The British Sundial Society

BULLETIN

VOLUME 17 (ii) JUNE 2005

Front cover: The 20" diameter horizontal dial in the Tiltroom Garden at Hampton Court Palace. It was made in 1765 by Heath & Wing for David and Eva Garrick's nearby villa. Photo: J. Davis.

Back cover: The mass dial at St John the Baptist, Strensham, Worcestershire. Photo: A.O. Wood.

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BULLETIN
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EDITORIAL

A new sundial has recently been dedicated at Downing College, Cambridge, in commemoration of the Bicentenary of the College. At the dedication ceremony, Dr King "….explained the basis of the equation of time and of Greenwich Mean Time. Those of us who thought that the only variation was in the appearance of Leap Year learned that every minute, hour and day is not of the same length…"

It is probable that at least one new sundial is put up somewhere in this country every year; and many of these new dials are officially 'opened' or 'dedicated' or 'unveiled' or inaugurated in some ceremony. How good it would be if at each such ceremony at least *one* more member of the public became aware that every minute, hour and day is *not* of the same length. If this piece of marginal gnomonic education occurred, the British Sundial Society would not have lived in vain.

DIRECTION COSINES FOR THE ACCURATE DELINEATION OF PLANAR SUNDIALS

TONY BELK

INTRODUCTION

I previously showed that a graphical solution to the design of planar sundials is possible using the stereographic projection.[1] However, I felt that an accurate way of calculating the various angles and distances should be available to eliminate the inaccuracies inherent in a graphical solution. This can be done if the directions and planes in space are defined by their direction cosines. All interactions between planes and directions and every angle between any of them can be found using two simple formulae.

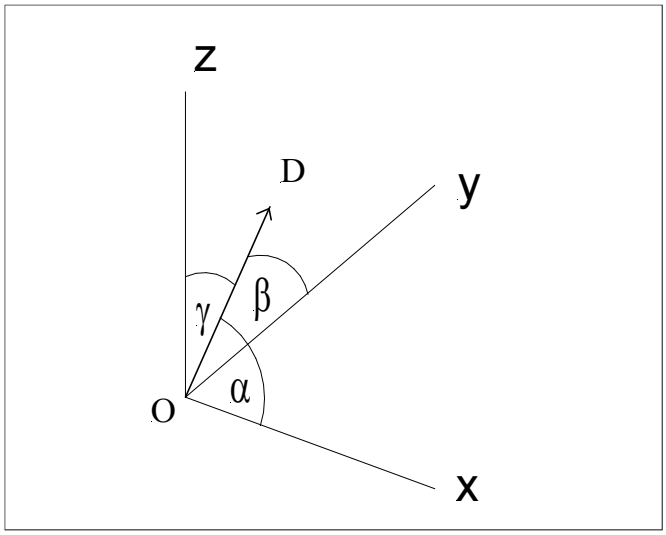

Fig. 1. The origin of direction cosines.

DIRECTION COSINES

Any direction ***D*** in space makes angles α, β and γ with three orthogonal axes Ox, Oy and Oz, Fig. 1. These three angles are connected by the formula:

$$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$$

this can also be written $h^2 + k^2 + l^2 = 1$, where $h = \cos\alpha$, $k = \cos\beta$ and $l = \cos\gamma$. The indices *h, k* and *l* are known as direction cosines. The direction cosines *h, k* and *l* also uniquely specify the plane perpendicular to this direction. The plane is written (*h, k, l*) and the direction [*h, k, l*].

There are two simple mathematical relationships between planes and directions specified by direction cosines.

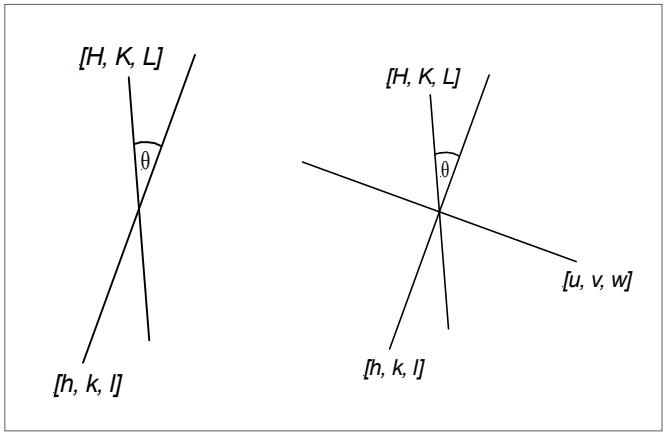

Fig. 2a. (left) The angle between two directions.
Fig. 2b (right). The direction [u, v, w] at right angles to two others.

