in relation to the geographic location – region/province/state/current location *etc*., producing the relevant maps for display.

In October 2010 a first 'edition' of JB's database was at hand, and SA produced a corresponding first edition of the Greco-Roman sundial map. A few specific maps were produced suitable for Jérôme's thesis. But this was not the final stage: the database had been changed, updated and upgraded several times.

By Spring 2011 the final database was to hand. During the summer there was the marathon effort of reproducing the Greco-Roman sundial GIS and then producing all the maps that were required.

The final maps were produced in November 2011 (A0 sheets) in two versions. One was a general map with symbols for sundials in general and for epigraphs of sundials, and with labels of the sundials' catalogue numbers. The second map was also a general map with labels of the catalogue numbers for each dial, but in this map the sundial symbology was according to the sundial typology.

On 2 November 2010 SA had displayed the map (the 'first edition', Fig. 1) at a map competition during the Israeli ArcGis software users' conference in Tel Aviv (by 'Systematics', the ESRI representative in Israel) and won the first prize.

Finally, SA produced KML (KMZ)[2] files of the sundials and their epigraphs to upload on to Google Earth. These files can be requested from JB. The maps themselves are part of Jérôme's thesis[3] which was successfully examined in April 2012.

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1. ESRI, Environmental Systems Research Institute, San Diego, California, is the producer of the leading GIS software *ArcView*, *ArcPad* and *ArcInfo*.
2. KML (KMZ) – the format for mapping files which can be uploaded to Google Earth. Any user can upload these files and view all the information in the file.
3. J. Bonnin: *Horologia Romana, Recherches archéologiques sur les instruments de mesure du temps à l'époque romaine ; étude typologique, urbanistique et sociale*, [Horologia Romana, Archaeological Research on Roman Time-keeping Instruments; Typological, Urbanistic and Social Study], Unpublished PhD thesis, Lille 3, France (2012).

Shaul Adam spent most of his career in the mapping & surveying field (survey, arial photography and GIS). During the last decade before retirement he became an expert in GIS. Clocks, watches and navigational instruments have been a hobby since boyhood to which he added sundials in the late 1960s. He first became interested in ancient sundials, especially Greco-Roman ones, during the 1997 BSS Sundial Safari in Germany. He can be contacted at *shaul.gisnav@gmail.com*.

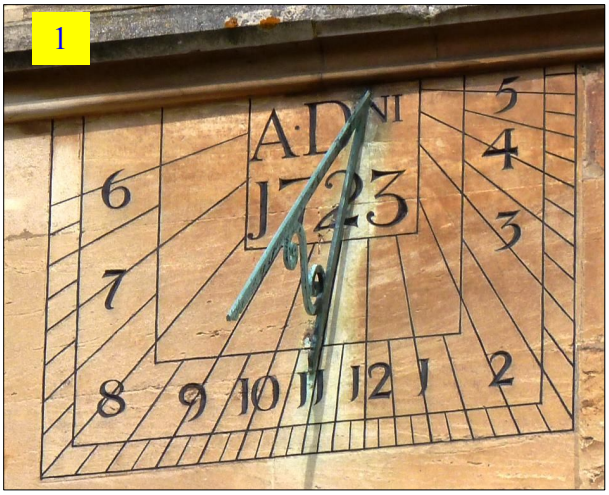
Jérôme Bonnin's (*jeromebonnin@laposte.net*) biography and portrait were published in *Bulletin* 23(ii), p.46 (June 2012).

NINE NEWLY REPORTED DIALS

JOHN FOAD

Thanks to a small army of regular reporters, previously unrecorded sundials of high quality continue to come to light. In the last few months I have received the following, as well as a number of good modern dials, and plenty of valuable second sightings.

1. A vertical on the tower at the east end of St George's Chapel, Windsor Castle, dated 1723 (previously known to exist but not reported) – SRN 7423. The remains of a second vertical can also be seen at the west end of the chapel.

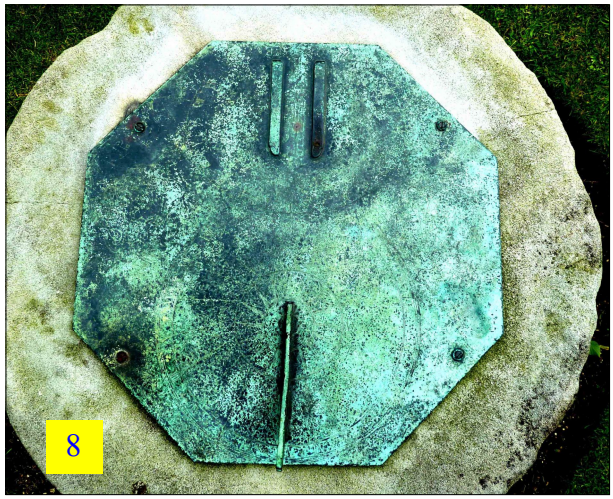


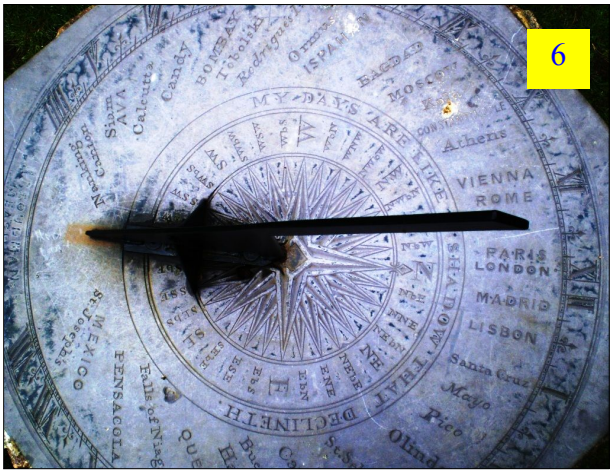
2. The cube dial at Restoration House, Rochester ("Miss Havisham's house" from *Great Expectations*) – again known but unreported – SRN 7420. The four dials face NE, SE, SW, NW, meaning that the four gnomons are pleasingly identical in angle. Scottish in style, but bought at Sotheby's in the 1990s, with no provenance.

3. A pre-1752 horizontal by John Davis of Windsor ("no surviving dials by him are known" – Jill Wilson's *Biographical Index*). Heraldic motto "Quo Fata Vocant". The provenance is under investigation, and more may appear in the *Bulletin*.

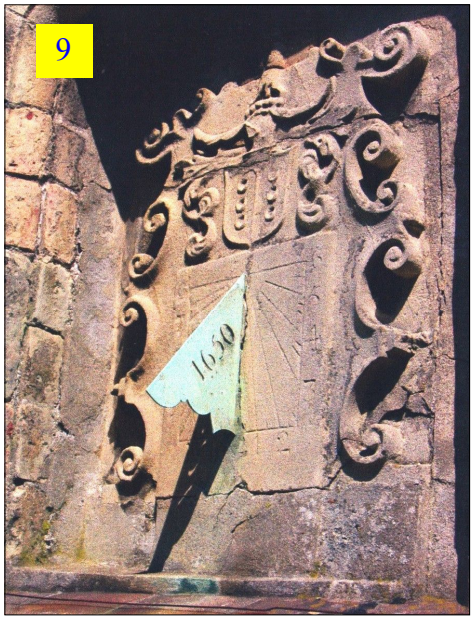
4. An 1837 cast metal vertical at Pudsey, W Yorks – SRN 7410. "WHSS" is for Woodhall Hills Sunday School. Around the four sides are many pairs and triples of letters, presumably the initials of individuals.

5. Another vertical in W Yorks, this one at Lumbutts and dated 1864 – SRN 7409. Signed J Whittaker and recorded in Gatty with its motto "How long is time learn thou of me / How fleet is time I ask of thee".





6. A slate geographical with 34 locations around the world, by Proudman of Measham, in Leicester Parks – SRN 7395. Said to be on its fourth gnomon, and still deserves a better one!



7. A wooden church vertical at Alderford, Norfolk - SRN 7384. The motto in relief "Redeem the Time" can still be read, but restoration is overdue. The good scrolled gnomon is cut from a thick metal plate.

8. A very unusual self-orienting horizontal at Burton Agnes, E Yorks, incorporating an analemmatic dial. This combination is not uncommon in portable dials, but I know of no other example in a fixed horizontal. Not yet properly photographed or researched.

9. A deeply carved and richly ornamented vertical at Lynton, Devon, with "1650" cut into the gnomon – SRN 7368. The true date is not known, but it is probably not later than 18th century.

BSS Newbury Meeting – 22 September 2012

Sue Manston

This year David Pawley organised the event (and the sunny weather) to coincide with the autumn equinox. Peter Ransom sent his apologies, so Geoff Parsons stepped in as MC for the day and started with a very warm welcome to some 30 members and visitors.

John Davis kicked-off by describing to us his *Mystery Welsh Sundial*. Acquired from an antiques dealer (for a reasonable amount after some lengthy negotiation), this very attractive brass dial has a thick plate with a good gnomon. It includes the equation of time, zodiac signs, the name William Hughes Bryngola Esq., a motto (Via Trita Via Tuta), a coat of arms and the date 1775. Unusually, it also includes transversals. So why the mystery? John could not find this maker's name in the lists of sundial, clock or instrument makers. Eventually his research led him to the Hughes family at the Bryngola estate in Anglesey. The back of the dial carries the name Owen, a known family of clock makers in North Wales who sub-contracted work to engravers in Liverpool. A prime candidate for the maker is John Owen (1719-1776) who would have made the dial for William Hughes.

A proposal for the *Romeo & Juliet Sundial* was explained by Doug Bateman. This very unusual dial has been designed by Valery Dmitriev of St Petersburg, Russia. Valery would like to install this dial outside the Shakespeare Theatre in Stratford-upon-Avon, and the relevant officials have already shown interest in the idea. Doug showed us photos of many of Valery's versatile dials with interesting and innovative gnomons. The Romeo & Juliet design is around 3 metres high, cut from steel, and casts a 'negative' shadow. There was quite a lot of discussion about the gnomon, with a few suggestions of how it could be improved. Doug would like to find a project manager who could take this forward. This would mean liaising with Valery, Stratford officials, manufacturers, funding sources etc. If anyone is interested in taking this on please contact Doug.

