The British Sundial Society

BULLETIN

VOLUME 29(iv)
December 2017

BSS Bulletin 29(iv)
December 2017

The BSS Website

As a reminder to our members, the main areas of the website are listed below in the order that they appear in the menu. Recent additions include the Members' Forum and the survey of Old Sundial Books; other popular areas are British Dials Online (an online map of recorded dials), How Sundials Work, the Sundial Glossary and much more. Please explore and remember that further contributions are always welcome.

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The BSS Sundial Glossary	*Comprehensive explanations of technical terms and much more from John Davis*
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Help and Advice	*A place for anyone to ask dialling questions*

Front cover*: A quality dial by Joshua Springer with an unusual gnomon representing the Greek god Triton, described by John Davis on pages 2–5. Photo: Kieran Holland.*

Back cover*: Facet-head sandstone dial in Pitmedden Garden, Aberdeenshire, photographed by Alan Mitchell on a recent visit to Scotland. On page 40, Alan describes two more of the sundials he saw on his travels.*

Editorial team: John Davis, Frank King, Christine Northeast and David Brown

Printed by The Lavenham Press Ltd, Lavenham 01787 247436

BULLETIN
OF THE BRITISH SUNDIAL SOCIETY

ISSN 0958-4315

VOLUME 29(iv) - December 2017

CONTENTS

EDITORIAL

In this issue of the *Bulletin* there are reports on the talks given at the Newbury Meeting in September. These talks often turn into *Bulletin* articles and John Davis's talk on William Lumb of Swillington and Ian Butson's talk on a sundial restoration project are both expanded into full articles this time.

Queries to the BSS Help-and-Advice Service are another rich source of potential articles and Sue Manston has given us some fascinating details about two interesting sundials that an enquirer asked about.

The Editorial Team frequently urge readers to photograph sundials that they come across when on holiday and then to write about them for the benefit of other readers. Mike Cowham hardly needs such encouragement and he has written about a large number of dials that he saw on a recent trip to France. Venturing rather further afield, Mike Isaacs reports on a couple of dials that he saw when he went to the US. Both dials are unusual, albeit in rather different ways.

We are most fortunate to be able to include another very entertaining article in Dennis Cowan's series on Thomas Ross and the sundials that he sketched and wrote about. An even longer-running series is the Postcard Potpourri that Peter Ransom regularly provides.

The Editorial Team were saddened to hear of the death of Frank Evans who wrote many articles for the *Bulletin* over the years and we include an obituary written by his friend and near-neighbour Tony Moss.

On page 38 you will see information about an exhibition at the Visconteo Museum in Pavia, Italy on "The Clockwork Universe", which deals with the astrarium created by Giovanni Dondi in the 1300s and the culture of the period. This arrived in the *Bulletin* offices after the September issue went to press, but as the exhibition continues until 23 December, it is still not too late to go.

A Happy Christmas to all readers.

Frank King

A QUALITY DIAL BY JOSHUA SPRINGER

JOHN DAVIS

In an earlier article,[1] I gave some of the background to Joshua Springer, a provincial instrument maker working in Bristol in the late 18th century. The article also described a well-made but fairly ordinary horizontal dial by him. Recently, a larger and much superior dial (Fig. 1) has been discovered in private ownership in Ireland which sheds a new light on his capabilities. Other than the dials described in the previous article, only one further Springer horizontal dial is recorded in the BSS Register.[2]

Fig. 1. The newly-located Joshua Springer dial.

The dial has been in the owner's family in Dublin for around 40 years and had previously been owned by a family friend, also in Dublin, for an unknown period. It would be surprising if it had been made for that location by a provincial Bristol maker as Dublin had its own mathematical instrument makers at that time.[3] It is a substantial dial some 15″ in diameter with several features which stand out as important or unusual.

The most obvious feature is the gnomon (Fig. 2) which, although rather thin for the size of dial, is both pierced and engraved on both sides with the figure of a merman. The figure can be identified as that of Triton, son of Poseidon the bad-tempered God of the Sea, by his conch-shell horn with which he is said to have been able to calm rough seas. This is unique in my experience and suggests that perhaps the commissioner of the dial was a seaman sailing from Bristol. The gnomon has at some stage been broken and has been rather inexpertly repaired with what looks like an untidy braised joint (Fig. 3), probably in the 20th century and using a gas torch. It is also slightly mis-oriented.

Fig. 2. The gnomon with the figure of Triton.

The next point of interest is the signature which reads (Fig. 4):

All sorts of Mathematical Philosophical & Optical
Instruments made & Repaired by
JOSHUA SPRINGER, *BRISTOL*

It is just possible that the "& Repaired" part has been added later as this lettering appears to be slightly larger than the rest but the spacing of the words, and the lettering style, looks correct as it is. If it were later, it might have been added when the gnomon was repaired although the quality of the repair workmanship is not what would be expected

Fig. 3. The rather poor repair to the gnomon.

Fig. 4. The signature. Note also the details of the EoT scale, the wheatear border and the extremes of the time range.

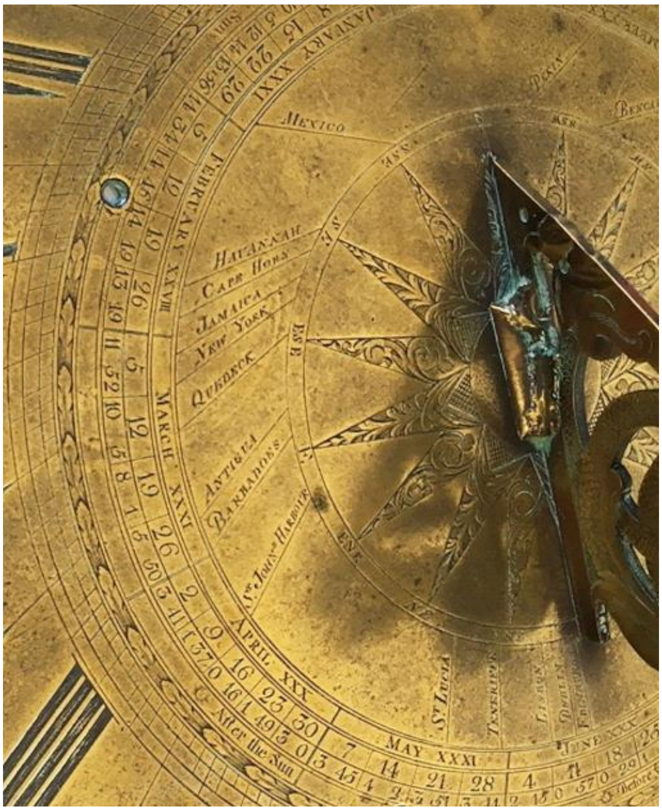

Fig. 5. Some of the geographical names.

from Springer – it is ironic that this inscription is on a badly-repaired dial. If the wording is original it would be unique and would show the importance of repair work to an instrument maker operating in a port where maritime instruments would have had a hard life.

The centre of the dial features a sixteen-pointed compass rose with all the points labelled and with very nicely-executed infill to the points using a slightly unusual pattern, not thought to have been copied from any other instrument maker.

Outside the compass is a band with the names of 28 places around the globe and a line indicating the time of their local noon as indicated by the sundial (see Fig. 5). The appearance of place-names on dials can be traced back at least to those made by Henry Wynne (d. 1709) and was often used by Thomas Wright.[4] The list of places on the Springer dial is shown in Table 1. This list is a slightly

Place Name	hrs	mins
Pekin	4	15
Bengal	5	55
Goa	6	8
Mauritius	8	28
Madagascar	8	57
Moscow	9	19
Jerusalem	9	40
Smyrna	10	13
Athens	10	28
Alexandria	10	1
Dantzick	10	47
Cape of Goodhope	10	54
Prague	11	2
Rome	11	10
NOON	12	00
Edinburgh	12	11
Dublin	12	22
Lisbon	12	36
Teneriffa	1	5
St Lucia	1	36
St John^{s} Harbour	3	26
Barbadoes	3	55
Antigua	4	9
Quebeck	4	40
New York	4	54
Jamaica	5	5
Cape Horn	5	20
Havannah	5	31
Mexico	6	54

Table 1. Place names on the Springer dial and their indicated times of noon.

unusual one even though many of the names commonly appear on dials. In particular, although Edinburgh and Dublin occur (they are very rarely seen) London surprisingly does not. This tends to support the seafaring connection and also the link to Dublin. One of the unusual places is Smyrna (now Izmir in western Turkey) the ancient Aegean port which has a biblical connection and also occurred on some of the Irish slate dials by Joseph McNally in the 1830s.[5] The dial also shows noon at both the Cape of Good Hope and Cape Horn: whilst the former is relatively well known on dials, the latter is rare and again points to a seaman.[6]

In theory, it is possible to determine the longitude for which the dial was delineated from the longitude of the locations (relative to Greenwich) and their indicated times of noon. In practice, this is complicated by the fact that longitudes were not known exactly at the end of the 18th century, especially for the more remote and exotic locations. The best locations to choose for the calculations are those near noon (small longitude corrections) and either with astronomical observatories or which are ports that would have been well mapped. Edinburgh and Dublin, and perhaps Lisbon, come into this category. The results are somewhat confusing though: although the dial is clearly not made for the longitude of Dublin (whose noon is shown at 22 mins past noon), neither is it made for Bristol at 2° 34′ W. It is strange that a mathematical instrument maker working in a seaport at that relatively late date had rather a hazy idea of longitudes.

Next comes an Equation of Time ring in the form of a complete uninterrupted circle with the months running anticlockwise and read from outside the dial. The number of days in each month is given after their names in Roman numerals – a rather old-fashioned format – and then comes the EoT value in minutes and seconds for every seventh day of the year. This starts on 1 January and thus finishes on 31 December so these two days are adjacent to each other which makes it clear that there is a significant discontinuity at this point, when the value is changing at around 30 seconds per day but the step is 38 seconds. The cause is the treatment of the leap year cycle: whereas some tabulated values were for 'averaged' years and hence would smooth over the year-end step, other compilers such as Ferguson (1785)[7] produced a set of four tables, one for each year of the cycle and continuing smoothly over the inter-year gap but with a noticeable difference between the values for 1 January in consecutive years. Thus it looks as though Springer has used values taken from a single year of such a set of tables.

The 52 values of EoT in minutes and seconds are labelled "After/Before the Sun" with a ☼ symbol signifying the zero points. There is one engraver's error on 29 January where the dial shows 13m 56s when it should probably be 13m 26s. The high resolution allows a close comparison to be made between the engraved table and those published in the contemporary literature.[8] It was expected that Springer's source of data would be identified, potentially helping to date the dial, but unfortunately no exact match could be made. The values were close to those in the tables by Ferguson (all four years) and also to those of Atkinson[9] (1736) and the Society of Gentlemen[10] (1763) with the majority of the individual values being within one to three seconds and the maximum differences being about seven seconds; this, though, is sufficiently different to show that it was not their values that were transcribed. Possibly an earlier version of Ferguson's table had been used or another unknown source. It is clear, though, that it was a table from the second half of the 18th century that was used.

Around the EoT ring is a decorative oak-leaf (or wheatear) border. This pattern is sometimes thought to be an indication that the dial-maker was a member of one of the London guilds and certainly it does appear on most London dials. There is no proof though that it was used exclusively by them. The other Joshua Springer dials described in the earlier article use a slightly simplified version of this pattern. The article also showed that Springer is thought to have learned his trade in London (though not with a formal apprenticeship), in the workshop of John Wright, himself an apprentice to Benjamin Cole and successor of the great Thomas Wright (fl. 1718–47) who held the title of "Mathematical Instrument Maker to His Highness [the King]".[11]

The main chapter ring is delineated from 3:20 am to 8:40 pm which is a timespan capable of recording sunrise to sunset at locations up to 56° N, which is almost certainly further north than the actual design delineation. The elegant Roman numerals are read from inside the dial, as are those on the other Springer dials. This was decidedly out-of-date by the end of the 18th century and harks back to the dials of Thomas Wright who was resistant to the change of orientation. The hour numerals are supplemented by narrow diamond markers for the half-hours, again a simplification of the fleur-de-lys used in earlier periods. There are two division rings with the main, outer one divided in steps down to 1 minute (unlabelled). The inner ring, which in earlier times might have been divided to half-quarters, is in 5-minute increments but with a slightly unusual arrangement of marking lines, which grow longer towards the quarter- and three-quarter-hour positions, rather than having different lengths for the 5-, 10- and 15-minute intervals.

The back of the dial (Fig. 6) reveals that the gnomon is retained simply by two screws with no signs of alignment pins often found on high-quality dials. There appear to be two small delineation holes on the centre-line of the gnomon rather than the normal pair at the tips of the gnomon toe, though the dial does have an appropriate gnomon gap.

Discussion and Conclusions

It is difficult to date this dial exactly – is it early in Springer's career, when he still had strong London

Fig. 6. The back of the dial.

connections (shown by the wheatear border) or is it later, when he had accumulated greater experience? Unless the original owner can be determined or some account books miraculously appear, we will probably never know. The sculpted gnomon is a surprise and currently unique but the artisan who made it was clearly experienced in this type of non-scientific metalwork. To summarise, this dial lifts the standing of Springer from a good workman capable of producing sensible, ordinary but workaday mathematical instruments to a rather superior craftsman.

ACKNOWLEDGEMENTS

I am very grateful to Kieran Holland for notifying me of this dial and for kindly providing all the photographs shown here. John Foad made some useful additions and comments to an early version of the text.

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john.davis51@btopenworld.com

Welcome to Newbury

For those who travel to Newbury Meetings by train, this dial serves as a welcome sign just outside the station. It is high up the south front of a building, appropriately named Sundial House. Many readers will recognise it as being the handiwork of David Pawley who is the principal organiser of Newbury Meetings.

The dial is made from fibreglass and is surrounded by a pentagonal cornice which might equally have served as the frame of a dormer window.

Standing in a recess, the dial is subject to shadow from the cornice and, in the photograph, the shadow is starting to encroach on the west side of the dial plate.

Notice the shadow of the gnomon where it falls on the horizontal element of the cornice. If the hour lines were continued beyond the rim of the dial plate, it would be necessary to mark out the individual segments from different centres, all being on the gnomon.

FHK

THE CHORD REDISCOVERED

GRAHAM STAPLETON

At a recent BSS meeting, a discussion touched on a builders' measuring tool seen online that included a chord scale. The question "Could that be used to draw dials?" was voiced, but the conversation progressed and the question went unanswered. If you enter the term 'line of chords rule' into your preferred search engine, examples of the tool in question can be seen. It is in fact nothing other than a modern instance of the drawing instrument called the Sector, albeit one made for the artificer rather than the architect. A sector is an embodiment of the geometry of chords, enabling angles to be drawn directly. They also carry multiple scales: trigonometrical, e.g. sines and tangents, logarithms, lengths for polygons in a standard circle, and dialling scales (of which more below). More about these engaging instruments can be found on David M. Riches' well-illustrated site.[1]

Seeing this measuring tool, I was clear that it is perfectly possible to lay out a dial design with one; exactly how different the process would be, would call for practical experimentation to find out. Considering further, it struck me that using a sector and dividers would not be greatly different from using a protractor. It would be more of a challenge to try drawing a dial using a line of chords rule and compasses.

Chords: a Reminder

Many readers may not have encountered chords since school, not least because chords were anciently supplanted for most purposes by the development of the other trigonometric functions. So I digress briefly with a reminder about them, greatly aided by David E. Joyce's elucidation.[2]

Chords were the first trigonometrical ratio to be formulated; Hipparchus (fl. 162 to 127 BC) produced a table of chord values in fractions of 'steps', each 1/24th of a circle (i.e. 15°). Ptolemy (c.100 to c.168 AD) produced a much fuller table at the level of half degrees, with the possibility of resolving to arc-minutes. The half-chord, or sine, first appeared in India in the 4th- to 5th-century AD which, being based on more convenient right-angled triangles, gave rise to the trigonometry more familiar to us now.