1. The angle θ between the directions [*h, k, l*] and [*H, K, L*] is

$$\cos\theta = hH + kK + lL \qquad \ldots(1)$$

This is shown in Fig. 2a. θ is also the angle between the planes (*h, k, l*) and (*H, K, L*). A useful corollary of this is that the two directions are perpendicular if

$$hH + kK + lL = 0$$

If this is true then the direction [*H, K, L*] lies in the plane (*h, k, l*) and the direction [*h, k, l*] lies in the plane (*H, K, L*).

2. To find a direction [*u, v, w*] that is perpendicular to directions [*h, k, l*] and [*H, K, L*] the following relationships hold, see Fig. 2b:

$$uh + vk + wl = 0$$
$$uH + vK + wL = 0$$

and $u^2+v^2+w^2 = 1$

These lead to

$$u = (kL - Kl)/R, \qquad v = (lH - Lh)/R$$

and $w = (hK - Hk)/R$ ...(2)

where $R^2 = (kL - Kl)^2+(lH - Lh)^2+(hK - Hk)^2$

In this case the plane (u,v,w) contains the directions $[h, k, l]$ and $[H, K, L]$, see Fig. 2c.

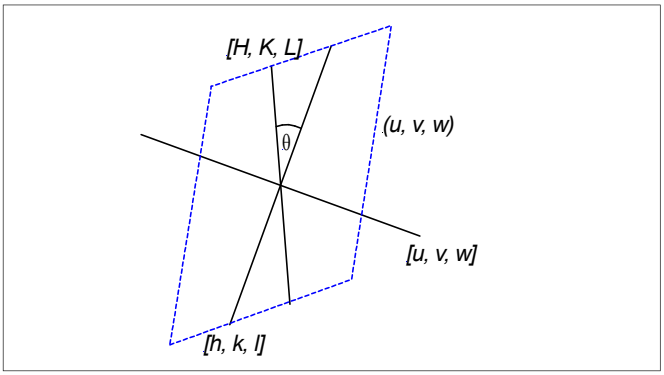

Fig. 2c. The plane (u, v, w) containing two directions.

The direction $[u,v,w]$ is also the line of intersection of the planes (h, k, l) and (H, K, L) see Fig. 2d.

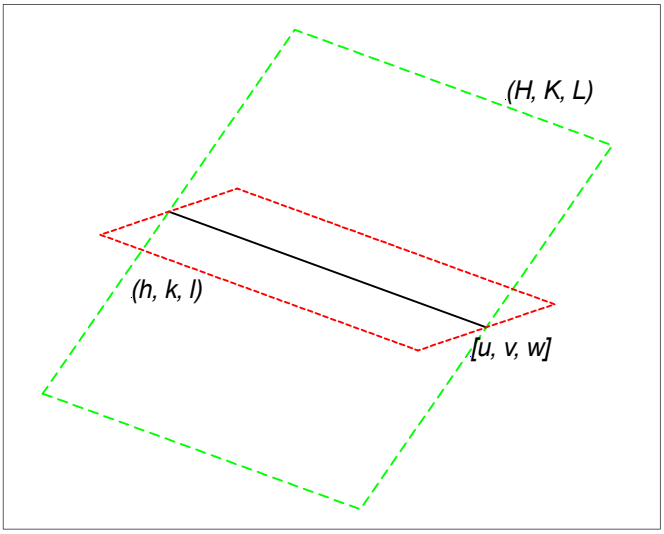

Fig.2d. The line of intersection [u, v, w] of two planes.

Every plane and direction in space can be specified by three direction cosines. The simple formulae (1) and (2) can be used to determine relationships between planes and directions and to calculate the angles between them.