Kevin Karney presented a talk entitled *Getting the Numbers Right (or wasting valuable time).* We all know (don't we?) that the numbers on the dial – whether Roman numerals or Arabic numbers – should point to the origin of the gnomon. Kevin wanted to design the layout of the numbers using computer software so he could produce a photo-etch-ready design. He wasted much time trying Adobe Illustrator, Delta CAD, free software called Nodebox and learning a new computer language called Python. Another suggestion was CorelDRAW, though there was some debate about this. Discussion also ensued about preferred aesthetics – do you prefer your Roman numeral IIII to have each I pointing to the origin of the gnomon, or do you prefer them to be parallel? With the discussion on Bézier curves having left some of us bewildered, one witty member said they "had the time, but not the intellect" – a quip to which there was a murmuring of agreement from some of the audience!

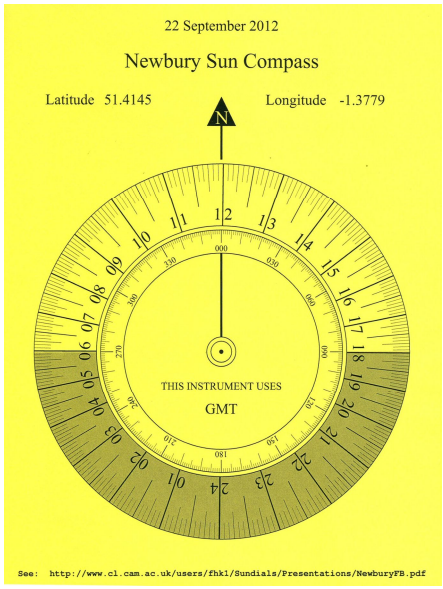
After a short break, John Foad described an on-going project to get a large proportion of the dials in the BSS Register on-line. Although the Register has previously been available only to members, the Society is planning to have easy, on-line access to many of the public dials – for example

those in parks and on churches. This amounts to about 3,000 dials to start off with. The first step, which John is undertaking, is to select which dials to put on-line. He would then like help from members to improve the description of each dial so it is more clearly understood by the general public. This can be done on-line, without needing to visit the dial; so if you would like to help by updating the descriptions for dials in your area/ county, then please contact John.

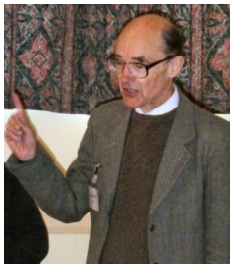
Bill Visick then showed us what the resulting website might look like. He

described some ideas of how each dial could be presented and asked for feed-back. The prototype system uses Google Maps and Street View. Bill demonstrated various filtering options which showed interesting (though not unexpected) results. For example, a map of horizontal dials showed they were mostly present in England, not Scotland; analemmatic dials mostly occur in Southern England; and multiple/pillar dials are concentrated in Scotland. Other refinements discussed included route planning, access by mobile devices and the ability for members of the public to add or edit entries.

After the Group Photo and lunch, the graveyard slot was ably filled by Frank King. His entertaining talk – *The Disposable Sun Compass* – was subtitled *A whole day's fun for no more than 5 pence.* We were all given our 5 pence worth in the form of a sheet of paper



with a sun compass designed for our immediate location, time and date. Frank designed this sun compass for members of the public who want to



build themselves a DIY sundial; it can be used to find the declination of a wall and it works for 1 location for 1 day – and then you throw it away. When asked to make a sun compass for every day of the year (which would cost £18.25) Frank came up with the more economic weekly version. This could be calculated for a Wednesday, say, when it would be exactly correct, and reasonably correct for 3 days either side (a bargain at £2.60 and saves on trees too!).

The penultimate talk was given by Michael Maltin on the subject of Sun Navigation. As a BA Captain he frequently found himself in foreign climes – between flights – with little to do. On one such break in Bahrain, Michael found himself a large piece of card, drew a circle, bisected an angle,

and with the help of two watches (GMT and local Bahrain time) he found his longitude and latitude. He bemoaned the fact that the skill of navigating by drawing lines on charts has, like Morse code, all but died out. We should pass this knowledge on to younger generations so it doesn't disappear forever. (I have a passion for hugging trig points, but that's another story .....)

Geoff Parsons gave the last presentation of the day on Mean-Time Sundials.

He took us through a history of Pilkington & Gibbs heliochronometers, the Pilkington Sol Horometer and the Homan heliochronometer, and showed us some fine examples from his own collection. Geoff demonstrated how each sundial worked, and described the pros and cons of each dial. William Homan was a South African who settled in Glasgow. His heliochronometer is similar to those made by Pilkington & Gibbs and it was manufactured around the same time, but it isn't known if he developed his design independently.

The day finished, as usual, with a tour of the many wonderful exhibits.

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Newbury Exhibits

(Above) David Hawker demonstrates his simple but ingeneous protractor for setting the gnomon angle. (Right) David found this dial plate in an antique shop. It looks to date from the early 1900s. But how did the gnomon/nodus work?

(Left) A slate polyhedral dial in the form of Kratzer's brass one for Cardinal Wolsey, by David Brown.

More pictures on page 33

BUILDING A SUNDIAL AT CHESTNUT COTTAGE

RICHARD and JUDY CECIL

We live in a rural part of Essex – Chestnut Cottage was aptly named: it had two large horse chestnut trees very close to our front door and also a young tree away from the house, nearer to the road.

The trees were not looking so well a few years ago and when examined by an arboriculturist they were considered a threat to the house.

We decided it was time to refurbish the driveway and front of the house. Going back to 1980 when we first moved in – we acquired a bungalow with only a parking space near the road and a pathway from the road to the house. Just what the removal men did not want to see! There was a lovely cottage garden but we needed a more convenient way to get in with a baby on the way...

We developed a gravel drive and the areas up to garage door and close to the house we made from concrete paviors 200 mm by 100 mm by 60 mm thick sitting on a sand bed on the previous construction. These fitted around the trees to allow some movement. However, by the turn of the century there had been significant movement which was another reason for redesign. So...

Surveys were done. Richard had worked as a civil engineer before becoming a physics teacher. Plans were drawn up for tree removal, taking up existing blocks and replacing with better drainage and some sort of feature – perhaps another tree – but further from the house – perhaps a water feature... We hired a theodolite and a staff and used it to do a tacheometric survey of the area in front of the house. One person holds the staff in a variety of places and the other records a horizontal angle as well as two readings from the staff. These latter two readings are based on sighting just above and just below the horizontal using two stadia wires in the instrument itself. The angle from the horizontal is the inverse tangent of one two hundredth, meaning that the radial distance from the theodolite is 100 times the difference between these readings. This radial distance with the angle gives a plan position. The mean of the two staff readings gives height information. It's a quick and easy way of doing a survey to determine a layout and plan a drainage arrangement.

Then the idea of a large sundial emerged. The civil engineering background dictated a need for concrete and steel – and a consideration for sufficient room for a road. Richard's father, who passed away in 1998, had looked longingly at our driveway and perceived a need to be able to turn around without reversing! This set a lower bound on the diameter for any construction. But you must be clear that kerb to kerb turning circle figures are not the same. Up popped the intersecting cords theorem to convert kerb to kerb turning circles and the wheel base into the minimum diameter of the roundabout. It proved satisfactory and I have yet to meet a small vehicle that cannot be driven around in one go! There are plenty of drivers who do not succeed though! So...

Fig. 1. The setting-out centre can be seen, marked by a plant pot.

We started by marking the centre of the circle. We hammered an approximately one-metre-long scaffold pole into the drive onto which we cast a concrete block and marked the centre with a nail. This became the centre of the circle and also defined the height of the plane of the finished surface. Judy was our early digger. She dug for new drains for both the downpipes from the house and for gullies in the new drive. We then laid edging kerbs across the front of the house.

The gnomon would be the feature – stainless steel, the hours would be constructed from concrete bays and blocks. More ideas then led to adding a polar version of the equation of time in coloured blocks so that those in the know could actually read the time accurately.

Then came the construction. But actually construction and design were to some extent concurrent! First remove the trees – not so easy – getting them cut down was OK – but removing the roots – with digger, ropes attached to car and pulling – digging by hand – all very dirty and hard work.

Fig. 2. We bought this digger and then sold it on after the project was complete. We also helped some neighbours with it too. It needed new tracks but not much else.

Lifting the original blocks, cleaning and stacking was easier – we employed some child labour – that is our adult children, at a price, I seem to remember.

We used a laser level and long tape for much of the setting out. The first laser level we bought was self levelling with three lasers pointing in broadly three directions and oscillating sending light across a horizontal plane. They are very effective particularly in an indoor environment. However since the plane of the dial was not to be horizontal (for drainage purposes) a laser that needed manually levelling proved a better buy – not very expensive either. But it was patient work finding the beam at the remote end particularly when the sun was shining in the same direction. We would set up the laser using the points we had already determined on the plane and then could readily get the level required for any other point.

We thought long and hard about how to construct the surface of the dial itself. Should we do it all in paviors of which we had some experience? That would require a lot of cutting of blocks. We did buy a block splitter but a cutting disc in the end proved more useful. However they can be dangerous. Our neighbour borrowed it and cut into his thigh fortunately missing all the key connecting organs but it was a scare. Or were there other simpler methods? We opted for marking the hour lines with paviors and infilling with concrete. We were careful when pouring concrete to ensure the lines of paviors either had concrete behind them already or had some aggregate compacted behind them as they are not very robust horizontally when just laid on a line of concrete. An advantage of this form of construction is that it provides for movement which will inevitably happen. This can come from thermal effects, from ground movement or even from traffic loading. Any construction that doesn't allow for movement will have it forced upon it in the form of cracks!

Fig. 3. The formwork for the base to the gnomon. Reinforcement, pieces of angle, drainage pipes, drain inspection chamber and the original setting out point for the centre which is there today though buried. The key worker is hard at it.

Fig. 4. Lining up the gnomon. A hammer is a plumb bob. The blue is a polythene sheet that acts as a slip membrane.

Then there was laying concrete. We did some ourselves – mixed it ourselves – very slow and hard work. A key point in the quality of that was to compact it properly. Since we had borrowed a whacker plate from a friend, who just happened to have one, we used that. It is important not to have too much water in concrete. The chemistry requires less than the requirements of workability so having a dryish mix and compacting it with a whacker plate worked well. However it was proving too arduous a task.

We decided to ask a local drive-laying contractor to put in some of the concrete for us. He did about a third of it and finished it very well. I (Richard) could not persuade him of the need, as I perceive it, to compact it thoroughly. So since we had phased the work to allow us regular access to the garage, when it came to the last part, we got a man with a lorry that mixed the concrete as it came off the back of the vehicle. It was still hard work to compact it (we hired a vibrating poker), place the reinforcing steel and then finish it to a level and with a reasonable finish. Consequently that part is not as smooth as it might be. We had some ready-mix delivered – then we had to work so fast to get it finished off before it set.