A chord may be defined as a finite straight line, both ends of which lie on the circumference of a circle.[3] Illustrating this in Fig. 1, the circle centred on O has a radius of one unit length. As the internal angle AOB is 60° this is an

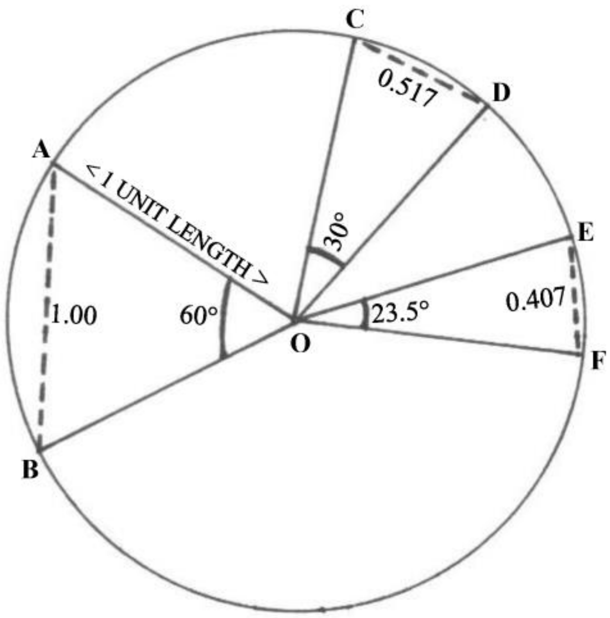

Fig. 1. Construction of chords with some sample values.

equilateral triangle (all of the sides and angles the same) and hence the chord AB is also one unit length. For angle COD, 30° gives a chord CD of 0.517 of a unit length. EF, the chord of 23.5°, turns out to be 0.407 unit length. Those familiar with trigonometry will see from Fig. 1 that the relationship between the chord function, *crd*, and the half-chord or sine function, *sin*, is:

$$crd(\theta) = 2\,sin(\theta/2)$$

For practical applications, a scale of chords can be drawn along a straight line (Fig. 2). Based upon a unit length CO, with the angles of a quadrant emanating from C, their corresponding chords will then originate at O. These are

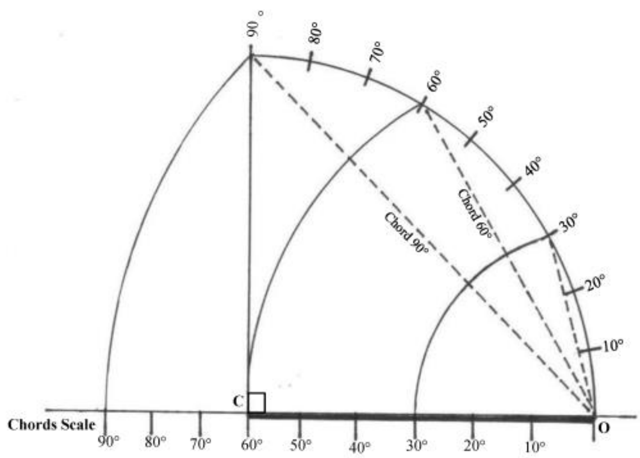

Fig. 2. Derivation of a chords scale from a quadrant.

then transferred as radiuses to the baseline to produce a scale of chords.

An obvious advantage of this scheme is that the scale is fairly even, not heavily compressed towards one end. What is possibly not evident is that a chord scale of 90° laid out over a length of 12 inches is the equivalent of a 17-inch diameter protractor. Also, since the chord scale's length is 90% of its degree scale circumference counterpart, this compactness does not come at the cost of lost legibility. The only limitation in use is that all angles have to be drawn in a circle of a set radius – the same one that was used to generate the scale. Hereafter I shall call this the base radius (BR).

Drawing a Dial with a Chords Rule

My favoured method of setting out a horizontal (or direct south) dial is that of Bedos de Celles. This is described by Waugh[4] and, along with several other methods, in Wikipedia.[5] My experiment, left incomplete for clarity, is shown in Fig. 3. I commenced by laying out a chord scale with just the values that would be needed, selecting a base radius (BR) so as to fit the paper. These measurements could either have been taken from a chord rule, or generated with a diagram as given in Fig. 2. Lacking a chord rule short enough for the page and wishing to expedite the work, I calculated the required chord angle values with the help of my trusty book of five-figure tables. Whatever means used of setting out the angles, be mindful that the overall size of the drawing is almost entirely controlled by the length of the gnomon (OG). As I did not need to depart from the normal description of setting out the lines and angles, I will not use up space iterating their sequence here. In my attempt, two of the arcs required by the method could be drawn with the base radius, but if the drawing is being made to a specific size of dial plate, then it is possible that construction lines for the angles will complicate the page. Overall this was not harder than using a protractor, but I admit that working with compasses does demand greater attention. I certainly feel it necessary to have some idea of what our predecessors had to do, even though there are times when software helpfully expedites the job.

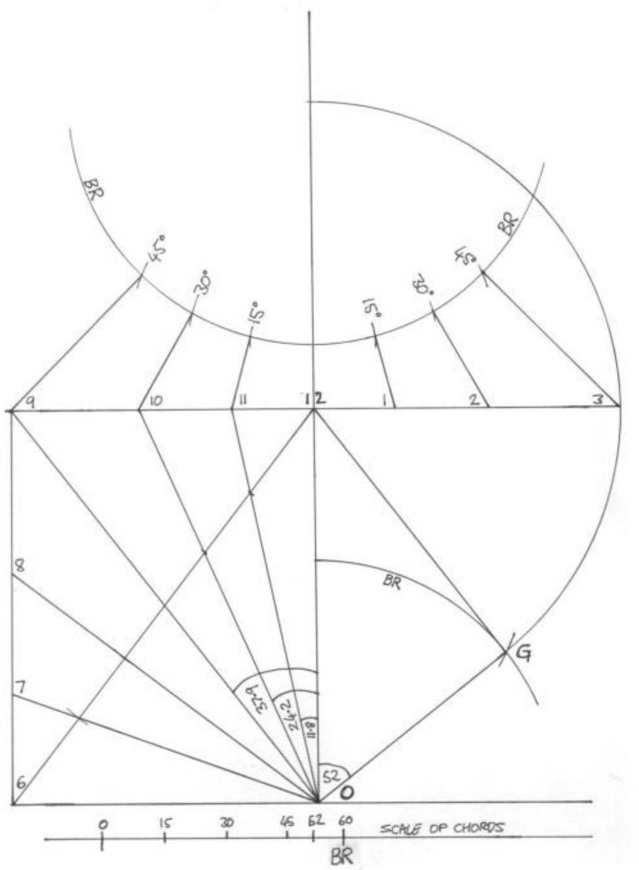

Fig. 3. Delineation of a dial with angles measured by chords.

The Diagonal Line

I consider the diagonal line between the intersections marked 12 and 6 to be an elegant solution. It provides a point of symmetry so that the hour lines already drawn can generate the ones remaining. Without it, one either needs a large piece of paper to accommodate the extensions of the 15° intervals, or the dial has to be drawn rather small to fit the whole layout on the paper. Looking at this line, I was reminded of something that I couldn't quite put my finger on. It was only some while later that it came to me: the line resembles the one used to delineate when using dialling scales.

Samuel Foster and George Serle

Having studied all of these drawing methods, it was galling to find that Samuel Foster had anticipated most of them and simplified dial drawing in 1638. With a simple device, hour lines for many kinds of dial could be drawn without calculation and scarcely any measurement. This originally took the form of a nomogram,[6] which was adapted into dialling scales on a rule by George Serle in 1657. To my mind this is the only instance of Foster having been improved upon. Like the sector, dialling scales would sometimes also have scales for chords, polygons and the like.

Dialling scales have not been written about in the *Bulletin* for two decades,[7] so I invite someone to take up the challenge. In the meantime, the best source of information is Fred Sawyer's article in the NASS *Compendium*.[8] Otherwise they are covered in Cousins[9] and the NASS website; in the 'Sundials for Starters' feature, where a printable set of scales can also be found.[10] These could be the start of an interesting exploration of dialling for someone.

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manaeus2000@yahoo.co.uk

Sundial-Themed Products from RedBubble

Frank H. King

I am indebted to our Vice-President, Fred Sawyer, for drawing my attention to the products offered by a company called RedBubble. These days, you can print photographs on a huge variety of media including cakes and the sides of buses. RedBubble print photographs on throw pillows, tote bags, T-shirts, greetings cards and many other items. Intriguingly, a number of their products feature sundials. If you are wondering what to buy your nearest and dearest for Christmas, you might consider a throw pillow which shows off the Paternoster Square Noon Mark (see Fig. 1).

In Fig. 2 you can see the same design on a tote bag.

Readers wondering whether I am in receipt of a percentage of their sales may be assured that this is not the case. To those concerned about the infringement of my Intellectual Property, I reply that I am untroubled. Should RedBubble prosper mightily by selling images of the Paternoster Square Noon Mark, I shall simply marvel at their marketing skills. I shall also wonder why those who work in the Stock Exchange didn't long ago appreciate the investment opportunities that are cut into the principal face of their building!

Fig. 1. A throw pillow to brighten up your drawing room.

Fig. 2. A tote bag.

Note

To explore the RedBubble website follow these instructions:

- Visit *www.redbubble.com*
- Using the singular, search for *sundial*
- A selection of items appears (not all sundial related and some better than others); click *Bags*
- Click a design that appeals to you
- Scroll down and see the variety of items that feature this design

fhk1@cam.ac.uk

SUNDIAL RESTORATION AT ST MARY'S CHURCH, MENTMORE, BUCKINGHAMSHIRE

IAN BUTSON

This article is based on a talk given at the 2017 BSS Newbury Meeting.

Most people will have heard of the Rothschild family, famous as international financiers for their business acumen and wealth, and also for their philanthropy. They are a large family, still spread across much of the world.

During the Victorian period, various members of the family acquired large estates in Buckinghamshire, with it even being informally referred to as 'Rothschild-shire'. In the Vale of Aylesbury, large houses were acquired or built for family members, all being in close proximity, the area becoming known as the 'Rothschild Enclave'. These houses are still in existence, the most well known of them probably being Waddesdon Manor and Mentmore Towers.

Adjacent to the estate of Mentmore Towers is St Mary's Church (Fig. 1), with a vertical sundial above the south entrance porch.

When I first visited the church in 2003 the dial was leaning forward, and in danger of falling down, its two upper fixings having become detached from the wall (Fig. 2).

Fig. 2. The dial in 2003.

Fig. 1. St Mary's Church, Mentmore.

By 2006 the dial had been removed and was stored inside the church.

Early in 2009 I was asked by a benefactor if I would assist in the restoration of the dial, to which I gladly agreed.

The original painted wooden sundial (Fig. 3) was constructed from a single piece of ¾ inch thick plywood, supported by four strip metal pieces as fixing lugs. The

Fig. 3. The original dial.

Fig. 4. Damage at the lower left-hand side of the dial.

Fig. 5. Front and back of the new dial before painting, with the original dial alongside for comparison.

gnomon assembly was found to be in generally good condition. The paintwork was badly worn, faded and flaky. On closer inspection it was found that, although most of the wooden dial plate was sound, quite a large area at the lower left-hand side was rotten, as was the softwood surround in that area (Fig. 4). Considering this damage, it was felt that the dial was beyond reasonable repair, and that a new one should be made.

The new dial was constructed along similar lines, using ¾ inch plywood, but now with a mahogany hardwood surrounding border to increase resistance to rotting from trapped water. To assist further in reducing wood rot, the lower edge of the border was omitted, preventing water from accumulating there. This is a feature now often found on notice-boards and shop signs. Fig. 5 shows the front and back of the old and new dials.

The lower edge of the dial-plate board was also chamfered to a slight knife-edge to help reduce any water clinging to the bottom of the board. This was yet further protected by the addition of iron-on kitchen-furniture edging strip (Fig. 6).

The material for the new protective wooden edging was selected to give a much lower height profile than that of the original, which had cast a considerable shadow onto the dial plate.

Two new galvanised steel strips were fitted to support the dial in place, with brass screws being used throughout.

It was also decided that, in an effort to assist in reducing moisture from being trapped behind the dial, the new dial should not be placed flush against the porch wall, as had been the original, but should be fitted with an air gap of about ½ to ¾ inch behind, with the dial being mounted on stainless-steel studs, with adjustment nuts which had previously been cemented into the wall with quick-drying polyester resin.

Following construction of the new dial, the artwork and painting were to be executed by a friend of the church secretary. In the event, however, owing largely to her work commitments and several house moves, this did not take place. After a number of years and numerous unfulfilled promises, the dials were eventually recovered and other arrangements made for the work to be completed. The original gnomon, however, was lost during this period, and a replacement had to be constructed (Fig. 7).

Analysis of the original dial markings had been made, and also new measurements made of the declination of the church porch, it finally being established at 9° 30′ East of

Fig. 6. The chamfered lower edge of the dial-plate board.

Fig. 7. The replacement gnomon.

South. Although most of the original hour lines fitted fairly closely to this declination, several appeared to have 'drifted' over time. The gnomon, however, had been incorrectly placed on the original dial.

New hour lines were established, the gnomon correctly positioned, and with the artwork and painting promptly completed by BSS member Harriet James, the new dial was ready for installation.

This took place on a damp, grey and cloudy day during May 2017 (Fig. 8). With the stainless-steel fixing studs held in place with a template, a longish break for lunch was taken while the resin cement hardened. After the break, the template was removed and the dial then fitted into position, over the entrance to the south porch (Figs 9 and 10).

Fig. 8. Fixing the stainless-steel studs and template.

Fig. 9. The new dial.

Fig. 10. The south porch with its new dial.

By early in the afternoon the sun had appeared, showing the dial to be working perfectly.

At the end of a very long and frustrating saga, the new dial was finally in place.

irb42hw@gmail.com

TWO UNUSUAL EIGHTEENTH-CENTURY SUNDIALS

SUE MANSTON

In the last twelve months the BSS Help and Advice Service has dealt with over 60 enquiries, ranging from those that are simple and quick to answer, to those that require a fair amount of time and investigation. This article is about an enquiry that fell into the latter category.

A gentleman called Eric Patterson wanted information about his two sundials, as well as an idea of value and how to go about getting new gnomons made. Both dials looked interesting and appeared genuine, so some research was needed.

Eric had purchased both dials during his frequent 5am sorties to the Tuesday antique market at Kempton Park between 20 and 30 years ago. Over the last ten years the first dial travelled with him through the Middle East, India, Africa, Russia and the Far East, before settling in retirement in Cornwall, while the second dial lurked in a storage crate in Slough.

Eric's First Dial

This well-travelled, and rather damaged, brass dial is approximately 200 mm in diameter and is clearly marked "Tho. Wilks Fecit" with a date of "Ian, 16, Anno Dni, 1732" (Figs 1a, 1b and 1c). It is unusual to have an exact date on a dial, rather than just the year.

There are divisions for hours, half-hours, quarter-hours and 7½ minutes, and a separate chapter ring for the time in Jerusalem ("Ieruſalem, Diff. Merid. 2^h 28′ E"). The Roman numerals are read from the outside looking in. There is a 16-point compass rose and an inscription GRATA SUPERVENIET. These are the first two words of a motto listed by Mrs Gatty:[1] "Grata Superveniet quae non Sperabitur Hora". This, she says, is a quote from Horace and means "The hour that is not hoped for is most grateful when it comes".

Thomas Wilks

Thomas Wilks was a mathematical instrument maker of Pebworth, Worcestershire. His known dials include a signed brass sundial made for latitude 52° 13′ dated 1725; a sundial in the Museum of the History of Science, Oxford; a dial dated 1737 in the Museum of Lincolnshire Life; a dial at Maxstoke Castle, Warwickshire and another, dated 1752, understood to be in a private collection.[2]

The dial at Maxstoke Castle, Coleshill, Warwickshire, is SRN 6424 (Figs 2a and 2b). It is signed "Thos. Wilks Pebworth" and dated 1750. There is an Equation of Time

Figs 1a, 1b and 1c. Thomas Wilks dial dated 1732. Photos: Eric Patterson.