THE DESIGN OF SUNDIALS

A convenient orthogonal co-ordinate system for the design of sundials is to have the x-axis as the east direction, the y-axis as the polar axis and the z-axis perpendicular to both of these (also known as the equinoctial colure axis). The direction of the sun around the polar axis is determined by the time T and the sun's declination δ. Any location on earth is characterised by the angle between the horizontal and the polar axis (latitude φ) and the angle between its meridian plane and the Greenwich or other standard meridian plane (longitude λ). A dial plane is determined by its declination from the south d and its inclination from horizontal i.

The use of direction cosines allows all the relationships and angles between planes and directions defined by these six parameters to be calculated accurately and simply. At latitude φ the zenith is $[0, \sin\varphi, \cos\varphi]$ and the horizontal plane $(0, \sin\varphi, \cos\varphi)$.

The hour plane is the plane containing the polar axis $[0, 1, 0]$ and the sun's direction at local apparent time T. This plane, shown in Fig. 3, is not dependent on the sun's declination δ, but the sun's direction in that plane is dependent on δ. Where the hour plane cuts the dial plane is the hour line on the dial for that particular time.

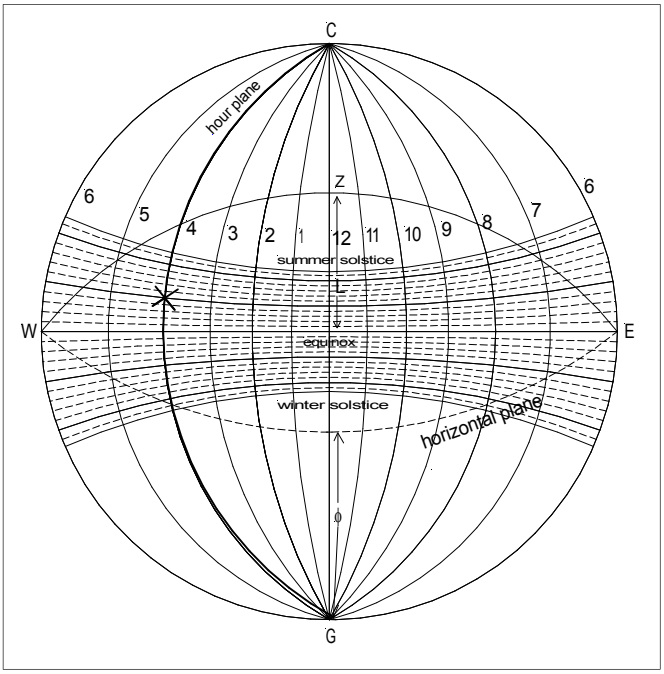

Fig. 3. The hour plane and sun's direction at 4:00 p.m., sun's declination 10 degrees.

The hour plane is $(\cos 15T, 0, \sin 15T)$

If we wish to use the zonal solar time T_{24} (Greenwich Solar Time in the UK) the difference in longitude from standard λ degrees (E is +ve, W is –ve) is incorporated and the hour plane formula becomes

$$\left(\cos\left(15T_{24}+\lambda\right),\ 0,\ \sin\left(15T_{24}+\lambda\right)\right) \qquad \ldots.(3)$$

Horizontal Dial

The dial plane is $(0, \sin\varphi, \cos\varphi)$ and the hour line is the line of intersection of that plane with the hour plane $(\cos 15T, 0, \sin 15T)$. Using equation (2) the hour line will have direction cosines

$$\left[\frac{\sin\varphi\sin 15T}{R}, \frac{\cos\varphi\cos 15T}{R}, \frac{-\sin\varphi\cos 15T}{R}\right]$$

where $R^2 = 1 - \cos^2\varphi\sin^2 15T$

Using this formula all hour lines can be found and the hour angles calculated from formula (1).