Friends helped, family helped...

Fig. 5. The finished sundial looking up the drive from our front door.

Then there was marking the position for hour lines of the sundial. Lying in the front garden at night trying to gaze at the pole star. But we couldn't! We hired a 20″ theodolite for a weekend and needed to determine north. Well, a theodolite will not point directly upwards and not even 50° up from the horizon so we had to sight on some stars with a lower altitude at the time. Coupled with a radio controlled clock we got some readings of a direction that was repeatable in day time and crunched a few numbers to determine north. We then used the theodolite to mark the positions of all the hour lines. Although the sun will never rise here before 4 am or set after 8 pm we decided aesthetically to have a full 24 hour lines with a corner on the two 12s and 6s to mark them out without giving the concrete a re-entrant corner to start cracking.

Then came the erection of the gnomon. We were just able to carry the gnomon by hand but to pitch it we tied it to the digger bucket near its centre of mass. We used eight pieces of M16 stainless steel studding between the flange cast into the base and the flange at the bottom of the gnomon itself and a series of nuts to allow adjustment. We did indeed need to buy a 24 mm spanner to finish tightening all the nuts once the position was settled.

Factors in the choice of design of the gnomon were that this puts the base virtually below the centre of mass and thus reduces moments on the foundation. It also meant that the centre point setting out mark could remain in place throughout the project and indeed it remains there to this day but is just buried in the flower bed we made. The gnomon does sway a bit in the wind. The soil around its base also serves to dampen this undesirable effect.

APPENDIX—Handout to Accompany the Dial

The Sun Dial at Chestnut Cottage

Coordinated Universal Time (UTC) [a time standard based on International Atomic Time (TAI) with leap seconds added at irregular intervals to compensate for the Earth's slowing rotation. Leap seconds are used to allow UTC to closely track UT1, which is mean solar time at the Royal Observatory, Greenwich.

The difference between UTC and UT1 is not allowed to exceed 0.9 seconds, so if high precision is not required the general term Universal Time (UT) may be used.

In casual use, when fractions of a second are not important, Greenwich Mean Time (GMT) can be considered equivalent to UTC or UT1. Owing to the ambiguity as to whether UTC or UT1 is meant, GMT is generally avoided in technical contexts.

Time zones around the world can be expressed as positive or negative offsets from UTC which replaced GMT as the basis for the main reference time scale or civil time in various regions on 1 January 1972.

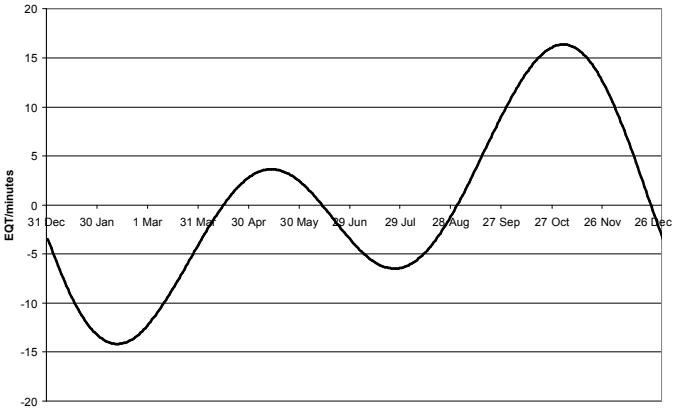
[The above paragraph is copied from Wikipedia.]

Local or Greenwich Time?

So when we designed this Sun Dial we had to decide what time we would aim to make it display. Since it is a Sun Dial, Local Solar Time seemed the most logical. Here at Chestnut Cottage we are East of Greenwich so the Sun goes over us just a little earlier than it does at Greenwich. The longitude here is East of Greenwich by approximately 33′ 00″. This means the Sun reaches here 132″ or 2′ 12″ sooner than it does at Greenwich. That is one correction that needs to be made so that the Sun Dial will tell the time.

Solar or Mean Time?

This is a Sun Dial so it seems reasonable that it show solar time. However our ordinary clocks show a Mean time. Hence Greenwich Mean Time. A mean time averages out the length of a day to be the same throughout the year. However the Sun is not so obliging. Sometimes in the year it takes less than 24 hours to pass over a point and at other times more. The difference between Solar Time and Mean Time is known as the equation of time and it varies throughout the year. The graph below gives a rough idea of its value which is more or less the same on a particular date. That will vary slightly because of leap years however. The cause of this difference is for two reasons. One reason is that the Earth travels around the Sun in a slightly elliptical orbit. In fact it is closest to the Sun at around Christmas time when it is going faster in its orbit both in speed and angular speed. The other reason is the inclination of the axis of rotation of the Earth compared to the axis of our orbit around the Sun.



You will see that the largest variations are nearly plus 16½ minutes at the beginning of November and minus 14 minutes in mid February.

Daylight Saving

Additionally in the summer we have a daylight saving time with our clocks running ahead of the conventional Greenwich Mean Time.

All 3 Corrections together

So as you look at the Sun Dial you can read Local Solar Time. To check if that is correct you will need to deduct from it 2 minutes for location (Local to Greenwich), the Equation of Time (+3¼ minutes on 22nd May)(Solar to Mean) and add 1 hour (GMT to BST when we are in BST). So if the Sun Dial reads noon the time on your watch should read 12:54:40.

Conversely if your watch reads 15:00 then the Sundial should read 14:5:20. I hope that it is about right!

Reading the time

The outer ring of markings represent the time with the hours marked off. Theoretically it is possible to see the sun from 4 am till 8 pm on the longest days but local obstructions will not allow the Sun Dial to be used to that extent. The hours of midnight, 6 am, noon, and 6 pm have an additional indication to help.

The inner ring represents the months and allows the value of the Equation of Time to be read off using the red blocks. The width of each red block represents one minute and a deviation toward the centre of the circle a negative equation of time, i.e. the Sun time gets to a particular value later than the clock. The division between December and January occurs in the same direction as midnight marking that point being a new day as well as a New Year.

Construction

The paving is about 125 mm of reinforced concrete on the original drive as a road base. The gnomon, that is the part that causes the shadow, is supported on a 1 metre square of concrete 300mm thick with a steel tube cast into it. The stainless part is secured and can be slightly adjusted using 18 M16 bolts.

There is a route through the tube to the house. The tube appears to have become the home for some birds!

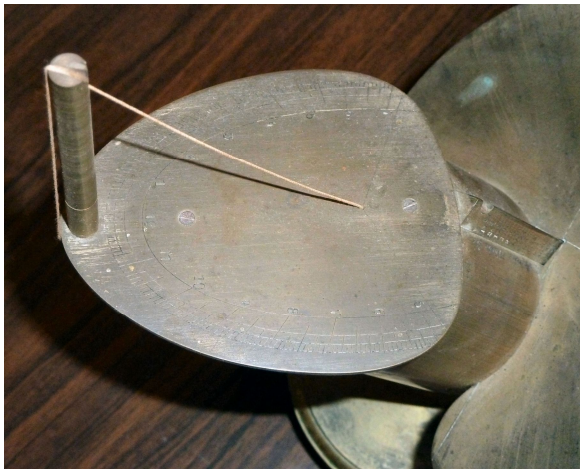
Richard and Judy Cecil met when they both read Engineering at Churchill College, Cambridge. Judy has since predominantly worked as a nurse. Richard has been an engineer and physics teacher. Their three children, now all adults, also went to Churchill College. They can be contacted at *cecil.family@clara.net.*

Newbury Pictures (continued from page 29)

Mike Shaw explains the Schmoyer mean time equatorial dial to a group including Ian Maddocks, Irene Brightmer and Frank King.

An attentive audience in the airy village hall.

Sue Manston discusses a helical dial with Chris Lusby Taylor.



This intriguing brass multi-dial was on display and warrants much closer attention. Would the owner like to describe it?!

THE RESTORATION OF A 19TH-CENTURY NOON CANNON SUNDIAL

MALCOLM BARNFIELD

Some months ago I was approached by a European collector of noon cannons to restore an example signed by Negretti & Zambra (N & Z). The marble dial was in good condition, complete with gnomon plus lens arm brackets but missing the lens, lens housing, adjusting arms and all screws. It had been purchased from eBay.

This collector already has two noon cannons that I made. One was site-specific to his latitude and the other a 'Butterfield', calibrated from southern Europe to northern Scotland. The enquiry challenged me so I readily accepted the commission. At first glace and having never seen the dial (it remained in Europe) this would seem to be a mission impossible but with some high resolution photographs and a few judicious measurements sent to me, the task is actually relatively simple.

Then with a little help from my friends and the web, I managed to get other good pictures of cannons from the period and earlier. Chris Daniel was kind enough to send me his Clocks Magazine[1] article on cannons which included pictures of the noon cannon he owned and Piers Nicholson's 'A Sundial Conceit'[2] article was extracted from the *Bulletin*.

Using all of this information then allowed me to scale the photographs and arrive at reliable dimensions for the European dial. The focal length of the lens thus became an arbitrary decision and using that length, the technical drawings could be made. Material thicknesses were closely estimated from the pictures to suit local material availability and then the parts were waterjet cut from solid brass. The lens housing, thumb-screws and nuts were turned from solid brass bar. See Fig 1.

Fig. 1. The brass parts made for the restoration.