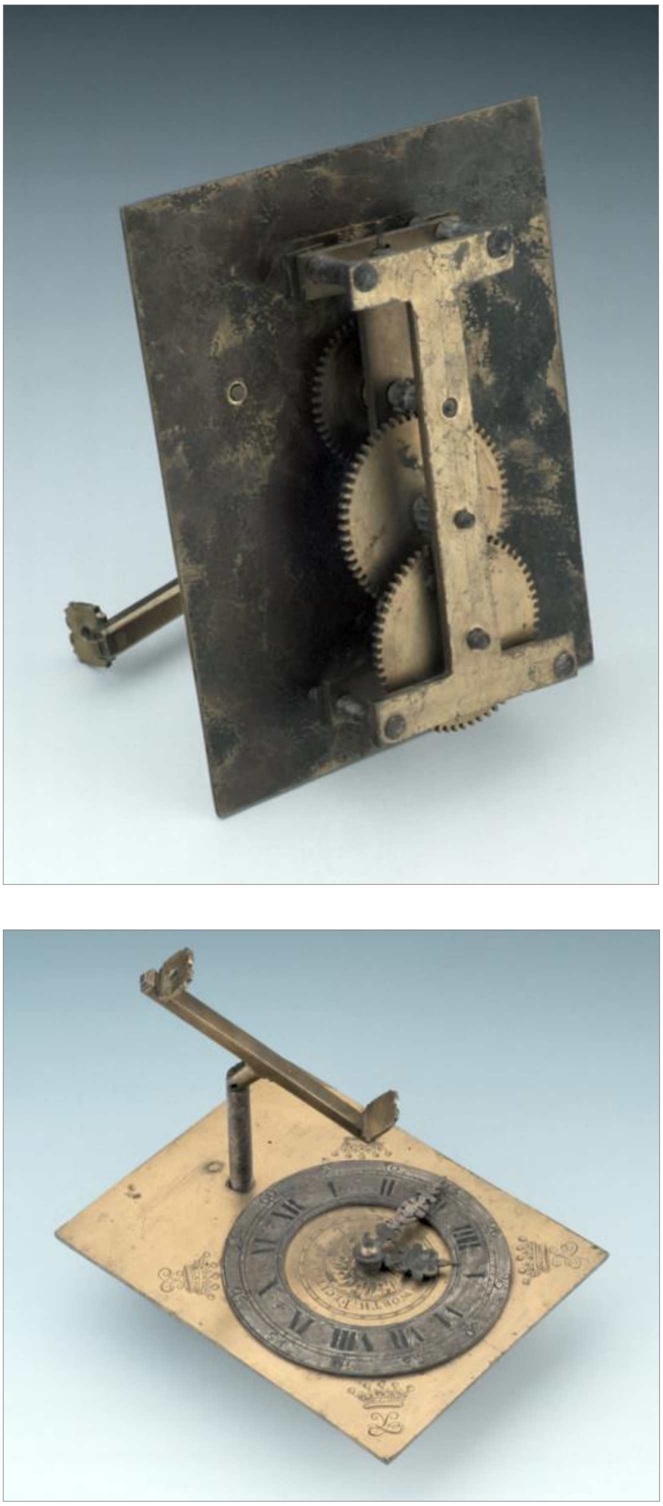
Figs 2a and 2b. Dial at Maxstoke Castle (SRN 6424). Photos: John Lester / BSS.

ring and many cities are marked showing the times there at noon on the dial.

The dial in the Museum of the History of Science, Oxford, is dated 1747 and described as a "mechanical sundial" by Thomas Wilks of Pebworth (Worcestershire).[3] It was presented to the museum by Viscount Dillon in 1927 and carries the monogram of George Lee, 3rd Earl of Lichfield (1718–72), Chancellor of the University of Oxford in 1762–72 (Figs 3a and 3b).

This very unusual dial must be set up with the clock face in the equatorial plane, with noon at the South. The main shaft that supports the alidade is polar-oriented. The alidade is aligned such that a pinpoint of light falls on the target, and the clock will then tell the solar time. At the equinoxes the elbow on the shaft is straight and the alidade is parallel to the dial face. At other times of the year the elbow must bend by an angle matching the solar declination.

The main shaft leads to two lots of gearing. First, a step-up by two so that one turn of the shaft makes the hour hand go round twice; secondly, a step-up by 24 so that one turn of the shaft makes the minute hand go round 24 times.



Figs 3a and 3b. A "mechanical sundial" by Thomas Wilks. © Museum of the History of Science, University of Oxford, Inventory No. 48562.

Now, at this point in our discussions there was a slight digression into constant velocity joints and 1959 Minis. When two shafts are connected at an angle and one of them rotates at a constant rate, then the speed of the other shaft varies during the rotation. Is this what happens with the Wilks dial? Well, it was decided probably not. Once the alidade is set at the appropriate declination for the day then you could, in effect, clamp it in place; only the main shaft needs to rotate.

Eric's Second Dial

This dial is very interesting too, and probably rare. It is approximately 240 mm in diameter and is believed to be part of an instrument known as a declinatory, used to find the declination of a wall (Fig. 4). The Roman numerals are read from the inside looking out. It is unsigned and probably dates from around the early 18th century.

Fig. 4. Eric Patterson's second dial, believed to be part of a declinatory. Photo: Eric Patterson.

The horizontal dial would have been fitted to a board of some sort. Figure 5 shows a similar dial fitted to the reverse of a large quadrant. At the centre is a fixing hole and the dial would have been rotated on this to set it up correctly. The removable gnomon fits into the slot and is normally stored away until required. The dial pivots on a plate with a straight edge which is held against the wall for which you need the declination. The dial is rotated until it tells the correct solar time (you are assumed to have a universal equinoctial ring dial or similar so you already know the time). The amount of rotation is read off a scale on the fixed plate using an index at the noon mark on the dial to give the declination from South.

Fig. 5. A declinatory used to find the declination of a wall.

Fig. 6. A Gunter's quadrant with declinatory. Collection of Historical Scientific Instruments, Harvard University, Inventory No. 7483.

A Gunter's quadrant with declinatory, shown in Fig. 6, is in the Collection of Historical Scientific Instruments at Harvard University.[4]

Conclusion

Sometimes the queries to the Help and Advice Service are easily answered, but other times they require many hours of investigation by many different people. And often it leads us to researching other dials as well, like the ones at Oxford and Harvard, and the dial makers themselves.

ACKNOWLEDGEMENTS

My thanks to Eric Patterson for his permission to write about his dials and to use his photographs. Thanks must also go to Frank King, John Davis, John Foad, Mike Cowham and Jill Wilson for their considerable help with the research needed to reply to Eric's query.

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suemanston@outlook.com

WILLIAM LUMB OF SWILLINGTON
Schoolmaster, land surveyor and dial designer

JOHN DAVIS

This article is a version of a talk presented at the BSS Newbury Meeting, September 2017.

Turin, in northern Italy, is not a usual place to look for a sundial by an 18th-century provincial English maker but that is where the dial shown in Fig. 1 was found. The owner, an antique dealer who had not realised it was English, had acquired it very recently from a local collector of surveying equipment but we have no idea how or when it travelled to Italy.

It can be seen that the dial, 6½″ in diameter, is heavily weathered with a thick patina. Someone has partially cleaned the area to the south of the gnomon so that the signature can, in the right light, be read as (Fig. 2):

W Lumb Swillington
Lat 53^{D} 45^{M}
1765

Fig. 2. Close-up of the signature. Note the small piece of the circumference missing at the top-left.

Swillington is in West Yorkshire, just to the southeast of Leeds, and a quick look at Jill Wilson's *Biographical Index*[1] shows that William Lumb (1737–1801) was a schoolmaster, land surveyor and dial designer. More worryingly, he was said to have made a dial for Swillington church in the 1760s which is now "missing" – could this be that dial?[2] The engraved latitude is certainly only an arcminute less than that of Swillington, well within the accuracy of the period. A little online searching turned up some more information in the form of some notes about Barwick, another town about 5 miles further north.[3] There is an entry from the church accounts 1765 for a payment to W. Lumb "for the dial" and also information that a Richard Lumb – surely a relative – was a churchwarden in Barwick

Fig. 1. The W. Lumb dial.

in 1769. (Nowadays, Barwick is remembered for the music *Barwick Green*, the theme to *The Archers*![4]) This led to the discovery that a much later member of the Lumb family had written a description of the local Barwick church which gave much more information about William as follows.[5]

It seems that William Lumb (jnr) was born in Barwick on 7 March and christened 26 March, 1734, three years earlier than the *Index* date. His father, also William, was Constable in 1743 and Overseer of the Poor in 1747. William jnr was married at Leeds, 1758, to Mary, the daughter of Richard Dawson of Carr House, Garforth. He was schoolmaster at Barwick and afterwards at Swillington, where he resided at Smeaton House. He was also High Constable of the Upper Division of Skyrack, parish register, land agent, land surveyor for the Swillington and Rothwell Haigh Inclosure Acts, and he designed sundials for Barwick (1765), Kippax and Garforth (1761), these being other local towns or villages. Strangely, this source does not mention a dial for Swillington. His son, Robert Lumb, became a JP and moved to Lowther about 1800 where he became chief agent for the Earl of Lonsdale. In a footnote elsewhere[6] we learn that another son, John, who

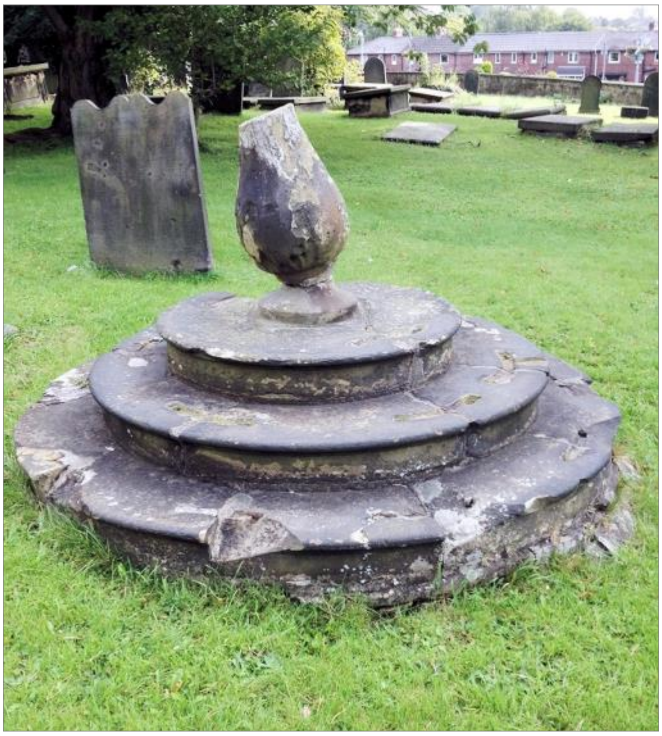

Fig. 3. The empty pedestal at St Mary's church, Swillington. Photo courtesy of John Webster.

died 1 August 1796 at Duke St, London, was "an eminent clock and watch maker".

The dials mentioned as made for Kippax and Garforth are not in the Register so the Registrar (John Foad) consulted local member John Webster who kindly agreed to go and look for them. Unfortunately, not only was there an empty pedestal at Swillington (Fig. 3), as had been expected, there were also pedestals, of different designs, with no dials at Kippax and Garforth (Fig. 4). At the latter, there was an accompanying stone plaque but the inscription has so far resisted deciphering. A dial plate by W. Lumb and recorded as dated 1768 had been reported by Alan Cook at Barwick in 1996 (SRN 3279) but, as Fig. 5 shows, it has been replaced by a modern 'garden centre' dial by 2017.

The reference to William Lumb living at Smeaton House is intriguing as John Smeaton FRS (1724–92) was a near contemporary and something of a local hero as a great civil engineer.[7] Smeaton's family came originally from York and John Smeaton had worked initially as a mathematical instrument maker with the much esteemed clockmaker Henry Hindley of York, known to have made at least one sundial. Smeaton had an extensive workshop at his home. This, though, was not Smeaton House but Austhorpe Lodge in nearby Whitkirk (Leeds), which was built by his grandfather. Smeaton House, which still exists as a Grade II farmhouse,[8] was owned by John's uncle (also John) until he died in 1743 – it must have had another owner before Lumb purchased it in the 1760s. This may thus be a red herring to the story of Lumb's dials which he "designed" but probably did not make himself, though the fact that a son went on to become a clockmaker does leads to a possibility that William had good local contacts with the trade and he probably knew John Smeaton.

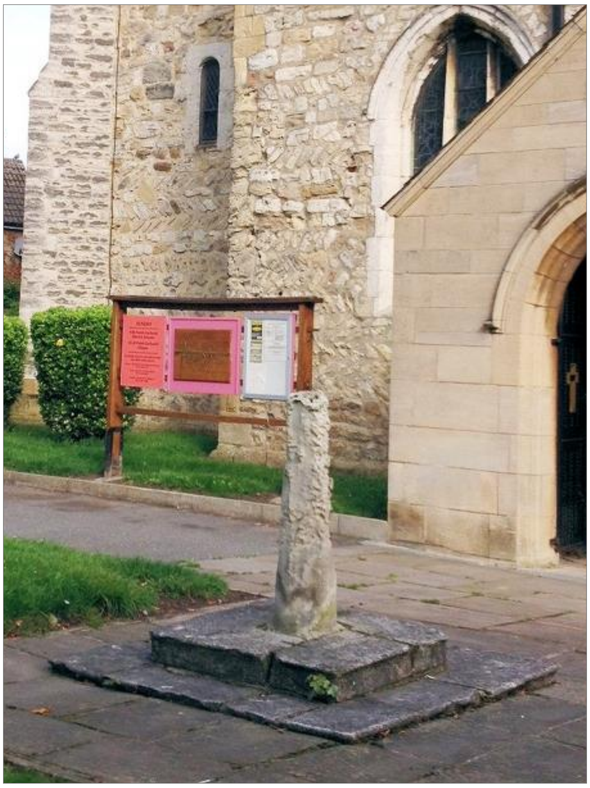

Fig. 4. The empty pedestals at Kippax (L) and Garforth (R) with an inset of the plaque at the latter. Photos courtesy of John Webster.

Fig. 5 (left and above). The dial currently at Barwick (SRN 3279) which replaces the W. Lumb dialplate that was reported in 1996. Photos courtesy of John Webster.

The Dial

The dial in Fig. 1, which is currently the only extant example of Lumb's work, is quite an ordinary horizontal but nicely made and with a plain gnomon which has evidently been cast with integral feet. The engraving is proficiently done with a simple four-point compass in the centre and a division to 5 minutes with the half-hours denoted by a small arrowhead. The Roman numerals are read from inside the dial, a hang-over from an earlier generation – fashions changed only slowly. The plate itself is quite thin, varying between 1.5 mm near the centre to 1.2 mm around the rim. The engraving has caused slight season cracking in places, leading to the loss of a small segment on the circumference, as can be seen in Fig. 2.

Fig. 6. Side view showing the gnomon profile and the pedestal spike.

One unusual feature is the large spike projecting underneath from the plate centre, screwed though the plate into the gnomon and shown in Fig. 6. The spike is tapered to be held in a filler material in the top of the pedestal – it can be seen that there are no holes in the plate for retaining screws.

The metallurgy of the dial was analysed by X-ray fluorescence (XRF) in the normal way and the results are shown in Table 1. The dial plate is quite a good quality high leaded brass for the period although it has suffered a large amount of dezincification at the exposed front surface. The cast gnomon, on the other hand, is a quite extraordinary alloy with roughly equal amounts of copper (Cu), lead (Pb), and tin (Sn). It has a thickness varying from 5.3 mm near the base to 6.0 mm at the tip. It is difficult to find a reason for this unusual material and it is most likely that it was an economical mixture of recycled items, with extra lead added both for cheapness and to lower the melting point and improve fluidity. Note, though, that the tin levels are far higher than for any bronze or bell-metal so extra tin must have been added to the mix. The most likely source of this would be old pewter utensils, a view confirmed by the high levels of antimony (Sb), observed (a typical sheet pewter of the period would be 92% tin, 2% copper, and 6% antimony). The use of this alloy points to a small local foundry, perhaps even a homemade one.