Vertical South Facing Dial

In this case the dial plane is (0, -cos φ, sin φ) and the hour line is

$$\left[\frac{-\cos\varphi\sin 15T}{R}, \frac{\sin\varphi\cos 15T}{R}, \frac{\cos\varphi\cos 15T}{R}\right]$$

where $R^2 = 1 - \sin^2\varphi\sin^2 15T$

Declining inclining dial

In the general case for a dial plane (p, q, r) whose declination from south is d (east positive, west negative) and whose inclination is i, the direction cosines are:

$$p = \sin d \sin i$$
$$q = \sin\varphi\cos i - \cos\varphi\cos d\sin i$$
$$r = \cos\varphi\cos i + \sin\varphi\cos d\sin i \qquad \ldots(4)$$

The hour line, the line of intersection of the dial plane (p, q, r) and the hour plane ($\cos 15T$, 0, $\sin 15T$) is:

$$\left[\frac{q\sin 15T}{R}, \frac{r\cos 15T - p\sin 15T}{R}, \frac{-q\cos 15T}{R}\right]$$

where $R^2 = q^2 + (r\cos 15T - p\sin 15T)^2$

Again, all hour lines can be found and the hour angles calculated.

If q is positive the dial is of the horizontal (northern hemisphere) type with the style pointing out of the dial face towards the north celestial pole. In this case the hours are numbered clockwise around the dial. If q is negative the dial is of the vertical (northern hemisphere) type with the style pointing into the dial face towards the north celestial pole and the hours numbered anticlockwise around the dial. The same numerical solution also gives the north facing vertical type (q positive) dial with the numbers running clockwise. If the value of q is zero the dial is of a polar type and its design will be covered in Part 2 of this article.

If the dial plane is (p, q, r) the sub-style plane will be perpendicular to it and contain the polar axis [0, 1, 0]. For all types of dial the sub-style plane will be

$$\left(\frac{-r}{\sqrt{p^2+r^2}}, \quad 0, \quad \frac{p}{\sqrt{p^2+r^2}}\right) \qquad \ldots(5)$$

These planes are all shown in Fig. 4 on a stereographic projection. The style height is the angle between [0, 1, 0] and the line of intersection of the sub-style plane and the dial plane. This line is

$$\left[\frac{pq}{\sqrt{p^2+r^2}}, \quad -\sqrt{p^2+r^2}, \quad \frac{rq}{\sqrt{p^2+r^2}}\right]$$

and the angle this makes with [0, 1, 0], the style height, is

$$\left(a\cos -\sqrt{p^2+r^2}\right) \qquad \ldots(6)$$

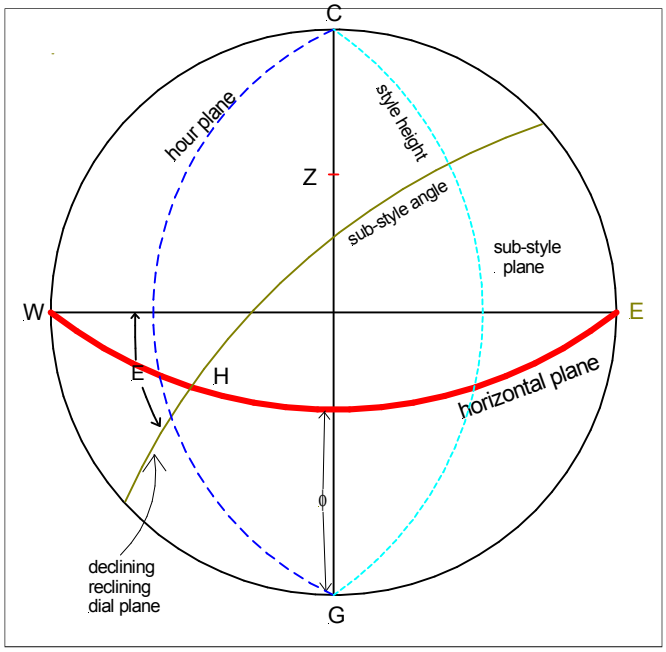

*Fig. 4. Stereographic plot of polar axis **C**, zenith **Z**, latitude **φ**, horizontal plane, dial plane, sub-style plane, hour plane, style height, sub-style angle, horizontal direction **H** and angle **E**.*

METHOD OF DESIGNING A DIAL

The sequence required to determine the hour line angles, sub-style plane, sub-style angle and style height for any planar dial using direction cosines is as follows:

1. input φ, λ, d and i.
2. if $\tan\varphi = \tan i \cos d$ it is a polar type dial; see Part 2 of this article.
3. find the direction cosines of the dial plane (p, q, r). (substitute in formula (4)).
4. find the horizontal line on the dial face (the intersection of the horizontal plane and the dial plane from equation (2)). Use the E-W line [1, 0, 0] for a horizontal dial.
5. find directions of the hour lines for all the hours chosen (the intersections of the hour planes with the dial plane from equation (2)).
6. calculate the angles between the hour lines and the horizontal line (using equation (1)).
7. find the pole of the sub-style plane (substitute in formula (5)).
8. find style height from equation (6).