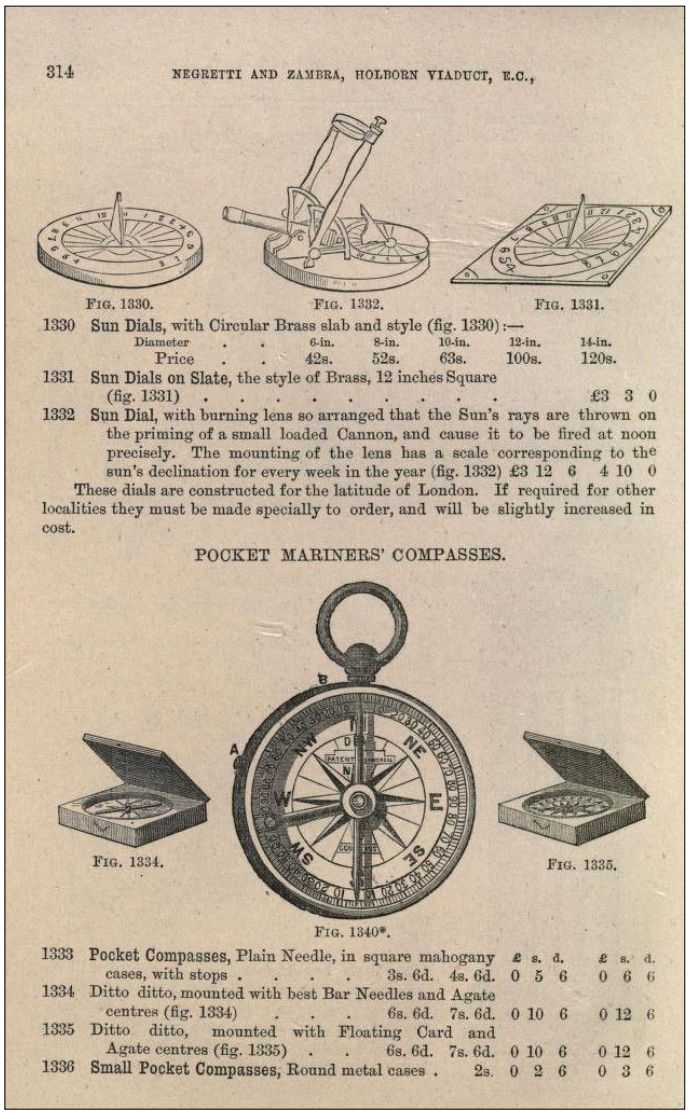
The gnomon angle indicated that the horizontal dial was made for the latitude of about 22° and it is inscribed 22° 35' 11". The clockwise hour calibrations and hour arc angles on the dial plate confirm this. So the sun was directly overhead of the dial twice a year. However there is an anomaly in the design. The hinge holes for the adjusting arms are 18 mm from the base plate whilst the height of the touch hole is 38 mm above the base. In my design that measurement is exactly the same so that when the arms are swivelled to accommodate the ever-changing solar declination, the concentrated beam of light from the lens, at its focal point, is always equidistant to the touch hole. I was never able to solve this mystery and taking into account that the minimum meridian solar altitude at that latitude is roughly 44°, this would have made the cannon difficult to fire during their winter, in December, and especially around the southern hemisphere solstice. The dial plate is calibrated from 4 am to 8 pm and this is odd for a location where the longest day is 13 hours and 31 minutes. There is no noon 'gap' on the dial since the gnomon is knife edged, a French pattern. The date scale inscribed in months and weeks on the western lens arm bracket is completely wrong and takes no account of the sun being directly overhead twice a year. It seems more appropriate for a latitude of about 43 degrees. If this scale had been followed the cannon would never have fired.

Again using the value of 22°, a Google™ Earth search of that latitude revealed that the dial could have been made for many former British colonies that straddle the latitude, particularly India and the New Territories of Hong Kong. The dial had come from an eBay company in India. No other history of it is known. It is inscribed in English so potential sites in Cuba, Mexico and North Africa seem unlikely. If the site for the dial was Hong Kong this would make the dial considerably younger than was originally thought since the New Territories were only leased from China for 99 years starting in 1898, but N & Z continued to operate into the 1950s so this may be possible.

So, was the dial actually made by N & Z? Philip R. Collins of Barometer World Ltd,[3] an expert on N & Z history, happily provided evidence that they were definitely supplied

by Francis Barker & Son (FB & S) and probably by Cealey, Wohlmann and Bradshaw too: both were English companies who made sundials from the mid-1800s onwards. Further confusing the source issue is the fact that the dial appears very similar to French designs of the time. N & Z were known to purchase from France from 1882 and onwards. Fig 2 is an extract from the 1886 N & Z catalogue which illustrates this point. The practice of selling goods made by others but signed for the seller was not uncommon then and the firm 'Liberty's' are known to have done the same. In addition, the Nicholson dial was made by FB & S and supplied to Abercrombie & Fitch in New York for the USA market showing that other English firms also exported. That dial is marked Abercrombie & Fitch Co. as are others. The Nicholson[2] FB & S English-made dial does not have the knife edged gnomon whilst the French-made Daniel[2] dial does but this could not be a clue to the real source of the dial under discussion since certain French makers like Victor Chevalier and his successors used both patterns. Thus the actual maker and date of this dial were never discovered and the possibility that N & Z made it themselves still exists.

Fig. 3. The restored noon cannon sundial.



314 NEGRETTI AND ZAMBRA, HOLBORN VIADUCT, E.C.,

FIG. 1330. FIG. 1332. FIG. 1331.

1330 **Sun Dials,** with Circular Brass slab and style (fig. 1330):—

Diameter	6-in.	8-in.	10-in.	12-in.	14-in.
Price	42s.	52s.	63s.	100s.	120s.

1331 **Sun Dials on Slate,** the style of Brass, 12 inches Square (fig. 1331) £3 3 0

1332 **Sun Dial,** with burning lens so arranged that the Sun's rays are thrown on the priming of a small loaded Cannon, and cause it to be fired at noon precisely. The mounting of the lens has a scale corresponding to the sun's declination for every week in the year (fig. 1332) £3 12 6 4 10 0

These dials are constructed for the latitude of London. If required for other localities they must be made specially to order, and will be slightly increased in cost.

POCKET MARINERS' COMPASSES.

FIG. 1334. FIG. 1335.

FIG. 1340*.

		£ s. d.	£ s. d.
1333	**Pocket Compasses,** Plain Needle, in square mahogany cases, with stops . . . . . 3s. 6d.	4s. 6d. 0 5 6	0 6 6
1334	Ditto ditto, mounted with best Bar Needles and Agate centres (fig. 1334) . . . . 6s. 6d.	7s. 6d. 0 10 6	0 12 6
1335	Ditto ditto, mounted with Floating Card and Agate centres (fig. 1335) . . 6s. 6d.	7s. 6d. 0 10 6	0 12 6
1336	**Small Pocket Compasses,** Round metal cases .	2s. 0 2 6	0 3 6

Fig. 2. Extract from the 1886 Negretti & Zambra catalogue. Courtesy of the University of California Digital Library.

My research into this topic indicates that noon cannons were fairly common and were manufactured in many countries – Britain, France, Germany, Italy, Poland, USA, Australia and South Africa to mention but a few – and they regularly appear for sale on auction web sites. Thus the real mystery here is why more of them did not survive through time? Of course these 'weapons' are illegal in some places so maybe people are not owning up.

Happily, when the replacement parts arrived in Europe they fitted the dial perfectly and both dial and cannon functioned but only after the dial was tilted up from north by over 30° to compensate for it having been made and calibrated for the latitude 22°.

A note about the lens is appropriate. It was made by Mark Burger of Independent Optics in Randburg, South Africa. His company specializes in spectacle lens manufacture and the measurement of a spectacle prescription lens is made in diopters. Diopter refers to the refractive power of a lens and is expressed as the reciprocal of the focal length in metres. This simple calculation makes life easy for those replacing a lens of any required focal length and for the lens maker himself.

ACKNOWLEDGEMENTS

Grateful thanks to Chris Daniel, Philip Collins, Tom Hughes, Jill Wilson and John Davis for freely supplying valid input and help in compiling this article.

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2. Piers Nicholson: 'Noon Cannons – A Sundial Conceit', *BSS Bull.,* 19(ii) (September 2007)
3. Philip R. Collins: *www.barometerworld.co.uk*

For a portrait and biography of the author, see *Bull.* 23(iii).
sundials@sundials.co.za

BSS SUNDIAL SAFARI TO CATALONIA

13-18 September 2012

This year our choice of venue for the Safari was Catalonia. Catalonia is an autonomous state and has nationality status. The principality of Catalonia was once much bigger but part of it has been lost to southern France. It is very proud of its heritage and although its inhabitants have to learn Spanish the preferred language is Catalan. The country borders France and Andorra to the north along the line of the Pyrenees. To the east is the rugged coast of the Costa Brava, to the west is Aragon and to the south Valencia.

We were based in the ancient town of Girona with its historic Jewish quarter. Among places we visited were Olot, the main town of the Garrotxa region. Olot is known as the city of volcanoes and is surrounded by 38 cones. We also visited Figueres, the birthplace of Salvador Dali, and Cabrils, an exceptional town of sundials. We of course visited Barcelona, the capital of the region, but you will read more of these in the following reports.

This trip would not have been possible without the great help from some of the members of the *Societat Catalana de Gnomonica*. We would especially like to thank Conxita Bou and her husband Carles, Francesc Clarà and his wife Maria, Andreu Majó who opened his private museum for us in Cabrils and finally Eduard Farré who escorted us around Barcelona.

Val Cowham

Dali's dial in Cadaqués

Figueres – Thursday 13 September

Twenty-eight BSS members, along with Carles Pelejero and his wife Conxita Bou, our guides from the Societat Catalana de Gnomonica, set off on the first day of the Safari to see sundials in the area immediately northeast of Girona. We were to be amazed at the beauty and number of sundials in this area, and its stunning coastal scenery.

The majority of the sundials seen were beautiful vertical dials, but in Vilafant we saw a modern pillar sundial in mild and stainless steel. It consisted of a vertical south-facing sundial at the top and near the base, an aperature which enabled a sunspot to be projected onto a horizontal sundial on the ground. This not only told the time, but also showed seasons of the year.

After a wonderful 3-course lunch in the largest fortress in Europe, Castel de Sant Ferran dating from 1753, we visited the fortress museum which housed an amazing display of 11,500 miniature cast lead soldiers.

Another highlight of the day was seeing the famous stone sundial carved by Salvador Dali in 1966, in the town of Cadaqués. Consisting of only a few very simple lines, a woman's face and hair are brilliantly depicted.

At the end of a busy but most enjoyable day, the members dispersed to various Girona restaurants to sample further regional culinary delights, in preparation for the next day's outing.

Martin & Janet Jenkins

Cabrils Sundial Museum – Friday 14 September

Leaving our hotel in Girona we made our way to Cabrils, a small town north of Barcelona where we were to visit the 'Museu De Rellotges De Sol' of Andreu Majó. On entering the lower section of Andreu Majó's house, we were greeted by an Aladdin's cave filled with sundials. On our left we were presented along the whole length of the wall with patterns of 5×3 ceramic sundial tiles two deep designed for outside use. The dials had no gnomons and each had a unique pattern and colouring.

A wall of tile dials in Cabrils Museum

Below these tiles were cabinets packed full of different type dials for inside use – universal ring dials, polar and diptych dials, all in metal. There were also reproduction dials of various types and sizes – large cylindrical and spherical, small rings and large circular polar dials. Three more cabinets showed a myriad of different dials including some paper kits for a digital sundial.

An interesting dial stood alone, with a spiral upright and a circular band and diamond-shaped gnomon.

We saw a remarkable sundial designed as a beach towel, in orange and blue. In the centre was a slot into which an umbrella could be inserted and moved along to the correct date to enable solar time to be shown – a longitude correction was also printed for various places.