The spike is predominantly iron (Fe). At this period, it is likely to be wrought iron but the XRF technique is not able to 'see' the small carbon content that it is likely to have. The results do show a significant amount of lead though this is probably mainly on the surface as a result of having at one time been leaded into the pedestal.

Area	Cu	Zn	Sn	Pb	Ag	Ni	Fe	As	Sb	Bi	Comments/Others
Dial plate (back)	64.4	32.0	0.14	3.16	0.08	0.04	1.31	nd	0.02	nd	Mechanically cleaned
Dial plate (front)	70.7	23.3	0.2	5.53	0.11	0.03	0.14	nd	0.02	0.07	Semi-cleaned area at S
Gnomon (average of E & W sides)	36.6	1.5	20.3	33.4	0.26	0.37	0.73	nd	6.4	0.11	Very variable
Pedestal spike	0.77	0.22	nd	1.0	0.01	nd	85.9	nd	nd	nd	Partially cleaned

Table 1. Composition of the William Lumb dial in wt% as measured by X-ray fluorescence (XRF). (Details as per ref 9.) nd = not detected.

Conclusions

William Lumb, if not exactly prolific as a sundial designer, was one of many educated people who took on the challenge of designing dials in the 18th century. The challenge remains to find further examples of his work and to solve the question of who actually fabricated the dials for him.

ACKNOWLEDGEMENTS

I am grateful to John Foad, Jill Wilson and John Webster for their help in researching this dial.

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john.davis51@btopenworld.com

NOTES ON THE 2017 AMERICAN ECLIPSE

FRANK H. KING

The solar eclipse on 21 August 2017 was especially notable because the path of totality spanned the United States from the west coast to the east coast. One might naïvely suppose that this path would cover a sufficiently large area for there to be plenty of room for all would-be observers, but it takes only a little imagination to appreciate the scope for truly massive gridlocks on the roads leading to the good sites.

Fig. 1. Jefferson Barracks.

The 2017 NASS conference was held in St Louis, Missouri, and we knew that the period of totality in the area would be

Fig. 2. The Mississippi River and railroad.

around 1:15 pm. The organisers had chosen an ideal place for observation. This was in the grounds of the Jefferson Barracks[1] which date from long before the Civil War and are still in use by the US Army. They are a few miles downstream along the Mississippi River from St Louis. The plan was to visit a few sundials on the way, paying careful attention to traffic reports as we went along. In the event, we omitted only one scheduled stop and arrived at the barracks with time to spare.

We had packed lunches in one of the barracks buildings (Fig. 1), and then went to the viewing area (Fig. 2), where we overlooked the Mississippi. Foreground interest was provided by a railroad.

The Barracks have a sundial (Fig. 3), and we noted that the root of the gnomon did not align with the VI–VI line. Did this reflect the quality of US military hardware as a whole?

Fig. 3. The Jefferson Barracks sundial.

Fig. 4. Roger Bailey with his solar observatory.

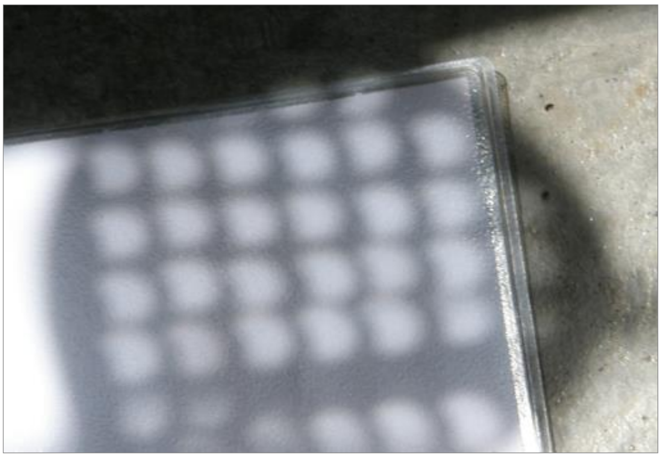


Fig. 5. Images from a kitchen strainer.

A number of NASS members had brought along various gadgets for observing the progress of the eclipse. Roger Bailey used the railings round the sundial to prop up his equipment (Fig. 4).

At the simpler end of the gadget spectrum we saw how a kitchen strainer could be used to cast multiple images of the sun (Fig. 5).

For a brief moment, captured in Fig. 6, a number of delegates were spotted heading for the shaded wall of one of the barracks buildings. Characteristically perhaps, I was seen heading in the opposite direction.

It was suggested that I was much more interested in the splendid hat that Bill Gottesman was sporting for the occasion. What had actually caught my attention was not Bill's hat but the little mirror that he was holding in his hand. He was using this as a reflection instrument to cast an image of the sun on the wall of the building. The image is shown in Fig. 7 where it is being admired by some of the soldiers who are stationed at the barracks as well as by some visitors.

My thoughts were on whether it was reasonable to expect to see an image of the sun on the wall given the size of the mirror and the distance to the wall…

Fig. 6. Why am I not following the crowd?

Fig. 7. The image of the sun on the wall of the barracks building.

The analysis is strongly akin to considering the patch of light that you see on the floor of a room when the sun shines through a hole in the ceiling. I am thinking here of the great noon lines (*meridiane*) found in a number of churches and cathedrals in Italy and France.

If the hole is sufficiently large, such as the 9 metre diameter hole in the roof of the Pantheon in Rome, then the bright patch on the floor will be the same size and shape as the hole. If the hole is sufficiently small then, instead, you see an image of the sun.

Cassini believed that, to obtain an image, the diameter of the hole should be no more than one-thousandth of the height of the hole above the floor. Experiment suggests that you will obtain an image even if the hole-to-height ratio is reduced to around 1:400 but the quality is undoubtedly degraded. Cassini's disciple Bianchini, who set out the meridiana in S. Maria degli Angeli in Rome, noted that the hole was about 22 metres above the floor and so chose to have a hole about 22 mm in diameter. I am using modern measurement; metres and millimetres had yet to be invented!

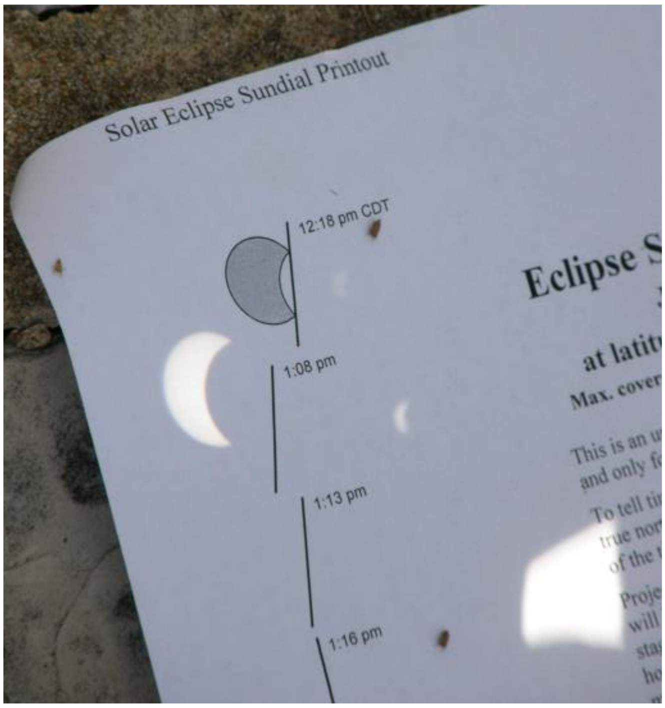


Fig. 8. The Bill Gottesman Eclipse Sundial.

The calculations for a mirror are essentially the same. You can think of the sun shining through the mirror from the back and the edge of the mirror serving as the rim of the hole.

I did not measure Bill's mirror and I did not pace out the distance to the wall but let us guess that the mirror was 30 mm in diameter; Cassini would then be satisfied if the wall were 30 metres distant. The mirror was probably a little larger than that and the wall a little nearer but the ratio was unlikely to be outside the 1:400 limit. The image was certainly of lower quality than the image that Roger Bailey was achieving with a better optical arrangement.

Bill's mirror was a mere sideshow compared with his truly ingenious Eclipse Sundial. You can see and hear Bill himself explain this instrument by going to *eclipsesundial.com* and playing the video that is heralded by this page. The heart of the instrument is the printout shown in Fig. 8.

In essence, you imagine a line connecting the two cusps of the crescent and note that this line rotates as the eclipse progresses. You have to begin by setting the orientation of the printout correctly and, subsequently, you note where the line of the cusps most closely aligns with a sequence of lines drawn on the printout. This way you can determine the time of day! In Fig. 8, the line between the cusps approximately aligns with the 1:08 pm line on the printout. At this stage of the eclipse the rotation is quite slow so the precision is not very good. Moreover, the instrument fails during the period of totality but observers have other things to concentrate on at that time!

I took the advice of an astronomer friend in Cambridge who advised that there was little point in taking photographs during the period of totality. "Others will take much better photographs than you can." That said, I was surprised by the subjective changes in light level. The sky was unquestionably darker during totality but the sky was still noticeably blue. It seems clear that all those photographs of total eclipses that I have seen in text books came from cameras that were stopped well down!

Perhaps the strongest memory from the period of totality was the tremendous noise from the cicadas in the nearby trees. I have no idea what cicadas get up to at night but whatever it is, they certainly don't do it quietly.

NOTE

1. The senior US Army Officer who welcomed us to the Jefferson Barracks gave us a brief history and noted, *inter alia*, that the first successful parachute jump took place here. He did not tell us about the unsuccessful jumps. For a very readable history, visit: *en.wikipedia.org/wiki/Jefferson_Barracks_Military_Post*

fhk1@cam.ac.uk

NEWBURY ONE-DAY MEETING

23 September 2017

Nearly 40 members of the Society met once again at Sutton Hall, Stockcross near Newbury for the annual one-day meeting, splendidly organised by David Pawley. Wendy kept us supplied with plentiful tea and coffee, and a wide selection of biscuits.

Morning

As is customary, early arrivers helped set out the chairs and tables for exhibits. This year the 'special feature' was 'Heliochronometers', and there was an impressive array of these, along with the other exhibits.

Peter Ransom, our regular Master of Ceremonies, welcomed us all and, in particular, those attending the 'Newbury Meeting' for the first time. He was our first speaker...

Peter Ransom: *The Fort Belan Sundial – a chance find on 29 May 2017*

Fort Belan was built in 1775 by Thomas Wynn, then MP for Caernarfonshire and later to become Lord Newborough. It was the only purpose-built fort of the American Revolution, guarding a narrow passage of the Menai Strait. No shots have been fired in anger from the fort. In the 1820s, it was turned into a private fort with a small harbour for Spencer Wynn's steam yacht.

The watchtower was built in the 1890s and on its south face is a slate sundial painted white showing the hours and quarter hours from 7 am to 6 pm. It bears the words "Sun time of Belan Fort slow of Greenwich 17 minutes". This corresponds to its longitude of 4° 20' W.

Irene Brightmer pointed out that she had visited this dial in 2010 and it is in the BSS Register SRN 7222 and that the name "F Barker and Son, 12 Clerkenwell Rd. London" is engraved on the gnomon, a fact Peter had not noticed when visiting the fort on the Spring Bank Holiday.

The fort now consists of private holiday (bookable) apartments, but is open at bank holidays when the Anglesey Hussars, a re-enactment group, hold displays and fire cannons on the hour. In the adjoining harbour area is a chain cleaning stove, reputedly the only one left in the world. Chains from boats were fed through a hole in a wall, passed through a stove and then onto a grid before being returned to the boat in the harbour.

Brian Huggett: *A DIY Garden Heliochronometer*

Brian Huggett described how, just a year previously, he had known nothing about sundials. Looking at sundials when visiting open gardens with his wife, however, had inspired him to try to make one for his own garden that showed clock time in a simple manner. This had been achieved with accuracy to within a minute of clock time.

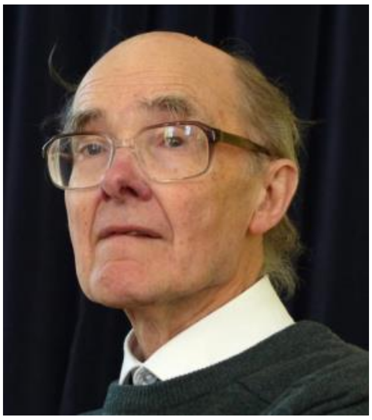
The fact of his heliochronometer working at all had come as something of a surprise to Brian, and he had certainly never envisaged writing an article for the BSS *Bulletin* or giving this talk.

The technical aspects of Brian's talk are covered in his article in the September 2017 *Bulletin* and, in greater detail, at *http://www.short-humour.org.uk/Heliochronometer/Heliochronometer.htm.*

Brian concluded by expressing appreciation for ideas and suggestions that had arisen as a direct result of contact with the BSS. He had not originally intended to make another sundial, but these ideas, his experience of operating his heliochronometer during the summer, and the interest and pleasure of being involved with the BSS had now made Mark 2 a distinct possibility.

Frank King: *Generalised Delineation: Multi-Centre Marking-out*

Frank King began by making the observation that one usually marks out a flat dial plate either from a single centre or from two centres.



As a first illustration, he considered a sundial with a rod gnomon. He noted that, if the rod has a circular cross-section, it will intersect the dial plate in an ellipse and that hour lines can readily be marked out from the centre of this ellipse.

As a second illustration, he considered a sundial with a gnomon whose cross-section was a rectangle. With its broad faces facing east and west, this gnomon will intersect the dial plate in a rectangle (the footprint) which is an elongated version of the cross-section.

We saw various ways of using this gnomon. One could mark out from the centre of the footprint, or from the two points at the ends of the south edge of the footprint or from the two points at the ends of the north edge which uses the gnomon in an underslung manner.

The underslung gnomon gives rise to problems at noon when, rather than a noon gap, you need, in effect, a negative gap. If the gnomon is used more conventionally this negative-gap problem occurs at midnight, assuming you extend the range of the back hours that far.

A naïve possibility is to mark out the daytime hours from the two south centres and the back hours from the two north centres. This is a disaster. There are now problems at both 6 am and 6 pm!

A much better way to exploit four-centre marking out is to use each of the centres for four different six-hour periods. The hour-lines now form an attractive spiral array. You have to read the time from the same edge of the shadow throughout the day.

The idea can be generalised for use with a circular cross-section rod gnomon which is rather stouter than normal. Here we again note that the rod intersects the plane of the dial in an ellipse but now the hour lines have to be tangents to this ellipse. If you have 24 hour lines then each one has its own centre. An example of this 24-centre marking out is shown in Fig. 3 on page 38 of this issue of the *Bulletin*.

Jackie Jones: *Promoting Sundials on Social Media*

Jackie Jones gave a short talk about her project of promoting sundials on social media. In June 2017 she posted a sundial each day on Facebook to increase awareness of them amongst her Facebook 'friends' who knew very little about them. The first one was the dial on the front of her house, followed by an Anglo-Saxon dial in Sussex, then mass dials, large church dials, equatorials,

pocket dials and many others. As well as the pictures, she included information about how they worked and any other interesting or important facts. Also included were some that don't work with an explanation as to why, as well as links to cut-out card dials.

The Facebook postings were kept on a very informal and personal basis so there was no feeling of being given a lecture, but still having a number of basic concepts explained.

She prepared it all in advance; the pictures were selected, adjusted if needed and put into order. They were all her own to avoid any copyright issues; therefore, many were holiday pictures and her own dials. All the text was written before so it could be copied and pasted each morning. Also included were as many links as possible to the BSS website.

Ian Butson: *A Sundial for a Flat Roof – Or, Should I be doing something more productive with my time?*

Ian's house has a flat-roofed extension facing 7.5° east of south and measuring 12′ × 10′; he looks out onto this roof from the room containing his PC. On obtaining an attractive terracotta roof-ridge finial, he wondered what better use could be made of it than as the gnomon of a horizontal sundial that he could see whilst working on the PC?