9. find angle between horizontal line and intersection of dial plane with sub-style plane using formula (1).

The above calculations allow the drawing of the dial and sub-style and its correct alignment.

To find Equinox, Solstice or other Declination Lines

In this method the distance of the declination line from the dial centre or origin along each hour line is calculated.
The length of the line from the dial centre to the declination line depends on the sun's declination δ and the angle E between the sun's direction at equinox and the hour line in the hour plane, Fig. 4.

If the sloping height of the style to the nodus is L and the sun's declination is δ, the distance along the hour line from the centre or origin of the dial O to the declination line is shown in Fig. 5, where N is the nodus and F the position of the equinox line:

$$X = \frac{L\cos\delta}{\sin(E+\delta)}$$

Hence the equinox and solstice lines or any other declination line can be drawn by calculating E and then X for each hour line.

At equinox the direction of intersection between the hour plane ($\cos 15T$, 0, $\sin 15T$) and the equinoctial plane (0, 1, 0) is [$-\sin 15T$, 0, $\cos 15T$]. This is line NF in Fig. 5.

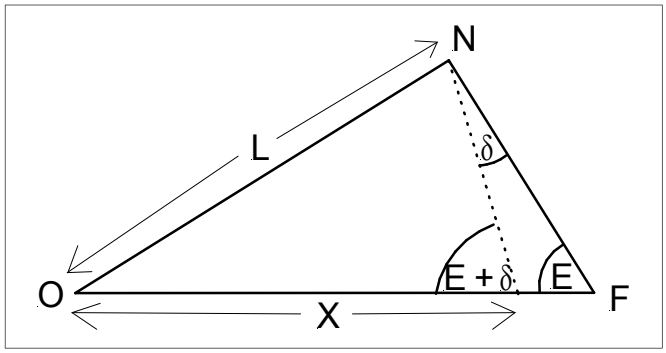

*Fig. 5. Construction in hour plane to determine position of declination lines, nodus **N**, origin of dial **O**, position of equinox line **F.***

For a horizontal dial the direction cosines of the hour line, OF in Fig. 5, (the line of intersection of the hour plane and the dial plane) have been given in the section on the horizontal dial above. The angle between this and the sun's direction at equinox is

$$\cos E = \frac{-\sin\varphi}{\sqrt{1-\cos^2\varphi\sin^2 15T}}$$

For a vertical south facing dial a similar argument leads to

$$\cos E = \frac{\cos\varphi}{\sqrt{1-\sin^2\varphi\sin^2 15T}}$$

For a vertical dial declining by angle d the formula becomes

$$\cos E = \frac{\cos\varphi\cos d}{\sqrt{1-\sin^2 d\cos^2 15T-\sin^2\varphi\cos^2 d\sin^2 15T}}$$

For the general case of the dial plane (p, q, r) the formula gives:

$$\cos E = \frac{-q}{\sqrt{q^2+\left(r\cos 15T - p\sin 15T\right)^2}}$$

The method described here offers a simple method of finding declination lines. The conventional method, described in the BSS Glossary 2004[2], requires a calculation of the sun's altitude and azimuth for each hour and the calculation of x and y co-ordinates from the sub-nodal point on the dial face.

SUNRISE AND SUNSET

Sunrise and sunset occur when the rising or setting sun's direction cuts the horizontal plane. The horizontal plane is (0, *sin φ, cos φ*) and the direction of the sun at time T and declination δ is [sin $15T$ cos δ, sin δ, -cos $15T$ cos δ].

When the direction of the sun lies in the horizontal plane :

$\sin\varphi\sin\delta - \cos\varphi\cos 15T\cos\delta = 0$

or $\tan\varphi\tan\delta = \cos 15T$ the well accepted standard formula.