Other unusual dials included a walking stick mounted with a small compass and gnomon – very useful if one gets lost on a long track in the wilderness. Also seen were:

- a watch strap with a dial and circular time base,
- a young boy on a see-saw with a fishing rod gnomon,
- a sailing boat with its large sail acting as the gnomon,

• a spherical glass sunshine recorder,
• paper dials,
• CD dials

and many more. A very lovely wall dial that caught the eye had a surround of fine brass filigree and a butterfly on the gnomon. We all enjoyed ourselves and thanked Andreu and his wife for their hospitality.

Leonard Honey

Cabrils Town – Friday 14 September

After the museum tour we visited a selection of vertical dials located on the walls of some of the villas. Cabrils has some beautiful villas and one we visited had its own private chapel. A vertical dial made with ceramic tiles overlooked the open eating area at Restaurant Can Rin where we had lunch.

One of the dials in Cabrils

Leaving Cabrils around mid afternoon, we travelled along the coast of the southern Costa Brava to the seaside town of Sant Feliu de Guixols. Situated on a building now used as an art gallery is an impressive vertical declining sundial. The sundial artwork shows two fishermen in a large mural made from ceramic tiles.

After a short stay we made our way to the next sundial location at the Monestir de Solius where we were shown two vertical dials, one fixed on the wall of a building forming part of a courtyard and dated 1752 with the motto 'Tempus Nostum Solius Sit' in brown artwork. The other was on the church tower of Santa Maria de Solius, octagonal in shape with the motto 'Ora Et Labora' and dated 1879. Before leaving during the late afternoon we were shown a selection of cribs depicting various scenes from the Bible.

On our way back to Girona we made a brief stop to look at a helical dial on the south side of Girona at Passeig d'Olot. Finally we arrived back at our hotel early evening.

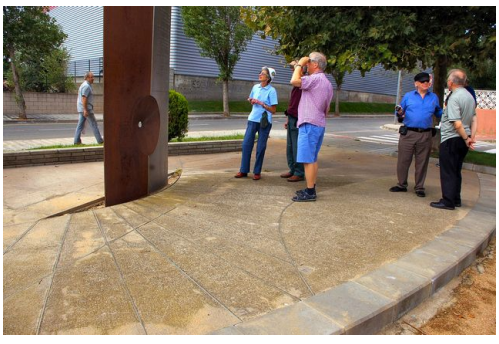
David Payne

Barcelona – Saturday 15 Sept

We met our excellent guide, Eduard Farré, vice president of the Societat Catalana de Gnomonica, close to an impressive spherical dial. It was a warm sunny day and the time was indicated as the shadow crossed a scale inscribed around the equator of the sphere. From there we moved to the beach to see a very interesting bifilar dial designed by Rafael Soler [see back cover]. The N-S gnomon was straight and horizontal but the E-W one was curved, allowing the ground level horizontal dial face to be much more compact than with straight gnomons.

The Castel de Montjuïc, with its commanding views over the city, has two well-restored eighteenth century dials and a very convenient coffee shop. Our next stop was to see a well designed analemmatic dial by Eduard and there were plenty of volunteers to be human gnomons. The Science Museum, where we had a good buffet lunch, also has a horizontal dial designed by Eduard. It has a large pyramid-shaped sheet steel gnomon with a slot for the hours around noon. It is the only dial I have seen where a notice discouraging ball games on the sundial might be appropriate.

Jim Marginson standing on the analemmatic dial in Maria Cristina Square



The dial at Vilafant

The Angels church had four vertical dials, one for each cardinal point and each with declination lines [see front cover]. Sant Josep Oriol church had a circular gold and white mosaic dial, and the Casa de les Punxes a very colourful tiled dial with many symbols, declination lines and an analemma.

Having spent a very pleasant day seeing this interesting selection of dials and thanked Eduard, our final visit was to Gaudi's cathedral, still being finished but a very impressive sight and an immense tourist attraction.

Tony Belk

Girona – Sunday 16 September

After all the activity of the last few days, it was pleasant to have a more leisurely start for our Sunday morning walk around Girona.

Guided by Mike, the first stop was at the History Museum, where a bemused assistant directed some 25 of us towards the vertical C18 dial, set high on the south wall of the inner courtyard. From here, it was a short walk to the cathedral, where two further dials could be seen. One dial was partially obscured by a superimposed modern clock face, a combination of old and new, with Arabic and Roman numerals. The other vertical dial was cut off by the angle of the wall.

Clock and dial at Girona Cathedral

Probably the most interesting dial of the morning was the scaphe dial at the Butinyanes Convent which, according to Sister Josefina, was made from local Girona stone and dated from the late C17. The gnomon had been replaced by a simple metal bar for protection and for many years the dial had been planted with pots of flowers. Some members then spotted two further small dials on the stone, one behind and the other below the scaphe. A glimpse inside the richly decorated C19 convent chapel was an additional bonus.

The scaphe dial at Butinyanes Convent

After this, the more energetic members of the party walked towards the medieval walls, when our leader spotted a semi-derelict dial, unknown to us, on the face of what looked like a church tower. Following coffee and a steep climb through a somnolent suburb, we arrived at two further vertical sundials, both on private houses, made up of large white tiles and yellow smiley sun faces.

During the afternoon, we all pursued our own interests before meeting up again for the evening meal.

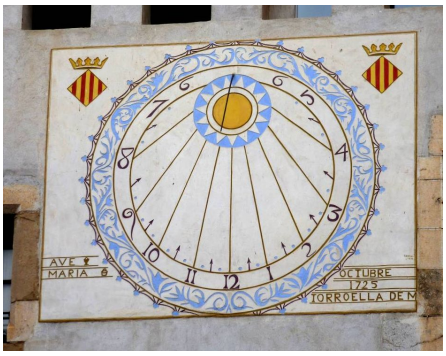
Carolyn Martin

Torroella de Montgri – Monday 17 September

Day 6 of the Safari and once again a busy day has been planned for us. Grey skies and some rain greeted our early morning start to explore the central area of the Costa Brava region. Our hosts Carles and Conxita were again able to join us for the day and to explain the area and the dials we were to visit.

The coach-drive took us through the rugged countryside of this area to Palau-sator, to view a fine dial with geometric decoration and the motto 'Només compto les Hores Serenes' (I count the peaceful hours), set above the entrance to The Tower of the Palace at the old 10th/11th century castle. Unfortunately, the nationalist flag of Catalonia had become misplaced on its halyard and was languidly obscuring much of the dial. However, the occasional gust of wind allowed most of the dial to be seen now and then. There was time for refreshment in the nearby cafe or a wander around the old town before returning to our coach and on to our next visit.

The popular holiday resort of L'Estartit was the next stopping point with three interesting dials to visit. First, a large but simple circular dial on an old farm-house close to the Castell Montgrí camping site and then two in the town itself. The painted dial on Roberto Restaurant by the sea-front, was from 1918 and decorated with a blue floral border and a symbolic Costa Brava cockerel below. Within the town, the shops still busy with last-minute holidaymakers, a simple dial (with the local latitude and longitude shown) is painted on the Perola or Clock Tower of the Houses of the Americanos. The Perola is the place where the local fishermen dyed their netting and a cartoon painting below the sundial illustrated these associations.



A dial at Torroella de Montgri market

Our next visit was to the town of Torroella de Montgrí to see a very large south-facing 'sgrafito' dial overlooking the bustling market place, the stalls offering a wide selection of local produce. The circular dial has a radiant sun below the gnomon, a blue floral surround and is dated 1725. At the church of Sant Genis the remains of two vertical dials were visible high up on a buttress.

Lunch had been arranged at the Palau Lo Mirador Restaurant where an extremely decorative ceramic dial was to be found in the courtyard. With the motto 'Docet Umbra', the hours are recorded from 7 am to 5 pm and the centrepiece shows two cherubs placing flowers in a huge vase. The spandrels include the moon and stars, a blazing sun-face and winged cherubs at the lower corners, but sadly the dial's gnomon is missing.

Martin Jenkins and Mike Cowham Inspect the dial at Torroella de Montgri

La Bispal d'Empordà antique shop

Lunch in the restaurant was most welcome following the activities of the morning. In the light and dreamy atmosphere of the dining room an extensive three course menu had been specially prepared for us, with further choice being available within each of the courses.

In the town of La Bispal d'Empordà, which had a large French settlement in the 1780s and was occupied during the Napoleonic period, there were two sundials to examine. Set into the front wall of an antique shop in the main street, a large concave smiling-faced sundial greeted us with its surrounding hour numerals made of small glazed tiles. Having such a cheerful face made this dial rather appealing. Nearby in Plaça Jacint Verdaguer was an attractive surround in the classical style painted directly onto the upper wall of a building. A gnomon was fitted, but no hour lines or numerals were to be seen.

At Monells a simple square stone sundial overlooks the central area of the old village. This area is bounded on all sides by stone buildings, many having arched supports below, enclosing covered storage areas. An interesting bowl, made of stone, and dating back to ancient times, is still set into the walls on the south side of the square. It was used for measuring grain.

Our final visit of the day was to the village of Flaçà to see a fine stone sundial on the church in the Plaça de L'Esglesia. Perhaps recently restored, it has a sun-face at the centre, Arabic numerals and floral decoration at the corners. Returning to our coach for the journey back to Girona we passed another fine dial on a house in the Carrer Les Feixes. South facing, it is marked with the dates 1596-1988 above and Can Silvestre below.

For your scribe, a full and satisfying day with many interesting places visited

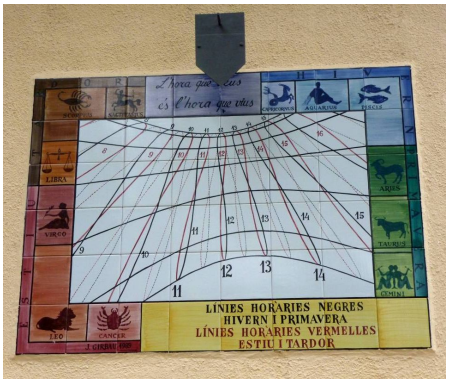
and dials seen. Particularly memorable though, the tiled dial at Palau Lo Mirador and that on the antique shop in La Bispal d'Emporda, both typifying the ceramic art work of the area. And of course the memorable and relaxing lunch at the Restaurant Palau Lo Mirador.