Angles for the hour lines were established, with suitably numbered inverted flower-pot saucers for hour markers. From the height of the gnomon and the appropriate elevation of the sun, distances were calculated for placing markers on the noon line to indicate the summer and winter solstices.

Sadly, it soon became apparent that the use of this finial was not ideal: it cast a shadow generally too wide to be reasonably accurate, and the considerable variation in the shadow length throughout the year made it difficult to read accurately.

It was therefore decided instead to use a conventional sloping gnomon, for the local latitude of 52°. This was constructed using materials to hand: some flat steel strip, a metal plate on which to fix it, some DIY right-angle brackets and M6 gutter bolts. A cross bolt at the tip of the gnomon would act as a nodus. The assembly was weighed down with lead sheeting attached below the plate and with part of a cut brick.

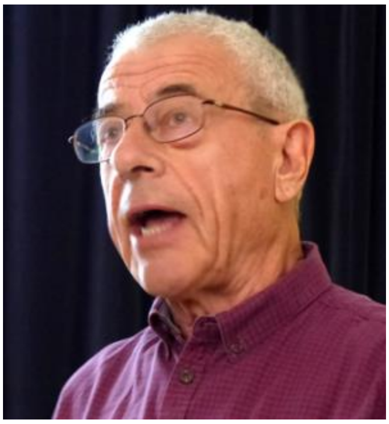
The hour markers were set against the measured hour angles, and adjusted to take into account the EoT and the local longitude correction factor, when the sun shone. They were positioned in a pleasing curve across the roof, so that the time from 6 am to (almost) 6 pm would be displayed. Distances for the summer solstice, equinox and winter solstice were calculated, with square quarry tiles (again, to hand) marked with Roman numerals, set in a straight line, to indicate the time during the day at the solstices. Unfortunately, the point where the winter solstice would be indicated is off the flat roof and a little way up the back wall where the flat roof joins the house: the point on this wall will be marked, but on the day of the winter solstice, 21 December, leaden skies will almost certainly prevail!

David Hawker: *Finding a Motto*

Back in 2000, David wanted a motto for a wall dial he was making. He said that he had found the motto in a line from the poem 'One Evening' by W.H. Auden and he recited part of this poem. The line came from the following verse:

> In the burrows of the nightmare
> Where Justice naked is,
> Time watches from the shadow
> And coughs when you would kiss.

It's quite fun to see that the relevant line, 'Time watches from the shadow', when used as a sundial motto can be interpreted in a very practical way as well as the poetic.



John Davis: *Another 18th Century Dial Designer*

In the final talk of the morning, John Davis described a small dial from William Lumb of Swillington. An article based on his talk appears on pages 15-18 of this issue of the *Bulletin*.

Lunchtime

After John's talk we went outside, where it was now beautifully sunny, and we lined up for the group photograph by our official photographer Mike Shaw.

Many people enjoyed eating their lunch in the sunshine, chatting with other attendees. Meanwhile, those in the hall looked at the varied exhibits and items for sale.

Afternoon

John Davis: *A Gamble that Paid Off*

After the lunch break John presented 'A Gamble That Paid Off', showing a weathered dial plate which had an added brass plaque covering the maker's name. Removing this revealed an important addition to our list of makers of mathematical instruments in the Midlands during the Industrial Revolution. This talk will appear as a *Bulletin* article in March 2018.

Irene Brightmer: *An 'Astronomical Dial' and an Eighteenth-Century Ephemeris*

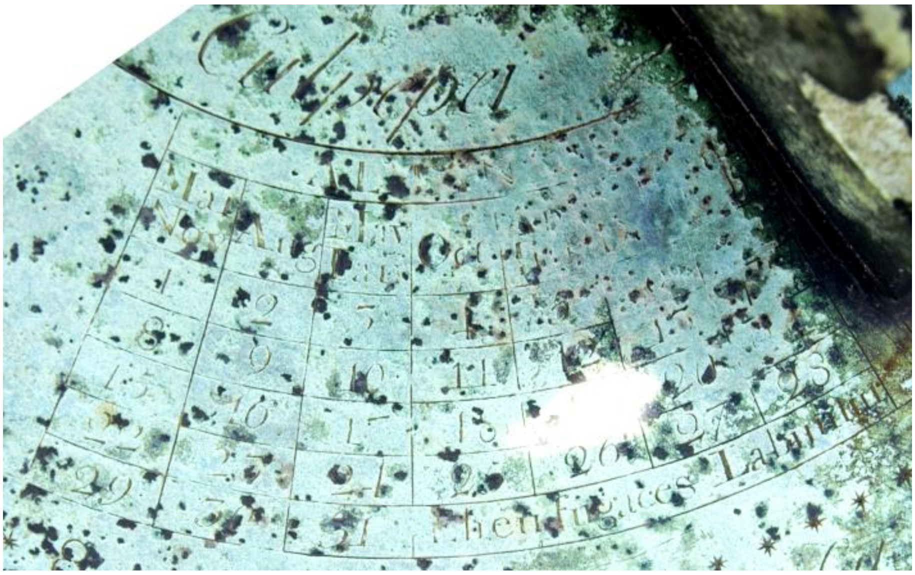
Irene reported on a dial by Edmund Culpeper recently recorded in a country house garden in North Wales. The horizontal dial was made in the 1730s, is signed and has the latitude and a motto, as well as the coat of arms of the owner. It also displays a wealth of astronomical detail. The pierced gnomon is arched over the central point of the dialplate so that the point represents the sun at the centre of the solar system with the orbits shown of the six then-known planets. An EoT table and a table showing a perpetual calendar are also shown. More unusually the distances from the sun of each planet in millions of miles are given, and also the length of time of each planet's orbit around the sun in months, days, hours, minutes and seconds.

Archival research has shown that these details reflect the interests of the owner of the dial. His copy of Parker's *Ephemeris* for 1726 still survives, with astronomical tables personally annotated and shopping lists which include a new telescope and new astronomical publications. In addition, he described his observations of the Aurora Borealis in October.

This dial is a rare survival of the collaboration between a provincial amateur astronomer and a highly

An assemblage of heliochronometers.

Part of Kevin Karney's GINs and GUNs display.



The 'cryptic calendar' on the dial by Edmund Culpeper, the subject of the talks given by Irene Brightmer and John Foad. Photo: Irene Brightmer.

proficient London dial-maker who used his engraving skills to display the extremely fine detail which has survived to this day.

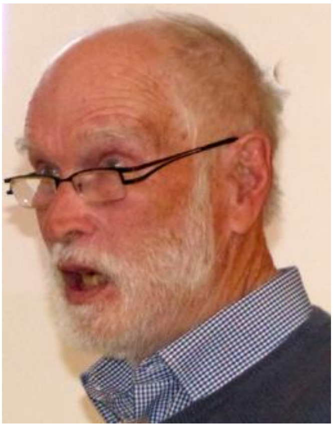
John Foad: *Culpeper's Cryptic Calendar: Speculations on its Use, and on the Date of the Dial*

The Culpeper dial described by Irene Brightmer in the previous talk includes the skeleton of a perpetual calendar, but no instructions for its use appear on the dial plate. John Foad explained how it can be used for any year, given a table that links a day of the week to the Dominical Letter. The dial is undated, but it must have been made between 1730 and 1737. The layout of the calendar seemed to make 1733 the most likely date. [But unfortunately, John now reports that further research following very useful feedback at the meeting makes this conclusion invalid. The date is still unknown!]

Patrick Arnold: *Experiments with a Stick Dial*

A sketch in a book on the history of navigation shows Pytheas examining a primitive sundial with a vertical stake (gnomon) in the centre of radiating lines (hours?). The caption below the sketch claims that Pytheas could calculate by this instrument the latitude of Marseilles. In truth, said Patrick, he probably spent many days or years noting the length of the sun's shadow on the meridian line and thus compiled an ephemeris which he used to calculate the latitudes of various places on his epic voyage to the British Isles and Arctic Circle.

At this point Patrick was struck with the idea of a portable gnomon calibrated to show the sun's altitude for 53° of latitude on any day and at any time. First, he needed twelve faces to record each month; this resulted in a set of three sticks, each having four faces. Each face is divided into three columns, each column representing ten days. From the bottom end of each stick, a base length is measured and marked 20 inches for the summer months and 30 inches for the winter months. Then a table of hourly altitudes in degrees is calculated for the 5th, 15th and 25th of each month. It is possible to calculate the approximate 216 altitudes either by trigonometry or graphically; however, the table of pre-calculated altitudes makes life easier. The tangent of the altitude angle multiplied by the base length gives the position of each hour as measured from the bottom of the stick. These hourly marks are neatly squared across the column and scored with a suitable marker.



In use, a place is marked on a level area of ground. The stick is held upright on this place and the fall of the sun's shadow is noted, and another mark is made the base length away from the first mark. The stick is again held upright on the first mark and a finger is slid down the face of the stick until the shadow of the finger falls on the second mark. Where the finger rests the time can be read from the appropriate column.

Kevin Karney: *GUNs & GINs – an Old Gnomonic Idea Revisited*

The circular Gnomonical Universal Nomograph (GUN) – covering the whole world – and the slide-rule-like Gnomonical Instrument Nomographic (GIN) – covering the British Isles – were demonstrated. These devices extend the idea introduced in the Pilkington Sol Horometer to find the Equation of Time, whereby a non-linear scale is moved against a linear scale. The Sol Horometer method suffers inasmuch as it caters for neither the leap year cycle changes in the Equation of Time, nor changes in noon EoT in different time zones, nor the longitude error between one's location and the time zone meridian. The GUN and GIN overcome these shortcomings.

The GUN and GIN, like a slide rule, have

- two fixed scales (one with the leap-year-cycle table of the Equation of Time and one with the resultant EoT and the Solar > Mean correction)
- a moving scale to input the required date and longitude offset
- an alidade/cursor to line things up

The devices, albeit made of laser-cut MDF, could be read to an accuracy of 1/2 minute. A thin card version of GIN was available to take home for those interested.

Kevin Karney: *Why Bother to Correct your Sundial – Ways and Means*

Kevin pointed out the essential difference between the 'True Time' gnomonists who like simple dials and those like himself who believe that all dials should somehow attempt to indicate Mean Time. He holds this belief because it is difficult to defend gnomonics to those who write off sundials since they do not indicate what is on their phones. He enumerated with examples the many and varied ways to provide mean time.

These comprise three main classes:

- correction tables (continuous, intermittent or 'Victorian')
- correction graphs (cartesian, polar or intrinsic)
- direct mean time dials

The latter he sub-classified as those with:

- shaped hour lines (as in the Dolphins dial)
- moving hour lines (as in the Sol Horometer)
- shaped style (as in the Schoymer dial
- moving style (as in the Double Analemmatic)
- shaped alidade (as in the Aten heliochromometer)
- moving alidade (as in the Pilkington Gibbs & Cooke heliochronometer)

He illustrated the practical ways in which, with single cams, double cams, or gears, one may mechanically generate the Equation of Time. The talk ended with a demonstration of the Lusby-Taylor astronomical method for generating the EoT.

Ian Butson: *Sundial Restoration at St Mary's Church, Mentmore, Bucks.*

In his introduction to his account of the restoration, Ian gave us some interesting background to the district; in particular, as it had been adopted by the Rothschild family as a favoured area for the acquisition of their estates and construction of large houses including Mentmore, this part of Buckinghamshire became known as 'Rothschild-shire'. Ian showed us many slides of their logo (five arrows) on buildings and, indeed, incorporated into the gnomon of a horizontal sundial at Wing (SRN 7304). He then moved on to describe the restoration of the wooden sundial at St Mary's Church, an unexpectedly protracted process.

The full story appears in an article on pages 9–11 of this issue of the *Bulletin*.

Andrew James: *Equation Clocks of Joseph Williamson*

The life of Joseph Williamson (c. 1665–1724), clockmaker, is little documented, even though he was Master of the Clockmakers' Company in 1724, and died during his year of office. In a letter to the Royal Society, published in *Philosophical Transactions* in 1719, he writes of having made all the 'equation clocks' in England to date, either while working for other famous makers or on his own account. As most of those who might have contradicted him, but apparently did not, were still alive, it seems likely that he was telling the truth.

Most of the devices he made for others showed the Equation of Time, that is, the difference between clock and sundial time; but a few longcase clocks signed by him survive, in which, originally, a cam rotating once per year raised and lowered the pendulum very slightly (by less than 1/32") to diminish and increase its effective length and time of swing, in such a way that the clock kept solar time rather than mean time. As in England solar time has been unfashionable for clocks for 300 years, most have been modified to keep mean time. However, an example of such a longcase movement was displayed at the meeting; although otherwise modernised it retains its original cam.

Andrew James: *Where Clockwork Meets Shadows – The Equation of Time, Three Unusual Mechanisms*

The Equation of Time has long been a fascinating complication for clockmakers to reproduce mechanically. The usual, and simplest, method is a 'kidney-shaped' cam, which either moves a hand or by, some differential, adjusts the relative motion of a timekeeping hand. The speaker illustrated three more complex mechanisms.

Joseph Rittenhouse, American astronomer, in c.1773 made a clock, now at Drexel University, in which an eccentric pin rotated twice a year whilst carried epicycloidally on a wheel rotating once a year. This added two sinusoidal motions (with a refinement of disturbing the faster according to the slower) in their linear component and thence by rack and pinion to a hand.

Jean-Baptiste Schwilgué, in the Strasbourg Cathedral clock (1842), added the displacement of two vertical edge cams to obtain the solar equation and Jens Olsen, in the Copenhagen Town Hall clock, achieved the same addition using hypocycloidal cranks. Both were careful to distinguish the periods of the anomalistic (for the eccentricity) and tropical (for the obliquity) years and, like Rittenhouse, to perturb the obliquity's sine wave by the eccentricity effect.

Andrew demonstrated the gear trains of the Rittenhouse and Olsen clocks via detailed computer animations to aid understanding of their operations. He showed the difference between anomalistic and tropical years embodied in Olsen's gearing by simulating its running 10,000 years into the future.

Finally, Peter Ransom thanked all the speakers and expressed pleasure at there being so many interesting talks. He proposed a vote of thanks to David Pawley and Wendy for arranging another highly successful Newbury Meeting.

Compiled from synopses provided by the speakers.

Group and speaker photos by Mike Shaw.

IN THE FOOTSTEPS OF THOMAS ROSS

Part 21: Pencaitland Parish Church (and Bowden Kirk)

DENNIS COWAN

In Part 15 of this series of articles (on Scottish Churches),[1] I deliberately did not include Pencaitland Parish Church, as I had intended that it would be in a standalone article. At the same time, I mistakenly did not include Bowden Kirk. These omisssions are rectified here.

Pencaitland Parish Church is in East Lothian, situated about 12 miles south-east of Edinburgh. The church is mainly of 16th/17th-century origin with many alterations over the centuries, and probably stands on medieval foundations.