To find the times in zonal solar time T_{24} we have from equation (3):

$T_{24} = T - \lambda/15$

HOURS OF ILLUMINATION

The dial plane is illuminated between the two times when the dial plane (p, q, r) contains the sun's direction [sin $15T$ cos δ, sin δ, -cos $15T$ *cos* δ]. The sun must of course be above the horizon, which is known from the sunrise and sunset calculation above. This leads to

$$p\sin 15T\cos\delta + q\sin\delta - r\cos 15T\cos\delta = 0$$

For equinox $\delta = 0$ hence $p\sin 15T - r\cos 15T = 0$
or $\tan 15T = r/p$. This gives two values of T, twelve

hours apart.

For any other declination of the sun:

$$p \sin 15T + q \tan \delta = r \cos 15T$$

Solving this for sin 15T gives:

$$\sin 15T = \frac{-pq \tan \delta \pm r\sqrt{p^2 + r^2 - q^2 \tan^2 \delta}}{p^2 + r^2}$$

This gives two values of T and considering that T, 12-T, and 24+T all have the same value of sin, the correct value must be chosen for the 'on' and 'off' times. Below is given a guide to the choice of alternative values of T.

For a south-facing vertical type dial at equinox, the sun comes on during the twelve hours before 12:00 noon and goes off twelve hours later. At the winter solstice it comes on a few hours earlier than at equinox and goes off more than twelve hours after it came on. At summer solstice it comes on a few hours later than at equinox and off less than twelve hours later than it came on. A north-facing vertical type dial is the reverse of the equivalent south-facing version; substitute 'off' for 'on' and 'on' for 'off' in the above. For a horizontal type dial at equinox, the sun comes on in the twelve hours before 12:00 noon and goes off twelve hours later. At winter solstice it comes on a few hours later than at equinox and goes off less than twelve hours after it came on. At summer solstice it comes on a few hours earlier than at equinox and goes off more than twelve hours after it came on. Again, zonal solar time T_{24} can be found using the formula given above.

All these calculations described in the sections above can be achieved by a simple spreadsheet giving all angles, distances and times required to plot a planar dial with any declination and inclination at any location. Alternatively, a simple computer program can be written to draw a planar dial.

COMPARISON WITH ESTABLISHED CALCULATION

a) This method gives the same angles and distances as the conventional methods.

b) In this system the position of the solstice lines is calculated from the centre or origin of the dial along the hour line, so only requiring one additional number to be found, as the hour angle is known. In the conventional method first the sun's altitude and azimuth must be found for each hour, then x and y co-ordinates are calculated and plotted from the base of the perpendicular dropped from the nodus onto the dial plane, the sub-nodus point.

c) This method also offers a method of finding the hours during which the dial is illuminated, which is not generally available.

d) The only problem is that care must be taken in choosing the value of angles as the cosine of θ and $-\theta$ are both the same and the value of the sine of θ and 180-θ are the same.

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1. T. Belk: 'The Stereographic Projection as a Graphical Method for Designing Sundials. Part 1' *Bull BSS* 13(ii), pp. 85-88 (2001), Part 2 *Bull BSS* 13(iii), pp. 123-127 (2001).
2. J. Davis Ed.: *BSS Sundial Glossary.* British Sundial Society, 2004.

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BOOK NOTE

Carpinteria de lo Blanco y tratado de Alarifes y Relojes de Sol (1633). *Editorial Maxtor, Fray Luis de León 20, 47002 Valladolid, Spain, 2003.*

This manual of carpentry has four chapters on the construction of sun dials. These four chapters comprise 24 pages with 8 diagrams and 1 table. It uses a graphical method which appears similar to those in standard textbooks. The chapter headings are:

XXIX treating of graduated quadrants to make sundials.
XXX how to make horizontal and vertical sundials
XXXI how to make declining sundials
XXXII the latitude (in degrees) of places in Spain, the Canaries, Cape Verde and the West Indies.

A supplement of 1727 discusses moon dials and also gives a table of latitudes in degrees, minutes and seconds.