Ian Butson

Olot area – Tuesday 18 Sept

The last day of the tour took us away from the fertile fields between Girona and Barcelona to travel inland to the narrow wooded valleys of the Garrotxa area. The region is noted for its numerous extinct volcanoes and part of one village is perched on a cliff edge of basalt columns. The weather changed too, with an overcast sky and the local mountain tops (about 500 m altitude) were shrouded in cloud.

The BSS group at La Vall de Bianya near Olot



Analemmic dial in Sant Joan les Fonts

The first dial of the day was, to me, the most rewarding because it is a mean time dial very similar to dials of this type which I helped to restore and which brought me into the field of sundials! The dial is on a privately owned house in the village of Saint Joan les Fonts, and designed by a professor Joan Girbau in 1989.

La Val de Bianya

The lines are precisely delineated with dotted analemmas for the half hours. The lower text instructs to read the black curves in the winter and spring, and the red in summer and autumn, whilst the upper translates as 'The time you see is the time you live' or in other words, the time you are seeing is the time on your watch.

Our next stop was outside a very handsome villa in La Vall de Bianya, and although we could not gain access, modern telephoto lenses make up for this to reveal a dial part sgrafito and part in relief – truly a work of art. Neither were our stomachs neglected on this tour with many excellent meals, and in the town of Olot we had a choice of regional cooking such as pork cheek with sausage, or cuttlefish in a cream sauce. The town made us welcome with a brief introduction to the area by the deputy mayor in the council chamber.

An afternoon stop was in Les Preses, with an old dial with acanthus-like scrolls and a 'sun' face, and dated 1900. A further stop was made in another of the small charming courtyard style villages with a few dwellings surrounding a paved area and a water pump, in this case, Sant Privat d'En Bas.

The final two dials of the tour were in the extremely attractive small town of Besalú with its narrow streets and medieval bridge. One of the dials was rather neglected whilst the other was on the wall of a hotel, elegantly painted on tiles but with the gnomon at a rather unfortunate angle. If the dial is as painted and fired in 1880 then the dial face is in remarkably good condition.

Mosaic tile dial in Besalú

Our hosts Carles and Conxita

Finally, what better to conclude with than a photograph of our local hosts, Carles Pelejero and Conxita Bou, members of the Catalan Sundial Society. Those with good memories will remember them from the Oxford conference in 2004. And of course the very last words must be an appreciation for the enormous amount of work that Mike and Val Cowham have done to arrange and coordinate such a wonderfully successful Sundial Safari.

Doug Bateman

[Photos from Mike Cowham, Robert Sylvester, Doug Bateman and Ian Butson.]

THE CELTIC QUARTET RE-VISITED AND AUGMENTED

TONY WOOD and JOHAN WIKANDER

A previous article on '*A Celtic Quartet*'[1] has described four related dials. The dials were regarded as 'mass dials', that is, medieval dials with a uniform 15° hourly delineation and no evidence of a polar gnomon. They were unusual in not being carved on church walls but on separate pieces of stone. Three of the dials had numerals round the circumference with a remarkable similarity between those on the dials from Cornwall and Ireland. The supposition is that the dials were mounted on the church walls or window sills, (pedestals appear to be a later introduction[2]). The Welsh example was indeed so-mounted up to the early 20th century.

It is worth mentioning that an alternative explanation for these dials has been advanced – that they were equatorial and mounted at an appropriate angle with a rod gnomon passing through the central hole.[3] So far there is no corroborative evidence[4] although a well-attested equatorial dial, carved from a block of stone, has recently been discovered at a monastery site in Bristol.[5]

Now a further very similar dial to the original four has been discovered, this time in Norway (Fig. 1). The similarity to the Irish dial (Fig. 2) is remarkable, being in slate also, marked for horizontal setting and having numerals and hour lines at 15° intervals through the full circle. However, the numerals are 'Arabic' and there are half-hour lines also.

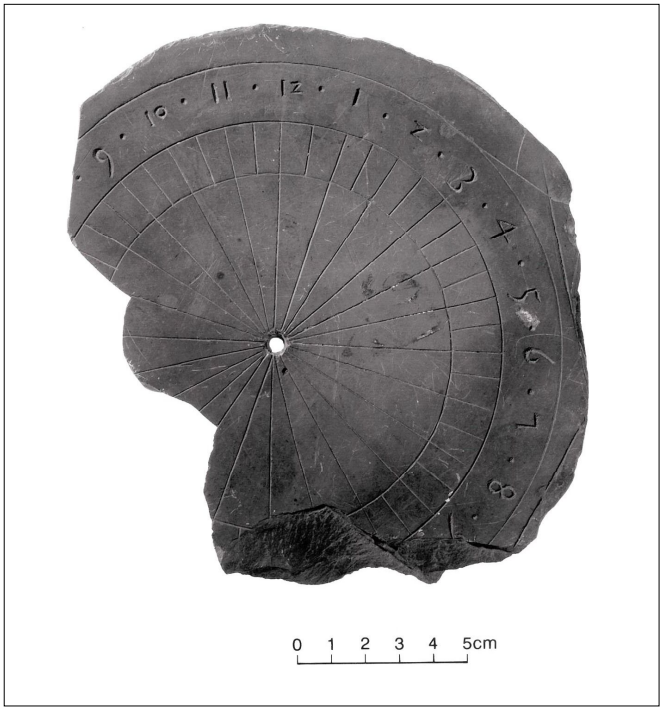


Fig. 1. The Vardøhus dial.
Photo: Adnan Icagic, Tromsø University Museum.

The dial was found at Vardøhus, a fort built in the Middle Ages (c. 1300) in northern Norway, above the Arctic circle – in fact at 70° 30′ N. It is made of slate, most probably from the local source at Finnmark. The outer circle of the design has a diameter of 166 mm. Tromsø Museum currently has the dial on display. It is possible to obtain a dating for the dial from the style of the numerals: a date range of 1480–1550 has been proposed by Wikander.[6,7]

The similarities between the Vardøhus dial and members of the 'Quartet' lead us to search for connections. There was in fact a regular trade with England as the English-Russian Company was founded in 1554 and used Vardøhus as an intermediate port as it had a good harbour.[8]

There is a general 'maritime' connection between most of the dials concerned. Trading between Scandinavia and Britain was mainly to the north in Scotland and then round to Ireland. In Cornwall, all principal transport was by sea and trade with Ireland was relatively well established, probably from Roman times or before. The dial at Wickhampton in Norfolk, a late addition to the Quartet on account of its 'secretary hand' numerals and full circle delineation, is at an east coast inland port with Scandinavian/Norse connections.

Our original quartet has now grown to six or seven examples. It is speculated that one reason for the wall mounting of the Cornish dial was the difficulty of carving the local granite with a manuscript hand! The difference between the

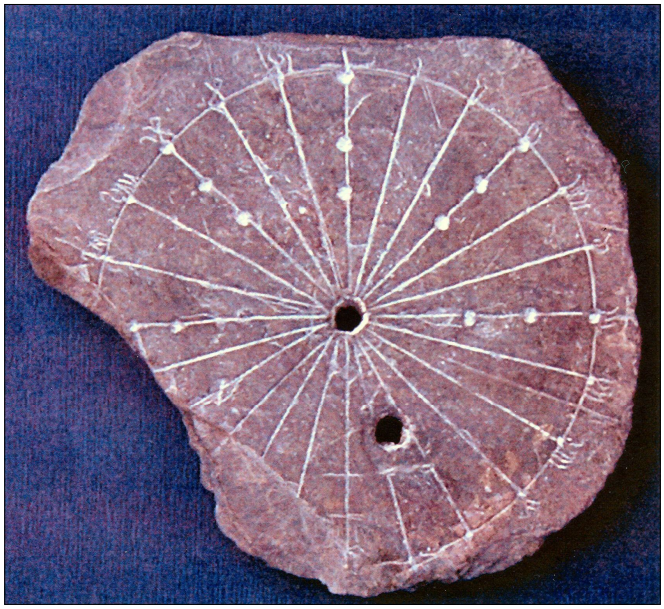


Fig. 2. The Bremore, Balbriggan (Co. Down) sundial.
Photo courtesy of Finola O'Carroll, CRDS Ltd.

vertical and horizontal setting of the dials is probably a reflection of local usage; in the north it is more convenient to have a vertical gnomon on a horizontal dial surface. The Vardøhus dial actually recorded all 24 hours at some times of the year. Other horizontal dials occur in Ireland and Scotland on cloister sills and cross bases, the conventional vertical mass dial being very rare. Local usage in England would certainly be a vertical dial with a horizontal gnomon.

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HELICAL SUNDIALS

I have recently become the temporary guardian of a helical sundial made by our late member Aylmer Astbury who lived near me in Suffolk. It has been generously donated to the Society by Aylmer's son Michael.

It consists of a 1" wide brass strip wound into a helix with a row of small holes along the centreline to mark the hours, with punched numbers on both sides of the strip. At the equinoxes, the terminator shadow runs perpendicular to the edge of the strip but at other times of the year it is at an angle—this is the reason that the hours are marked by dots rather than lines. The helix is supported at the latitude angle by an adjustable support which clearly had an earlier life with a different function. This is mounted on a polished slate base with green baize underneath.

The dial will be the subject of a sealed-bid auction—send me your offers before the Edinburgh Conference.

It is now 20 years since Allan Mills wrote on helical dials in the *Bulletin*,[1] explaining that they are a form of equatorial dial. It seems likely that Aylmer read the article and decided to make one for himself. Allan described two types, one which used the terminator of the helix's shadow to indicate the time (like Aylmer's) and the other with the helix arranged around a separate rod gnomon. Being equatorial dials with equi-spaced hour points, both designs of helical dial can be adjusted for longitude and the Equation of Time by rotating the helix appropriately on its axis. In Aylmer's example, this is readily achieved because the helix has a stub axle which fits accurately in the machined brass block at its base, though there is currently no scale to assist in the setting.

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John Davis

Mosque of Uqba

This rather interesting picture was taken by our correspondent Andrew Stroud on holiday in Tunisia, at the Mosque of Uqba, also known as the Great Mosque of Kairouan (a World Heritage site). The mosque dates back to 670 AD but the dial, showing the times of prayers, is more modern, from 1843 (or 1258 AH). It is in the centre of the courtyard, accessed by a small stairway and is engraved in an Arabic script of the *naskh* style on a marble slab. It was designed by Almed Essoussi, inspired by the famous dial of Ibn al-Shatir in Damascus. This dial, though, does not have the polar-pointing style but has four separate point gnomons. The courtyard also has a small vertical sundial with a similar style.

JD

SECURE FIXINGS AND FASTENINGS FOR SUNDIALS

TONY MOSS*

**Retired sundial designer/maker/installer*

Fig. 1. The dial at West Boldon before restoration.