It is unique amongst Scotland's churches in that it has three sundials, all of them different. In volume 5 of *The Castellated and Domestic Architecture of Scotland*,[2] Thomas Ross says:

"This is an extremely interesting church, presenting as it does examples of architecture ranging over a period of about three centuries. The earliest part—the Winton aisle—is pure Gothic of the fourteenth century, and not being connected with our subject is not shown here. The tower at the west end [Fig. 1] *is dated, over the doorway, 1631.*

"The main body of the church is believed to have been built soon after 1560. The west buttress of this part, shown in detail in [Fig. 2]*, contains a fine sundial with three faces.* [Fig. 3] *shows another dial which terminates the east gable. It will be observed that there is still another dial near the top of the tower, its gnomon being visible in the view."*

Perhaps this description was written before Ross developed his interest in sundials as it is included not in the section on sundials, but within an earlier section in this volume specifically on churches. In the section on sundials he merely comments that:

"There are five[3] *dials on this church. Three are placed on the three faces of the south-west buttress, one on the east gable, and one at the top of the tower."*

The first sundial indeed has three faces and is wrapped around the south-west buttress on the main body of the church (Figs 4 and 5). It is in a quite poor condition with no numerals remaining and only some hour lines on the south face, which declines slightly west of south. The hour lines

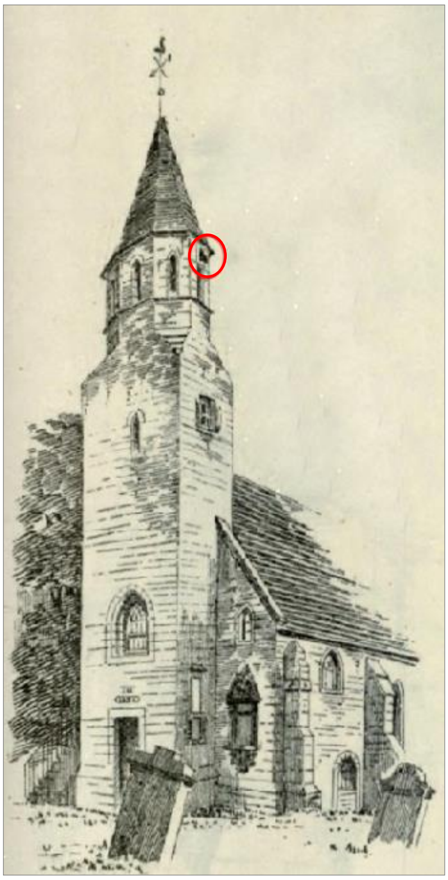


Fig. 1 (left). Ross's sketch of the tower at Pencaitland church with its sundial circled.

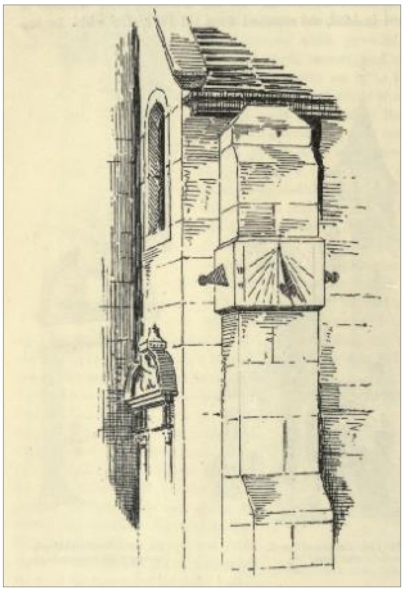


Fig. 2. Ross's sketch of the three-faced sundial on the south-west buttress on the church at Pencaitland.

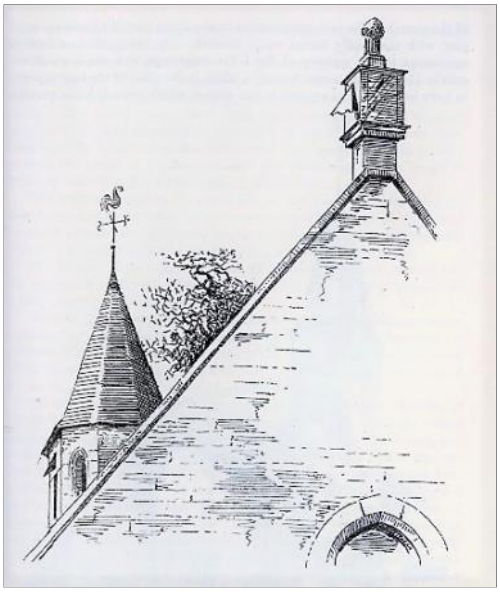


Fig. 3. Ross's sketch of the east gable of Pencaitland church showing the south and east faces of the cube dial as well as the sundial on the tower.

Fig. 4. The south and west faces of the dial on the south-west buttress of Pencaitland church.

Fig. 5. The south and east faces of the dial on the south-west buttress of Pencaitland church.

appear to have been re-carved but it is debatable whether the east and west faces have ever been marked out. All three faces have metal gnomons but they may have been replaced at some point. I'm not convinced that it ever was a working sundial.

As Ross says, the second sundial is on the east gable (Figs 6 to 8). It is a stone cube with dials on all four faces, and is topped with a pineapple-like finial. All faces have Arabic numerals and are complete with intact metal gnomons. It is without doubt the finest of the dials on this church.

The poorest of the dials is next. This third sundial (Fig. 9) is a south-facing vertical single-face stone dial high on the tower at the west end of the church, which contains an octagonal belfry and a dovecote. The dial is so high that it

Fig. 6. The east gable at Pencaitland church with the cube dial on top and the north and east faces in view.

Figs 7 and 8. The cube dial at Pencaitland church. Above: the south and east faces; below: the south and west faces.

Fig. 9. The dial on the tower at Pencaitland church.

must have been of no use whatsoever! The metal gnomon exists but in a precarious state. Only by zooming in closely can some very faint hour lines and a possible Roman iii be seen. I'm not surprised that Ross gives no detailed sketch of this dial.

As to the sundial at Bowden Kirk near Melrose in the Scottish Borders, Ross says:

"A sundial [Fig. 10]*, a feature very common on the churches of this period, occupies the usual position at the south-west corner* [Fig. 11]*, a few feet below a skew-stone, bearing a fleur-de-lis. The dial is dated 1666, and tells the hours with accuracy."*

Fig. 10. Ross's sketch of the sundial at Bowden Kirk.

Although parts of Bowden Kirk are from the 15th century, most of the present kirk dates from the 17th century and Ross comments that as usual for a church of this age, the dial is on the south-west corner. Unfortunately, this sundial is no longer in place. It has been replaced by a modern dial generally of the same design. This new dial shows the years 1766 and 1989 (Fig. 12) and a cross patty for noon. Other than that they are fairly similar.

One noticeable difference, however, is that in Ross's sketch in Fig. 10, it can be seen that the dial is canted to the south (the church faces about 15 degrees to the east of south), whereas the new dial (Fig. 12), which like the original is a south-facing design, is not canted. This is, unfortunately, a major error in the installation.

Although the skew-stone mentioned by Ross is still in place (Fig. 13), there is no longer any sign of the fleur-de-lis.

In order to find out what happened to the original dial and some information on the new dial, I e-mailed the church secretary, but other than a note to say that it had been

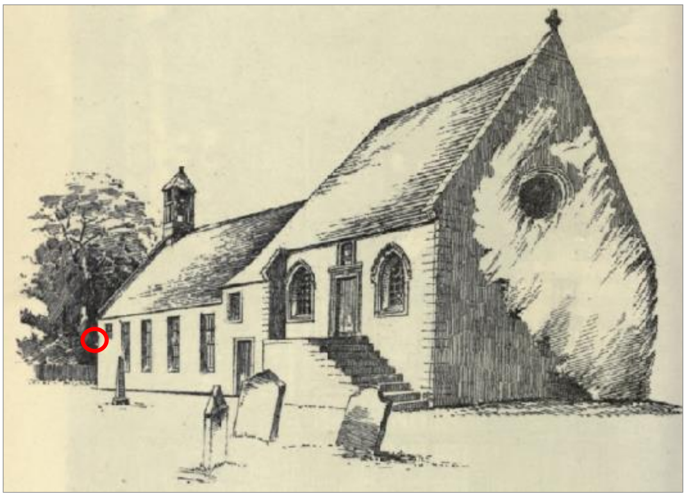


Fig. 11. Ross's sketch of Bowden Kirk with the sundial at the south-west corner (circled).

Fig. 12. The Bowden Kirk sundial today.

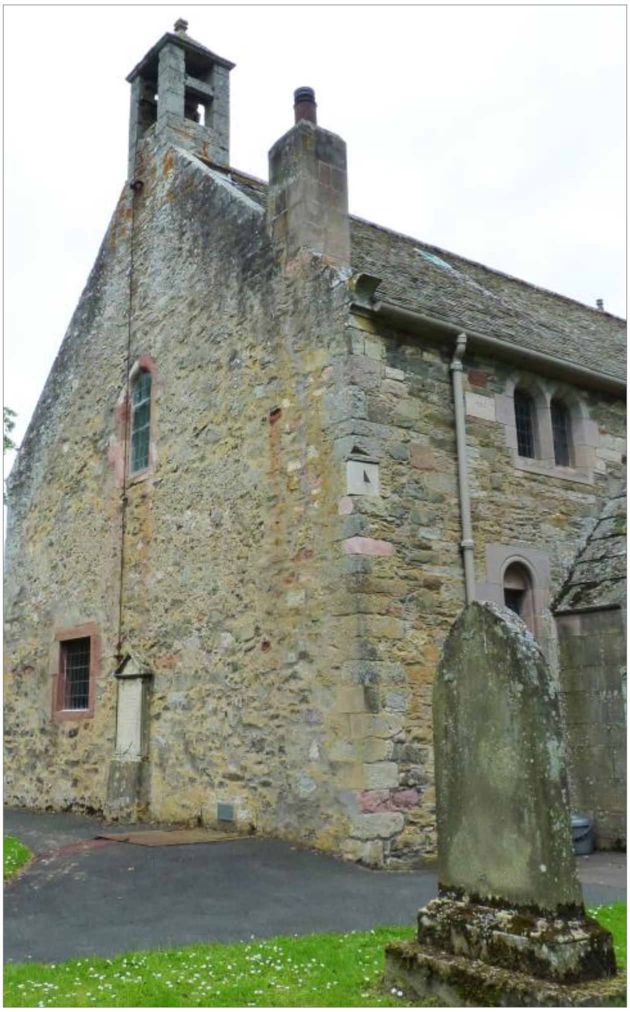


Fig. 13. The dial at the south-west corner of Bowden Kirk with the skew-stone above. The external bell rope, a common feature of many 17th-century Scottish churches, can also be seen.

passed on to the Fabric Convenor, no further response was received. So unfortunately I have been unable to find out any relevance to the year of 1766. It is possible that this was a misreading of the date on the original dial which perhaps had deteriorated since Ross's sketch. I assume that 1989 was when the new dial was installed.

BSS member Kevin Karney visited this church a few years ago and was advised by someone at the church that the maker of the dial was Ken Grant, but that is the limit of our knowledge.

REFERENCES and NOTES

1. D. Cowan: 'In the Footsteps of Thomas Ross Part 15: Sundials on Scottish Churches', *BSS Bulletin*, 28(ii), 20–25 (June 2016).
2. D. MacGibbon and T. Ross: *The Castellated and Domestic Architecture of Scotland*, David Douglas, Edinburgh (1892).
3. Confusingly, in this second passage, Thomas Ross is now counting the first sundial as three dials.

dennis.cowan@btinternet.com

Postcard Potpourri 41
Amen Court

Peter Ransom

This dial will be familiar to readers of the BSS *Bulletin*, because Maureen Harmer wrote about it (plus others) on page 16 of the December 2013 *Bulletin*. There are more details of this dial at *http://www.sundials.co.uk/~london.htm* where it is mentioned in the City of London Sundial Trail. The dial is in a private court, which belongs to the Chapter of St Paul's Cathedral.

Some sources attribute the horizontal eighteenth-century dial (SRN 2196) to Christopher Wren, some to John Rowley. The design of the gnomon bears the motif of the Deanery of St Paul's, the letter D and crossed swords, though on the postcard the D is reversed since the picture has been taken from the wrong side.

The postcard, by Judges Ltd, Hastings was posted in Muswell Hill on 25 August 1953 and mentions, amongst other things: "This sundial is rather lovely – I wonder if it survived the raids." Well, we know it did!

pransom@btinternet.com

A TRIP TO SOUTHERN FRANCE

MIKE COWHAM

Frequently, we take our holidays in France. In September/October 2017 we spent a week in Provence and each day we went in search of sundials. As usual we used the French website created by Michel Lalos[1] to determine where the dials were in that area, as well as for those on our route across France from England. The dials shown in this article are some of the more interesting of at least 82 dials that we found on this trip. Although we saw many simple mass dials, they were generally of poor quality, so these have not been included this time.

Our week was based in Département numbered 13, Bouches-du-Rhône, and most dials found were close to our lodging. Some days we travelled into adjacent départements, particularly to Département 84, Vaucluse, where there are many fine dials to be seen.

On our way to our gîte (cottage) we passed through various towns and villages. One fine large dial was found outside

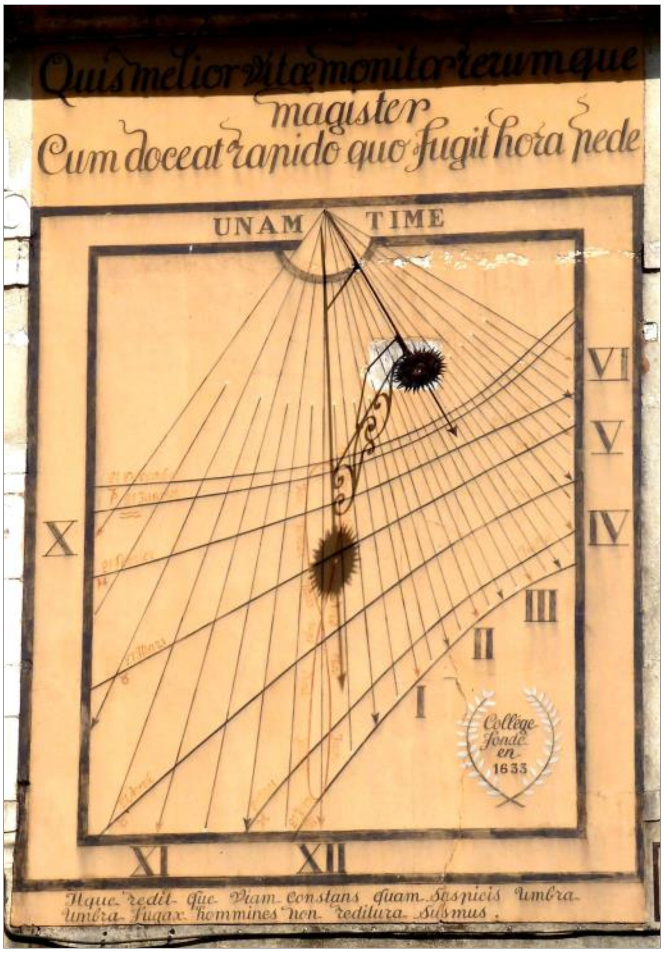


Fig. 1. College at Noyers in Département 89, Yonne.

Fig. 2. Dial on Chapelle Notre-Dame-des-Vignères at Cavaillon.

the college at Noyers in Yonne, founded 1633 (Fig. 1). The dial height covers two storeys of the building and its nodus is an attractive sun shape. The motto above reads:

Quis melior vitæ monitor rerum que magister
Cum doceat rapido quo fugit hora pede

(What better guide to life and master of affairs than that which demonstrates how quickly time passes)

At Cavaillon in Vaucluse, we saw an interesting early semi-circular dial on the south face of Chapelle Notre-Dame-des-Vignères (Fig. 2). It appears to have twelve equally-spaced hour segments.

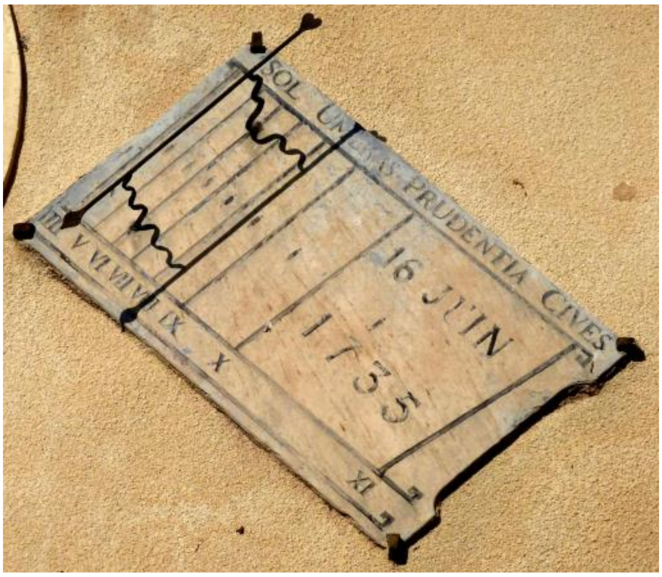


Fig. 3. East-facing dial of 1735 at Eyguières.

Fig. 4. Dial in Grand Rue at Lambesc.