Piers Nicholson
Epsom
Surrey

THE PORTABLE SUNDIALS OF THE MARY ROSE

MIKE COWHAM

Henry VIII's flagship the Mary Rose sank in the Solent on 19 July 1545 during an engagement with the French. Recovery of the hull proved impossible at that time and it was soon covered with a layer of silt, effectively preserving the unexposed parts by excluding oxygen and damaging organisms. We probably all remember the dramatic lifting of the remains on 11 October 1982 and many of us will have been to see the hull at Portsmouth, where it is still being treated with constant wax sprays to preserve it. Many exciting objects, over 25,000 in total, were found in and around the wreck and a selection of these are displayed in the Mary Rose Museum at Portsmouth. Essentially, the Mary Rose may be considered as a time capsule giving us a glimpse of what life was like on board a warship over 450 years ago. Amongst the finds were eight small pocket sundials.[1-3] A further dial has recently been found but is still under conservation and is therefore not yet available for study.

Late in 2004, I received a call from Wessex Archaeology asking for my assistance to help in writing the chapter of a book about the finds[4] and this gave me the opportunity to study these eight dials at close hand and to photograph them. In this article I am able to show this group of dials together for the first time, Fig. 1, and will discuss some of their interesting features.

All of these dials are made from boxwood. We can see that they were relatively low cost and hardly accurate items. With the provenance provided by the Mary Rose we can confidently put the date of manufacture to around 1540. Several authors[1, 2] have already suggested that these dials came from Nuremberg and I have maintained an open mind looking for positive evidence to support this theory.

Firstly, let me describe the dials, all of which are very similar, probably coming from the same workshop or at least from the same town or region. All of the dials are circular between 27mm and 38mm in diameter. They have a copper alloy folding gnomon, (probably bronze), hinged to the dial plate by two wire loops that pass right through the dial body. Each dial has an inset compass of about 12mm diameter that would have had a thin glass window to protect it, but in most cases this has been lost. The outside edge of the compass bowl is fitted with a copper alloy lining. Hour lines are generally shown from 4am to 8pm with no subdivision of the hours. The main differences between each of the dials are in their decoration and their cases. A selection of these are illustrated, Figs 2 - 6. See also Table 1 for comparative details.

Four of the dials are very similar. A fifth dial also belongs to this group but I have separated it because its numerals and markings have been filled with coloured wax leaving an almost smooth flat surface whereas the others were merely partly filled with paint or wax. Some of these dials have lids but all would have originally had one. A lid would be necessary to protect the relatively fragile gnomon when the dial was carried in a pouch or pocket. It was thought that the pocket in clothing did not generally appear until 17th century, but leather clothing found on the Mary Rose shows that pockets did exist at this much earlier time. The lid of one of these dials shows signs that it was originally fitted with a mirror. Two further dials are slightly smaller in diameter and were fitted into a spherical case of cherry wood with a suspension ring on the lid of one, also containing a mirror. The lower part of each spherical case is slightly flattened to enable the dial to stand on a flat surface. It is also perforated with five small holes. This lower section was probably used as a pomander to help combat the inevitable smells from so many sailors living in cramped conditions below decks. (Herbs were also hung up in places on board the ship to provide a masking fragrance.) The final dial (Fig. 6) is somewhat different from the rest, with a different style of decoration. It is still fitted into a book-like case made of beech, with an original wrap around leather cover. This case may be latched closed by two metal clasps. It was found in the carpenter's chest together with other relatively high status items. The tooling of the leather shows a double headed eagle and various other patterns with the inscription 'DEVSP ROVIDEBT', (*DEUS PROVIDEBIT – 'God Provides'*), written on two lines, split between the P and R.

Since these dials were found on the Mary Rose three more dials of an almost identical style have been identified. Two are in the Museum of London, one of them found in nearby Worship Street, Fig. 7, and the other, just half of a dial, was found on the Thames foreshore. The third, Fig. 8, in the Manor House Museum, Bury St. Edmunds was found during excavations in the aisle of nearby St. Mary's church in Bury. These dials may now be positively linked with those found on the Mary Rose, almost certainly originating in the

Fig. 1. The eight Mary Rose sundials.

Fig. 2. Dial A0942.