Vertical sundials of yesteryear were often of stone or slate with a blacksmith-made wrought iron gnomon set into a hole filled with molten lead. Iron and lead are close together in the 'galvanic series' and so should be almost immune from bi-metallic corrosion.[1] That may be so but evidence suggests that decay by simple rusting away of the iron was sufficient in itself given time.

Fig. 2. The remains of the lead plug holding the gnomon on the West Bolden dial.

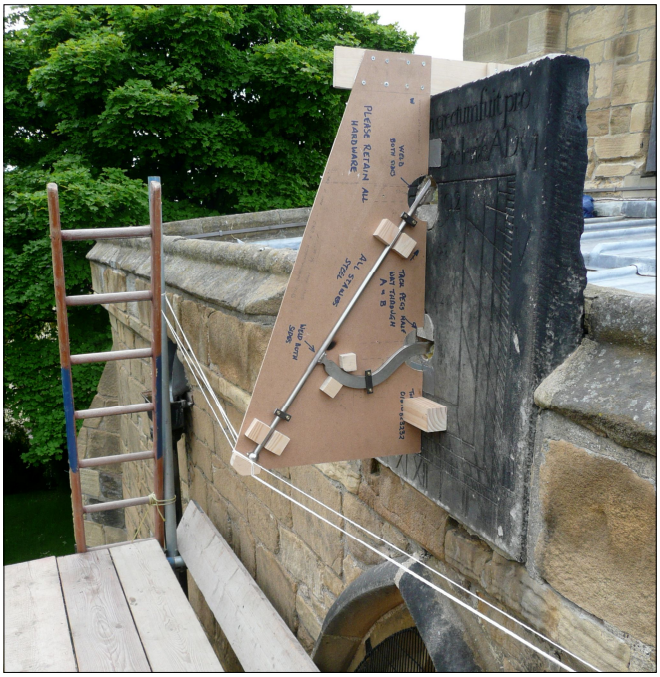


Fig. 3. The replacement gnomon and jig in position.

During 2008 I was asked to replace the gnomon on the church of St Nicholas in West Boldon.[2] What appeared to be remaining iron stumps set in two *huge* lead-filled cavities (Fig. 1) proved to be mere shells of crumbling iron oxide. The iron gnomon may have succumbed to rusting but the molten lead bedding proved its effectiveness by fighting my attempts to remove it to the last atom despite my using special chisels I made for the purpose (Fig. 2).

Fig. 4. The root of the gnomon during fixing, with a shaped piece of stone inserted for a trial fit.

A replacement gnomon in S316 stainless steel was designed with reference to a blurred image in an old wedding photograph but, as the stone dial was to remain undisturbed, molten lead could not be contained in its vertical cavities. The actual fixing was left to the stonemason approved by the church authorities so my contribution ended with an MDF 'jig' (Fig. 3) which would hold the gnomon rigidly in its correct alignment while the stonemason inserted shaped stone blocks secured with special acrylic paste. As with my usual practice, cross pegs can be seen in the cavity to ensure retention (Fig. 4).

A Sundial to Celebrate 100 Years of Rotary in Melton Mowbray

"It's a waste of money! It'll be in the river in a week."

So said a council representative when a centenary Rotary sundial on the grassy banks of a canal in Melton Mowbray was proposed. This wasn't the only objection because the local vicar, then currently chairman of the Rotary Club, said any such spare money should go to 'good causes'. However, money derived from 'grants' can't be directed to such things so a suitable scheme was proposed with clear community benefits *viz.* the proposed sundial would be placed in a 'socialising and educational area' with seats for adults and children where young families could meet to converse while experiencing the wonders of telling the time by the Sun. The ecclesiastical brow cleared at this attractive prospect. (Fig. 5)

Fig. 5. The completed dial with compass-point seating and a temporary sandstone top.

Fig. 6. The cast stainless steel gnomon and its wooden pattern for the Melton Mowbray dial.

Fig. 7. Mike Shaw adds extra weight to the dial, now fixed on its granite-topped pedestal.

In an area where a recently-built wooden skateboarding park had been vandalised and destroyed with *chainsaws* this was going to be a challenge! In brief, the solution was a 48" diameter dial plate in 10 mm thick stainless steel (bend *that* if you can!) and a massive cast and machined stainless steel gnomon with two 1" thick 'tenons' projecting 12" from its base. The tenons have cross-bolting at their tips (not shown in Fig. 6) to make extraction almost impossible from its masonry plinth which was finally topped with Chinese granite and Mike Shaw (Fig. 7). Certainly the dial could be defaced but perhaps only with sledge hammers. Inauguration was on 10 March 2003 since when I've had no reports that it is '*in the river*'.

Fig. 8. The Gosforth dial.

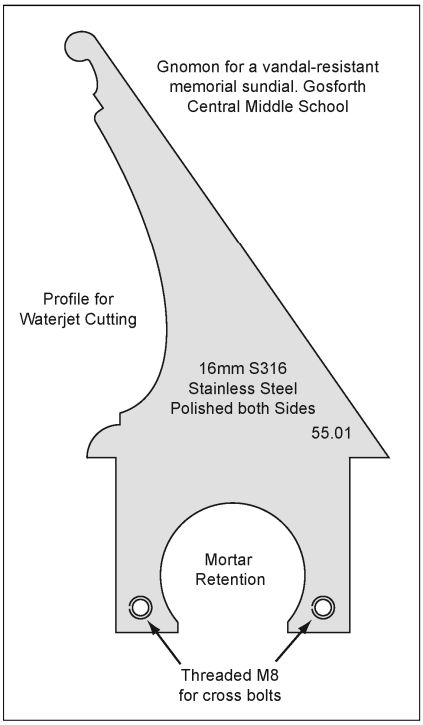


Fig. 9. The design of the gnomon for the Gosforth dial, showing the long tenon to retain it in the pedestal.

The Melton Mowbray dial used cross-bolting of the sub-gnomon tips to aid retention in mortar but alternatives can be designed into the actual gnomon profile as in the memorial dial for a Gosforth pupil which had been cruelly stolen. A sturdy replacement with a chunky gnomon was requested (Figs 8 & 9).

A medium-sized dial with a thinner plate *e.g.* 500 mm diameter × 5 mm thick metal, with the sub-gnomon bedded in mortar as above, could be attacked by levering the plate edges upwards. Complete removal would be unlikely but the subsequent damage would disfigure the dial. Insetting the plate into a shaped hollow discourages the insertion of a

Fig. 10. The pedestal at Lower Worsall near Yarm, recessed for the dial.

Right (top to bottom)
Fig. 11. Dial at Lower Worsall as installed.
Fig. 12. Worsall dial in place after 9 years.
Figs 13 &14. A replacement dial for Crowton in Cheshire re-created from a fuzzy wedding photograph, shown during fitting and again nine years later.

Fig. 15. The instruction leaflet for assembling a large bronze dial, showing the various retaining fixtures.

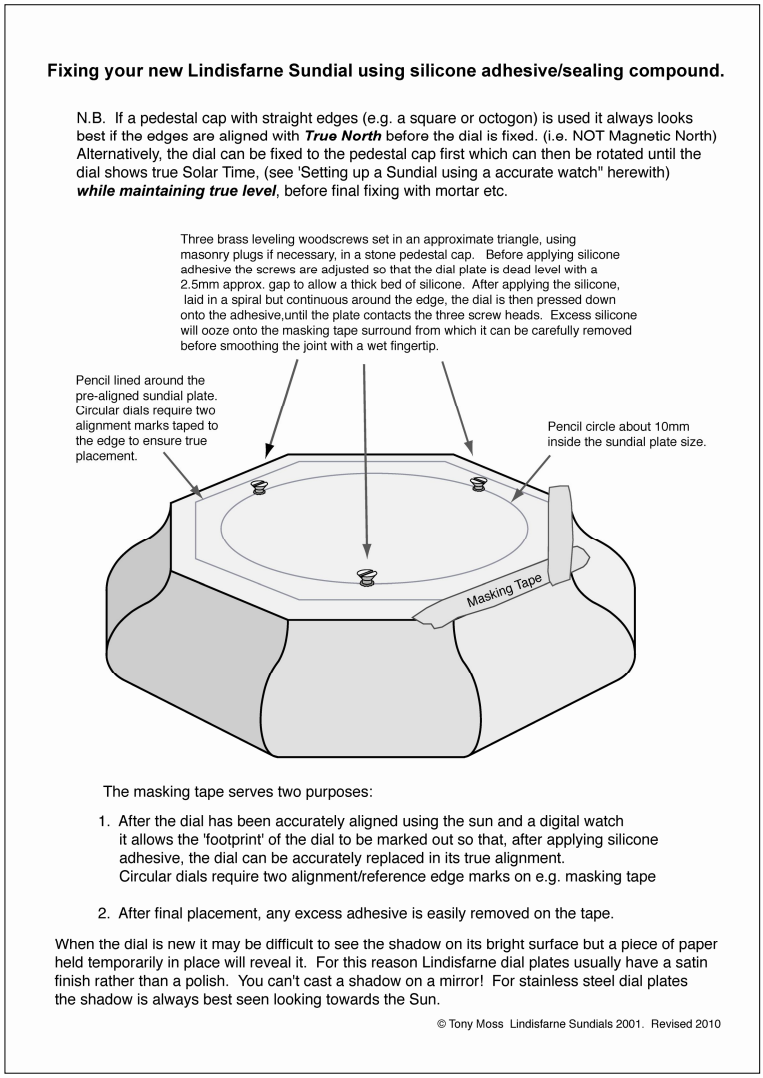


Fig. 17. Instruction leaflet for small dials using silicone as the adhesive.

Fig. 16 (below left). The dial of Fig. 15 and its fittings packed for transit to Canada.

levering tool under its edges. (Fig. 10.) With the peripheral gap filled with silicone, the whole assembly can be effectively weather proofed too. (Fig. 11.)

If the dial plate is thick enough (4 mm minimum plate thickness I would suggest) to accept a series of threaded holes near the rim, then retaining bolts, embedded in mortar or silicone, can be inserted from below. These look best with slightly rounded tips set flush with the plate upper surface. This visual evidence of extra security might well deter any attempt at removal of the dial if the object is theft for sale. No 'steal-to-order client' would want a seriously damaged sundial (Fig. 15).

Securely Fixing Small Dials

My usual procedure for small dials (*e.g.* those under 300 mm diameter) is outlined in the information sheet I supplied with my sundials (Fig. 17). This ensured the essential levelling and secure fixing in one operation.