Once at our gîte, we made daily trips in various directions. Travelling east from our cottage, we found an almost direct east facing dial dated 16 JUIN 1735 in the village of Eyguières, situated high on the front of the Tourist Office, in a building that was formerly the Hotel de Ville (Fig. 3). Its motto is:

SOL UMBRAS PRUDENTIA CIVES

(The sun shades prudent citizens)

In the Grand Rue at Lambesc was a rather attractively shaped, almost bell-shaped, dial, with an arrow-shaped gnomon (Fig. 4). It was undated but appeared to have some reasonable age to it.

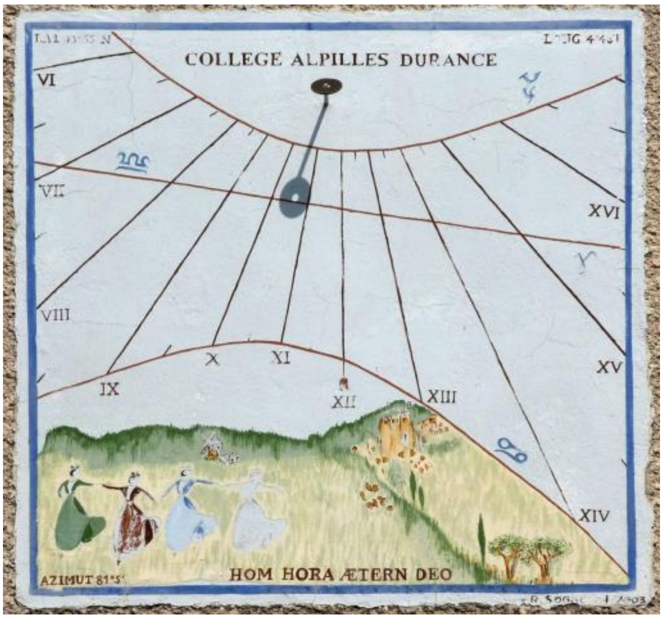


Fig. 5. Painted dial on Collège Alpilles Durance in Rognonas.

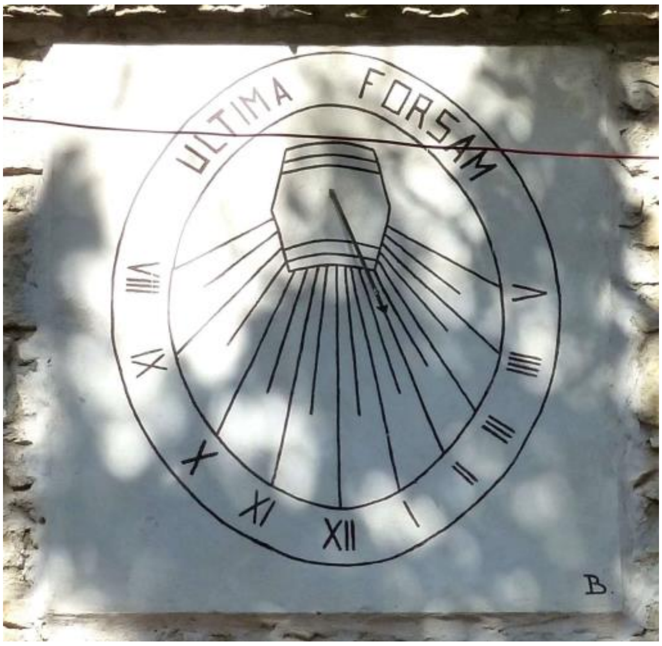


Fig. 6. Dial in Rue Pasteur at Mouriès.

Travelling north from our cottage, we found the following dials.

At Rognonas was a dial at Collège Alpilles Durance, overlooking the market square (Fig. 5). It was finely painted and it carries the motto:

HOM HORA ÆTERN DEO

(One hour for man eternity for God)

Its nodus was a disc at the end of its gnomon, tracing the equinox and two solstice lines.

At Mouriès was a fine oval dial in Rue Pasteur, painted on plaster on a wall (Fig. 6). It is now shaded by several nearby trees, preventing its full use. It appears to show a

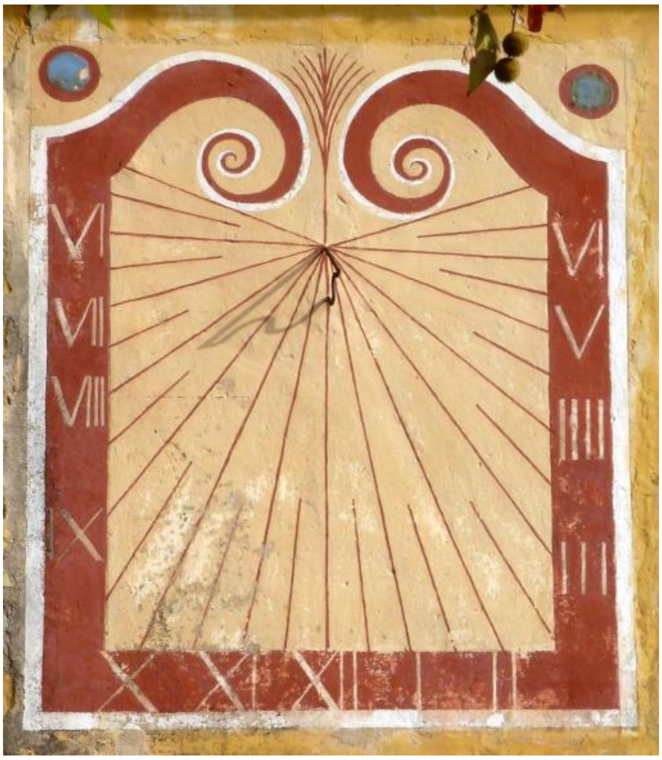


Fig. 7. Painted dial at Paradou.

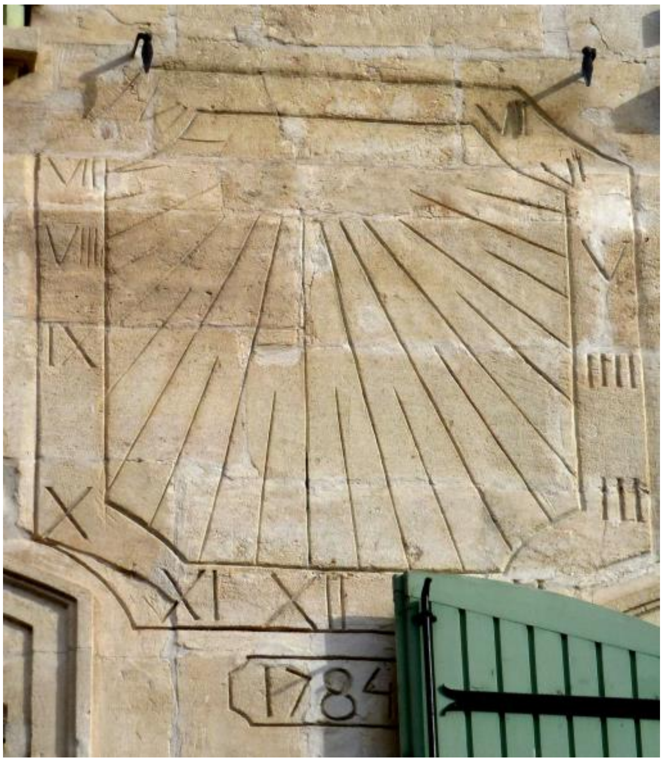


Fig. 8. Dial in Place du Marché, Tarascon.

wine barrel, a fine local feature, with the hour lines radiating from it. Its motto is:

ULTIMA FORSAM

(Last chance)

The dial at Paradou (Fig. 7) was colourfully painted although it will soon need another repaint.

I have included the dial, now missing its gnomon, dated below as 1784 (Fig. 8). It is carved on a house at Place du Marché in Tarascon and it is similar to many seen in the area, mostly on churches. Some of these dials are now hardly visible, but this, although partly covered by a shutter, was about the clearest that we had seen.

A rather attractively painted oval dial dated 1896, showing two young angels holding it, was found in St Martin-de-la-

Fig. 9. St Martin-de-la-Brasque with two small angels.

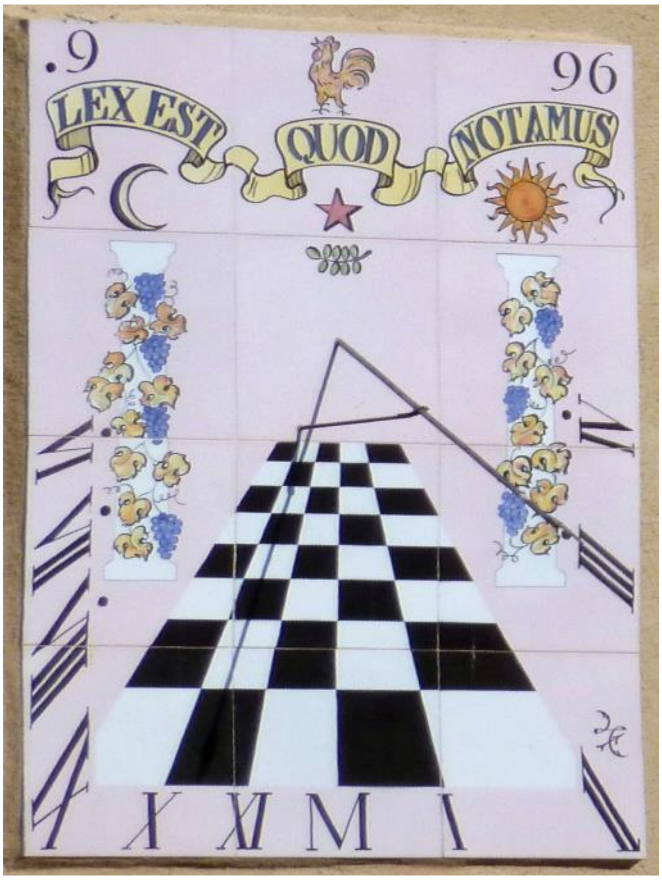


Fig. 10. Dial on a wall in Lauris, Vaucluse.

Brasque in Vaucluse, in Rue des Treilles but at the end of Rue du Cadran (*cadran* = sundial; Fig. 9).

A dial in Lauris, Vaucluse, in Rue Louis Mourre was attractively constructed in 1996 (Fig. 10). It appears to have been constructed on tiles. Its design shows a chequered floor which quite unusually follows the hour lines from IX to II. On either side are bunches of red grapes with their leaves. It carries the motto:

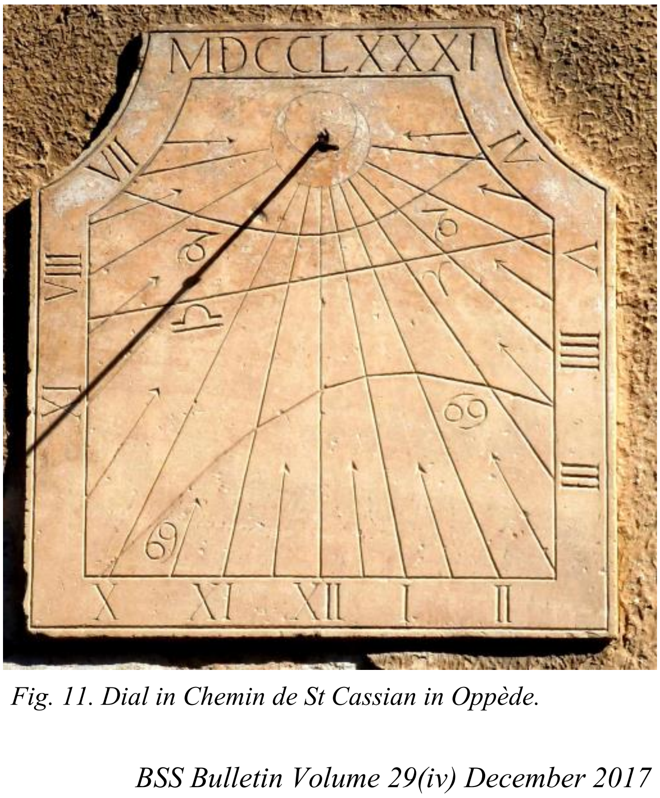


Fig. 11. Dial in Chemin de St Cassian in Oppède.

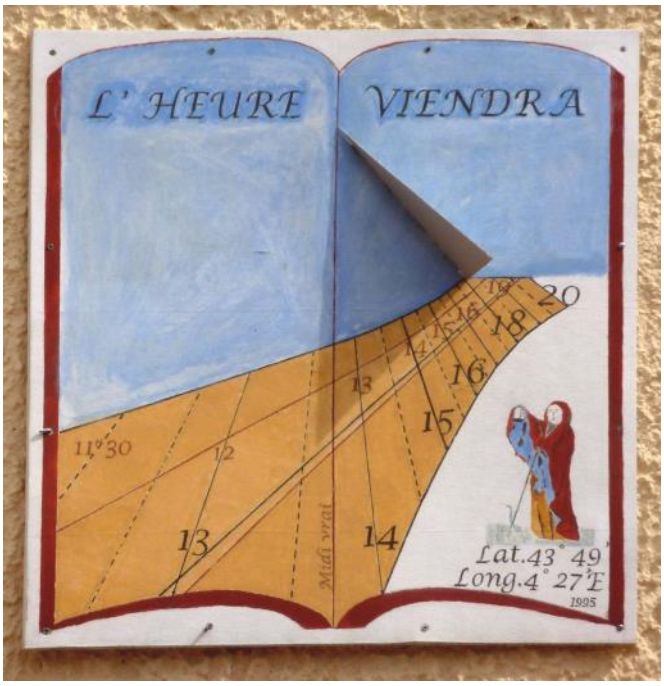


Fig. 12. Painted dial of 1995 at Manduel.

LEX EST QUOD NOTAMUS

(The law is what we observe)

Note that noon is not shown as the usual, XII, but just as M meaning Midi. This is also seen later on Figs 15 and 16.

A dial with its date in Roman numerals at the top was found in Oppède (Fig. 11). Its date of 1781 and its shape are interesting. It also has lines for the equinox and both solstices.

To the south of our holiday region we found a dial at Manduel, in Gard, Département 30 (Fig. 12). It was dated 1995 and carries the motto:

L' HEURE VIENDRA

(The hour comes)

Fig. 13. Dial on a house at Bouc-Bel-Air.

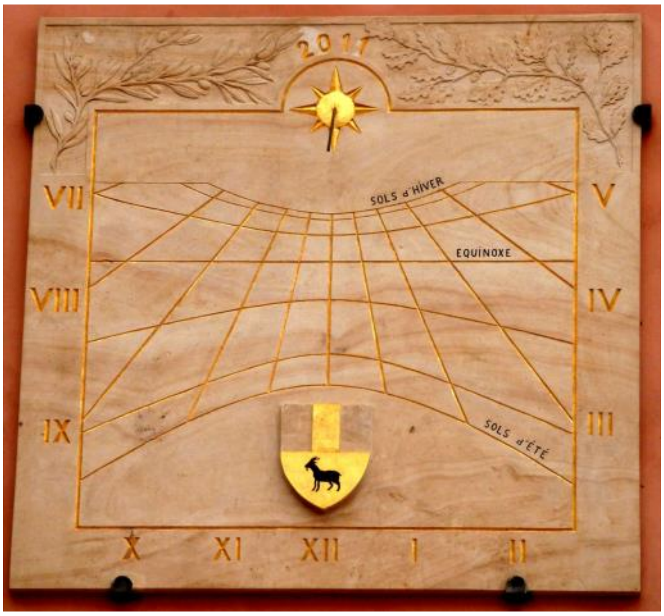


Fig. 14. Carved dial at Châteauneuf-le-Rouge dated 2011.

This dial has been repainted, with some small changes, since the version that is shown on Michel Lalos' website. It is interesting to see that the equinox line appears to be doubled. This also appears on the dial in Fig. 15 below.

In Bouc-Bel-Air was a delightful dial, painted on stone, on a house showing a man above, holding its gnomon (Fig. 13). It is dated 1999. On the architrave above the dial is the motto:

Fig. 15. Dial and clock at Dieulfit, Drôme.

Fig. 16. Dial on the Mairie at La Groise in Département 59, Nord.

TA VIE, SON OMBRE DANS MA LUMIÈRE

(Your life, it is a shadow in my light)

In Châteauneuf-le-Rouge was a fine dial apparently carved from wood in 2011 (Fig. 14). At the lower edge it carries the coat of arms of that city.

On our trip home we came across some other interesting dials. At Dieulfit, in Département 26, Drôme, we found a fine dial (Fig. 15) on the Tour de l'Horologe with a clock joined to it. To indicate the Equation of Time there is an analemma on the noon line, extending between the two solstice lines; there is a disc-shaped aperture nodus on the gnomon. It carries the motto in the Provençale language:

lou tems passo
passo lou ben

(The time passes, pass it well)

Note that the dial is showing the local sun time of about 10:25 and the clock is showing national time, 10:00.

We then spent a little time in the Alsace, remembering our BSS Sundial Safari there in 2008.

Then travelling north into Département 59, Nord, we found a very interesting and large dial on the Mairie at La Groise (Fig. 16). It too has the analemma, this time moved slightly to the right of the noon line. It was made there in 2005 by J.M. Ansell with the motto:

Le soleil et la Terre nous donnent la vie

(The Sun and the Earth give us life)

REFERENCE

1. *http://michel.lalos.free.fr/cadrans_solaires/*

mandvcowham@gmail.com

Holiday Pictures

Mike Isaacs

Fig. 1. The Cranbrook Institute of Science, with the dial on its pedestal, slightly left of centre.

In the summer of 2017, I spent four weeks visiting my son Richard in the USA. Whilst I was there, he took me to see some dials in Bloomfield Hills, a very desirable area north of Detroit. A near parallel would be stockbroker Surrey, very nice! The dials were at the Cranbrook Institute of Science and at Cranbrook House, the latter being the residence of the founder of the Institute situated a mile or so away.

The Cranbrook Institute of Science (Fig. 1) is one of five components of the Cranbrook Educational Community, Bloomfield Hills, founded by publisher and philanthropist George Booth. In front of the building there is an interesting and decorative dial (Figs 2–4). The NASS website explains that it was designed by Victor Edwards in 1928 and describes it thus:

An equatorial dial of cast bronze. The heavily patinated dial has Roman hour numerals IIII through VIII and a cast bronze

Figs 2–4. Dial at the Cranbrook Institute of Science.

pointer marked, "DAYLIGHT SAVING." It has an unusual crescent shaped arm with notch at the upper end. The arm is rotated until sunlight through the notch strikes an analemma on the lower inner curve of the crescent. Time is then read on a circular dial from an 'hour hand' pointer extending from the base of the crescent. The dial sits atop a marble pedestal engraved, "The A. Goddard Sundial."[1]

Fig. 5. Cranbrook House, with the dial in the foreground.

Cranbrook House (Fig. 5), where the other interesting and attractive dial was to be found, was built in 1907-8 in the Arts and Crafts Style for George Booth and his wife Ellen.

In the gardens in front of the house there was a horizontal dial (Fig. 6) that reminded me of the Vulcan aircraft, but apparently it is based on a swan! The description on the NASS website explains that the swan's wingspan is about 40 cm and that the height of the tail (which serves as the gnomon) is about 14 cm. The hour lines are feathers of the wings, and round the base of the gnomon there is a circle of Arabic numbers labelling the hours.[2]

Fig. 6. The Cranbrook House dial.

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1. *sundials.org/index.php/component/sundials/oneDial/770*
2. *sundials.org/index.php/component/sundials/oneDial/837*

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A PEBBLE DIAL BY GREG McDONOUGH

FRANK H. KING

The 2017 NASS Conference was held in St Louis, Missouri. Delegates were informed in advance that the conference organisers had arranged a total solar eclipse. Moreover, this was to be bundled in at no extra charge.

What delegates were not expecting was to be given a sundial made from a pebble. These were handed out just before the conference dinner. They are necessarily all different and my dial is shown in Fig. 1. It is a single-sided equatorial dial.

Such dials are made by Greg McDonough[1] in his workshop on the Wirral, across the River Mersey from Liverpool. The design of the conference dials clearly had the hand of Fred Sawyer in them. As well as being unusual, these dials are most attractive to look at and to hold.

Fig. 1. My pebble equatorial dial. The dial surface is 95 mm across and the maximum dimension of the pebble as a whole is 115 mm.

The pebble has two cut and polished surfaces. At the bottom, there is the base that it sits on and at the top there is a second cut surface which, in my case, is angled at 38° (my co-latitude) to the plane of the base. This ensures that the dial can serve as an equatorial dial but, of course, the user has to ensure that the line of greatest slope is north–south (with north at the bottom).

There is a stout circular gnomon and, given that this is an equatorial, the gnomon is perpendicular to the plane of the dial. Normally, with a rod gnomon, one reads the time from the centre of the shadow but in this case the leading edge is used. This requires the hour lines to be tangential to the foot of the gnomon. The hour lines themselves are only implicit. It is the spaces between them that are highlighted by the simple process of sandblasting alternate gaps. There is a special thin line for noon which is thereby made easy to identify and use as the reference time. You simply count forwards or backwards from noon to determine the time. In Fig. 1 the leading edge is indicating 10 o'clock. There is no danger of using the trailing edge accidentally; that edge crosses several hour lines and cannot therefore be the operative edge.

At first sight, the gnomon appears to be damaged; it seems to be chipped at the top. Far from being any kind of damage, this is part of the design. The crescent shape formed by this cut-out serves as a memento of the solar eclipse which we were to observe the day after the dinner. The cut-out doesn't run all the way down the gnomon: it gradually tapers to nothing and the trailing edge shadow is not degraded except at its outer end which is normally off the edge of the dial, as in Fig. 1.

The underside of the pebble (Fig. 2) is a work of art in itself. The latitude is noted and, on the left of an eclipsing-sun motif, there are Greg's initials, G Mc. On the right, there is the web address of Etsy, the peer-to-peer e-commerce website that handles the sale of Greg's dials. Below, we see "Windowsill Art", the trading name of Greg's online shop within Etsy.

Fig. 2. The underside of the pebble dial.

At the conference dinner, Fred noted that, since this was a single-sided equatorial, it would not function in the winter months. Just for once, Fred wasn't quite right. This sundial functions perfectly well in the winter months provided you hold it upside down! Looking up, the shadow now goes round anti-clockwise and one reads the time from the trailing edge. You have to be very careful about the orientation. Also, my arm gets a little tired demonstrating this use! I must design some kind of cradle which supports the inverted pebble but doesn't interfere with the line to the sun.

What Fred couldn't have known was that, a week before heading off to St Louis, I had finished (or so I thought) preparing my Newbury talk (see page 22) about marking out sundials from multiple centres. One of the diagrams I had prepared is shown in Fig. 3. This is an outline design for a horizontal sundial at 52° North. This dial has a stout circular cross-section gnomon whose shadow is to be read from its leading edge. Hour lines from 6 h to 18 h are shown in red and those for the back hours are shown in green.

When an inclined cylinder intersects a plane, the intersection is an ellipse. This, the base or footprint of the gnomon, is clear in Fig. 3. I had had to give a moment's thought to the mathematics of marking out all the hour lines which are, of course, tangential to the ellipse, and I wondered whether this design had ever been implemented. It seemed obvious enough but I couldn't remember seeing a real example. I had almost forgotten such musing when I suddenly found myself the proud owner of something very like the dial I was proposing to talk about! This was astonishing serendipity! Thank you Fred!

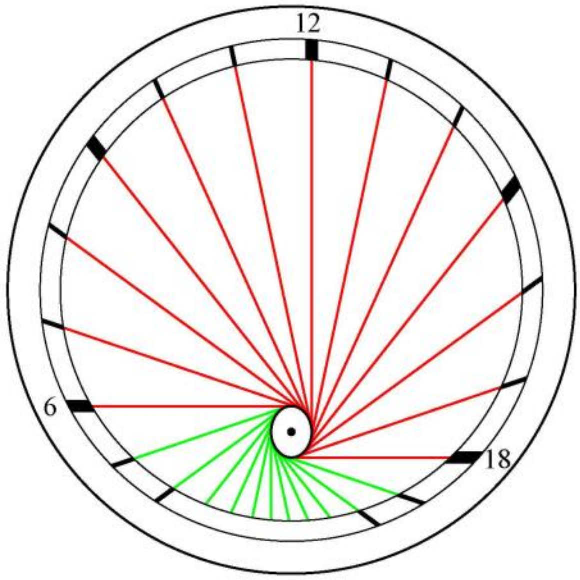

Fig. 3. The design adapted for a horizontal dial at 52° N.

The only down-side was that I naturally had to augment my talk by including pictures of this pebble dial. During the talk itself, I held the dial up as a prop and I later placed it in the display area where it was much enjoyed by the Newbury delegates.

NOTE

1. You can see more of Greg's designs by visiting *https://www.etsy.com/shop/WindowsillArt* and then if you scroll down you will see "Fred's 39 sundials" amongst other delights.

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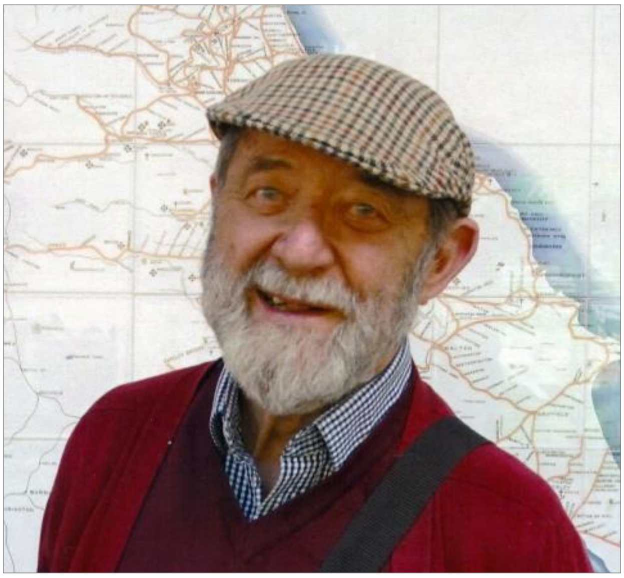
FRANK EVANS BSc PhD

Born on 28 August 1926, Frank Evans grew up in Croydon where his parents Alf and Beatrice were school teachers. They always had the highest expectations for their son but Frank had ideas of his own from a very young age: he always wanted to go to sea. Evacuated to Devon at the start of the Second World War, he got his chance: learning to sail in a dinghy, he never really looked back to shore again.

Joining the Merchant Navy as soon as he was old enough and spending some time at navigation school meant that he quickly became a ship's officer, securing his First Mate Certificate in 1949 after sailing with the Atlantic convoys during the war. He then spent a number of years aboard oil tankers and cargo vessels.

Frank met the love of his life when she was still at school – Rosie in fact lived in a neighbouring street – and he made a solemn promise to her that once they married he would leave his navy days behind. Sure enough the pair celebrated their wedding on 28 December 1948 and Frank left the navy for a place at the University of London to read zoology, biology and chemistry – ably supported by Rosie's teaching salary. Having to choose between an engagement ring for Rosie and a sextant for his career, the sextant won… temporarily. The ring finally arrived when their daughters were in their teens.

Taking to his new academic life with gusto, Frank graduated in marine biology before going on to complete a doctorate that included one of the most exciting periods of his life. For this he led a scientific expedition to Barbados



via Senegal in a classic yacht, *Petula*, prepared for exploration of the sea's surface. With a book and a film under his belt and two final posts in Ghana and Malta, he finally came ashore to a post near Newcastle at the University's Dove Marine Laboratory overlooking Cullercoats Bay. He was always happy to call Northumberland 'home' thereafter.

There isn't space here to do full justice to the range of Frank's passions and preoccupations in life. His hobbies and associations of recent years included ice skating, sundials (BSS member No. 37 in 1989), jazz, the rowing club, Tynemouth sea scouts, hill walking, 'wild' camping, membership of numerous marine biology organisations including the Porcupine Marine Natural History Society plus those editorships and article submissions already hinted at. Since Rosie's death, volunteering for Age UK renewed his zest for life, aided by the friendships he cherished through the Pen and Palette Club and Cullercoats Local History Society.

There are so many people with fondest memories of Frank and the wonderful mix of virtues that he combined – reflective, thoughtful, philosophical, independent – alongside his little eccentricities that people also appreciated, from the handkerchief in his pocket to his habit of always walking with an umbrella. On the way to weekly ice skating, aged 91, with daughter Susie, a stroke put this dear, learned, charming powerhouse of a man in hospital before he finally 'crossed the bar' on 26th October to make his last voyage accompanied by mementos of his seafaring days. He will be greatly missed by so many.

Compiled from extensive family memories and my own brief association.

Tony Moss

TWO SCOTTISH HARBOUR DIALS

ALAN MITCHELL

On a recent visit to Scotland to admire the scenery and to visit relatives and old friends, sundials were far from my mind. However, I kept coming across examples that I found interesting and which I feel deserve wider attention. The two dials described here, both associated with harbours, particularly intrigued me.

Fig. 1. Stonehaven Harbour, with the cube dial (SRN 0887) in the foreground.

At Stonehaven, Kincardine, a display board on the quay wall describes the history and development of the harbour and mentions a sundial dated 1710 located on a plinth on the north side (Fig. 1). The date can clearly be seen

Fig. 2. The Stonehaven Harbour dial from above.

(Fig. 2), as can a 32-point compass ring (with backwards letter Ns) and hour lines and numerals (to be read from inside the dial). Without protection from the weather, one wonders how long these will last. There were once gnomons on the vertical faces of the dial but they have now disappeared.

The picturesque village of Crail in Fife is always worth a visit. After my experience at Stonehaven I looked for a similar dial in Crail harbour but was disappointed to find no sign of one. However, on a cliff top path above the harbour (Castle Walk) I did come across the remains of a sundial (Fig. 3). On the railings adjacent to the dial there is a plaque that dates the instrument to the 17th century:

THIS SEVENTEENTH CENTURY SUNDIAL
SERVED SAILORS, FISHERMEN AND TOWNSPEOPLE
FOR WELL OVER TWO HUNDRED YEARS
IN ITS ORIGINAL POSITION AT CRAIL HARBOUR.
IT WAS REMOVED FROM THE HARBOUR IN 1883,
REPAIRED, RE-LETTERED AND MOVED
TO ITS CURRENT POSITION IN 1890.

Fig. 3. Sundial (SRN 1361) on Castle Walk, Crail.

I think it is a great pity that after so much trouble was taken in the 1880s to repair and re-letter the sundial, it has been allowed to deteriorate to such an extent that I could see no markings at all. Perhaps somewhere in Crail archives there are records of how the sundial once looked.

ao.mitchell@btinternet.com

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Mr David Brown
Gibbs Orchard, Sutton Rd
SOMERTON
Somerset, TA11 6QP
Tel: 01458 274841
david@davidbrownsundials.com

OTHER SPECIALISTS

Dr John Davis (Editor)
Orchard View
Tye Lane
FLOWTON
Suffolk, IP8 4LD
Tel: 01473 658646
editor@sundialsoc.org.uk

Mr John Foad (Registrar)
Greenfields
Crumps Lane
ULCOMBE
Kent, ME17 1EX
Tel: 01622 858853
registrar@sundialsoc.org.uk

Miss R (Jill) Wilson (Biographical Projects)
Hart Croft
14 Pear Tree Close
CHIPPING CAMPDEN
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biographical@sundialsoc.org.uk

Mr John Wilson (Librarian)
38 Stuart Close
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Mr Peter Ransom (Education)
29 Rufus Close
Rownhams
SOUTHAMPTON
Hampshire, SO16 8LR
Tel: 023 8073 0547
education@sundialsoc.org.uk

Mr J Mike Shaw (Newsletter Editor)
3 Millwood
Higher Bebington
WIRRAL, CH63 8RQ
Tel: 0151 608 8610
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4 The Village
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