After 15 years of commercial dial making the only known damage to any of my dials was caused by vandals setting fire to a wheelie bin in the middle of a mosaic analemmatic made in collaboration with a local artist.

REFERENCES

1. See www.corrosion-doctors.org/Definitions/galvanic-series.htm
2. See www.stnicholas-westboldon.org.uk/page_1216556069794.htm

Following a career in school teaching and teacher training centred on Design & Technology, **Tony Moss** set up Lindisfarne Aviation Ltd as a senior inspector and repairer of airframes. After a second retirement he established Lindisfarne Sundials, designing and making 150+ instruments for locations from Hong Kong to Vancouver Island. He was awarded the NASS Sawyer Dialing Prize in 2005. He can be contacted on *lindisun189@gmail.com.*

UTILE ET DULCE

ALEKSANDR BOLDYREV

In Russia there are wonderful translations of the books by Lewis Carroll. But it is not easy to find someone in Russia who is not only fluent in English but is also a fan of Lewis Carroll. I was lucky to meet such a person. One day a young lady came to my studio to look for a sundial for her garden.

For many years one of the walls in my studio has been decorated with a picture you must have seen a thousand times (Fig. 1). "Oh my God!", the young lady exclaimed, "it is a drawing by John Tenniel, Lewis Carroll's friend. This is exactly what I would like to have in my garden."

An exceptional customer! Even I did not know the name of the artist who drew this picture. It would be extremely pleasant to work with such a customer, I thought. Besides, you see, it is not every day one has the opportunity to work in collaboration with such a famous artist as (Sir) John Tenniel (1820–1914). I cut the pedestal of limestone. I think that my co-author John Tenniel would have approved of it. The pedestal height is 1100 mm. I usually make sundials with a diameter of 300 mm. But not this time: my customer demanded that the diameter should be exactly equal to one English foot (304.8 mm).

Fig. 1. John Tenniel's illustration for 'Jabberwocky'. Note the fluted column of the pedestal.

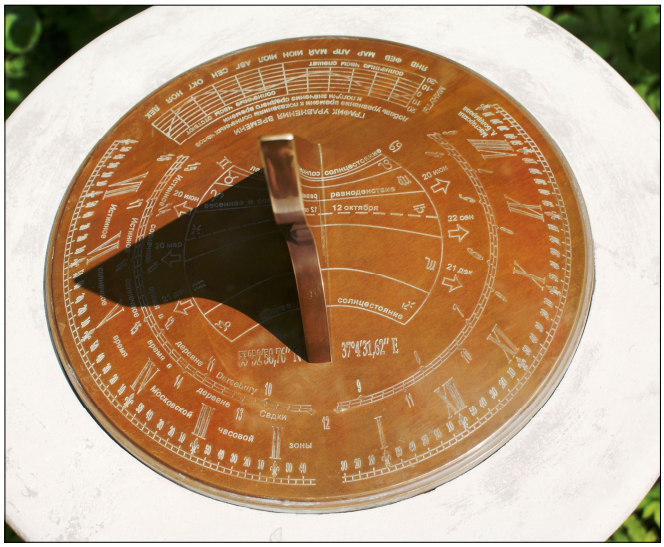
This sundial is set not far from Moscow. It measures the local time and the time for the GMT + 4 time zone. One of the scales measures the true solar time on the meridian of a small village Darsebury, Lewis Carroll's birthplace. The motto is *Utile et Dulce*. My highly enlightened customer says that this motto is invented by Lewis Carroll himself.* I believe her.

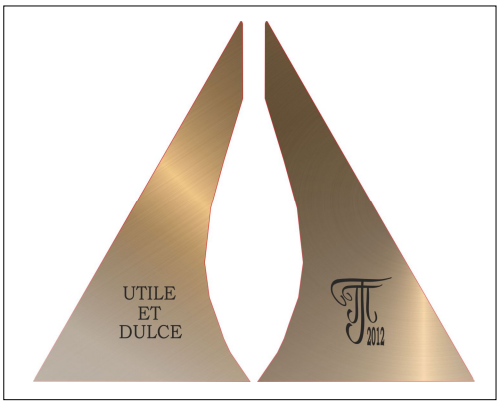
Of course you remember these lines:

> Twas brillig, and the slithy toves
> Did gyre and gimble in the wabe;
> All mimsy were the borogoves,
> And the mome raths outgrabe.

I really wanted to cast in bronze one of the animals mentioned in these lines. There are difficulties with the translation. I mean an animal which by Carroll's definition is a hybrid of a badger, lizards and corkscrews. I even made a little clay model.

Fig. 2. The complete 'Utile et Dulce' dial with happy client.





Figs 3 and 4. The engraved dial-plate and the gnomon with motto and signature.

"I do not need this terrible zoo in my garden", my client said, "I just want a little piece of Victorian England to live here in my garden." Now she has this little piece of Victorian England. Look how happy she is. *Utile et Dulce.*

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[* '*dulce et utile'* (pleasant and useful) is attributed originally to the Roman poet Horace. Note too that 'The Tove's Nest' is a regular feature in the *NASS Compendium*. Ed.]

THE *MERIDIES MEDIA* GREENWICH NOON DIAL

CHRISTOPHER DANIEL

Members of this Society may recall the article which I wrote concerning the history of the *Meridies Media* noon mark mean time sundial, designed in 1967 by Dr Tadeusz Przypkowski, the noted Polish sundial authority. This dial had been commissioned by the National Maritime Museum at Greenwich for installation on the south wall of the Meridian Building of what was then the Old Royal Observatory (ORO). At this time, these buildings were an integral part of the Museum and Dr Przypkowski had been commissioned to produce designs for seven other dials, to enhance the walls of Flamsteed House.

I was a relatively junior member of the Museum staff at this time, having joined the Department of Navigation & Astronomy in 1964. In 1967, I had been given direct curatorial responsibility for the Museum's extensive sundial collection, which was on display in Flamsteed House, which was then the only ORO building open to the public. Needless to say, when Dr Przypkowski's sundial was set in place, I had been given the task of supervising this work. Whilst the designer had specified that the dial should be made of green marble, the Ministry of Public Buildings and Works, who constructed the sundial, made it out of wood. As it happened, no one that I know of had seen a dial of this kind before and, as previously related, I discovered that

J. Davis

The re-created Meridies Media noon mark. The picture was taken at 13:00 BST on 10 October when the sun conveniently appeared through the clouds, having earlier appeared for observing the noon crossing of the central line.

the design was back to front! In 1969, the dial was duly rectified and repainted; but it was Przypkowski's unfortunate mistake and the solving of this problem which was the principal cause of my interest in sundials and my later involvement in sundial design.

In about the year 1991, Przypkowski's sundial had suffered from severe weathering and it was taken down. Forty years after it had been placed on permanent display, a chance meeting between Douglas Bateman and Dr Gloria Clifton in June 2009 brought about the idea of restoring Przypkowski's original mean time noon dial. In due course, I became involved in this matter and agreed to take on the reconstruction design of the dial. Firstly, it was necessary to estimate the costs and to raise the necessary funds with an appeal, principally aimed at members of the British Sundial Society; but their considerable generosity soon enabled the work to go ahead. The original gnomon was removed and taken to the Crucible Foundry for refurbishment and I became fully engaged in the reconstruction design work.

The design of the sundial was necessarily based on Przypkowski's original work, including the use of prominent Roman numerals to denote the months of the year. However, the little roundels, which he had used for the demarcation of the months, were altered to small red diamonds, partly as a matter of personal preference and partly as a subtle means of marking Her Majesty the Queen's Diamond Jubilee. The Roman numerals were also altered so as to make them look more elegant. However, unlike the normal delineation of such a sundial, this had to be related accurately to the dimensions of the gnomon and the exact distance of the nodus to the vertical surface of the dial plate, working to the nearest millimetre! Thus, the thickness of the dial-plate was 20 mm, whilst the longitudinal dimension of the analemma worked out at exactly 1500 mm, with dimensions of 1898 mm overall length and 530 mm overall width, with a weight of 54.4 kg.

I had commissioned Ben Jones, whom I had worked with before, to order the slate – Kirkstone slate – and to carve the dial, which he did with consummate skill. He also redesigned the numerals and lettering to make them more elegant. Against considerable pressure of other work, he finished the dial by mid summer and brought it up to Greenwich, suitably fixed in a wooden frame, to keep it from being damaged, where it was photographed and safely

J. Davis

The dial at 11:48:29 GMT on 10 October.

J. Davis

Part of the gathering at the opening: at the left, Doug Bateman talks to Darek Oczki and Rafal Zackowski from Poland, representing the Przypkowski family and, centre-right, Dr Kevin Fewster and Sir Mark Lennox-Boyd discussing sundials.

stored in the studios of the official photographers DPC. At this time, it should be remembered, the Royal Park of Greenwich and the Royal Observatory were completely off limits and closed to all who were not involved in the Olympics and the Paralympics. However, a date for the installation of the sundial was fixed for the 10 September 2012 and an 'unveiling' date for a month later on 10 October.

It was just as well that I had allowed a month between the installation date and the unveiling date, since we actually commenced the installation on Tuesday, 11 September. Nevertheless, although the scaffolding was in place at the time, it was no easy task hoisting the dial up to the correct level and fixing it in position. There were problems in replacing the gnomon in its original site, as a result of which the dial plate required some adjustment, which did not take place until Tuesday, 24 September; but, at last, a day later, the gnomon was installed and the scaffolding came down. All this time, the weather had not been at its best, with rain clouds hampering the work; but on Saturday 29th of the month, I managed to observe the spot of light at the centre of the sun image shadow and to check the dial's accuracy. On the following Tuesday, 2 October, excellent photographs were taken and I concluded that the sundial had an error of 40 seconds slow on clock time!

According to plan, on Wednesday 10 October 2012, on a day when the weather was kind and the sun shone for us, Sir Mark Lennox-Boyd duly declared the sundial to be 'unveiled'. Some thirty or so members of the British Sundial Society were present, as was Dr Kevin Fewster, Director of the Royal Museums Greenwich and members of the Museum staff, including Dr Gloria Clifton, Rebekah Higgitt, and Lucy Cooke, who had organised the Appeal Fund and the unveiling event. I was able to say a few words of thanks to the assembled gathering; but, in some sense, the beautiful and elegant *Meridies Media* sundial, that now adorned the wall of the Meridian Building in the Royal Observatory, might not have been there if Dr Tadeusz Przypkowski had not made a mistake in his design in 1967. Thus my thanks are not only due to Ben Jones, and all those who contributed to the sundial; but to the Polish doyen of gnomonics, who caused me to become a designer of sundials!

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