Fig. 3. Lower part of spherically cased dial A5076.

same workshops. The provenance of the Mary Rose also helps to give these three dials a positive dating. These additional dials have been considered together with those of the Mary Rose in my analysis and comments. It seems that no further dials of this type have been found, even on the Continent, although some round ivory dials are known of a slightly later period.

The dial numerals and decorative patterns were all applied using punches. Punch marking was the best method of

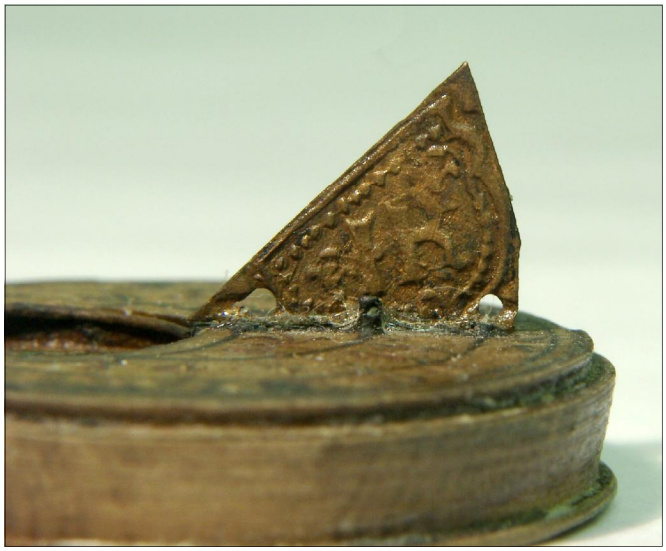

Fig. 4. Gnomon of A1669 marked 'I R'.

Fig. 5. Dial with wax filled numerals A1669.

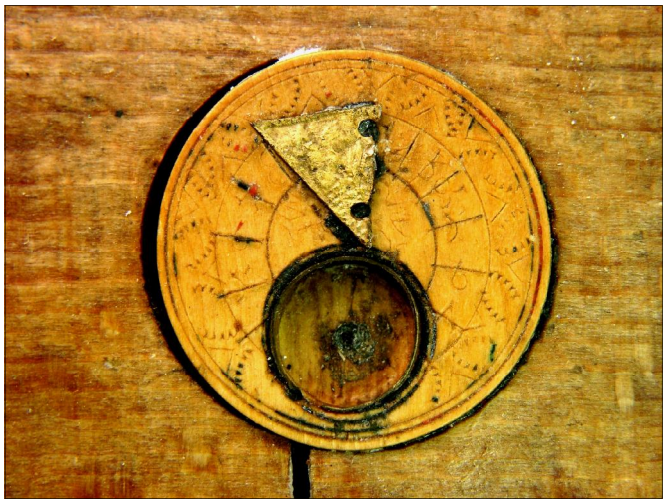

Fig. 6. Dial in book cover case, A5681.

Fig. 7. Dial from Worship Street, London. Reproduced by kind permission of the Museum of London.

Fig. 8. Dial from St. Mary's, Bury St. Edmunds. Reproduced by kind permission of the Manor house Museum, Bury St.Edmunds.

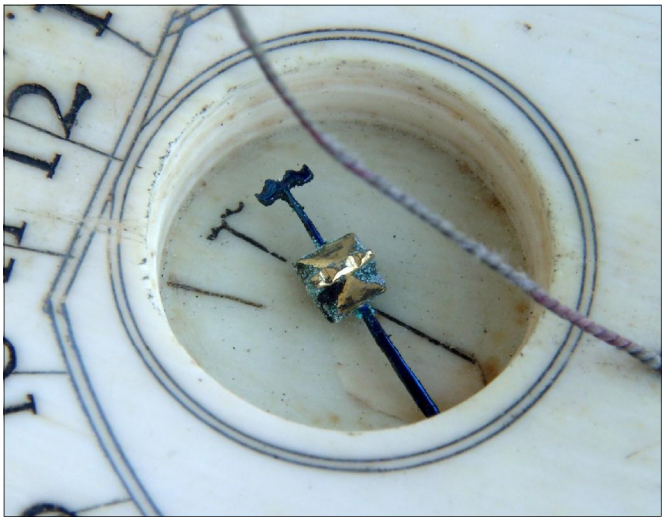

Fig. 10. Compass markings on ivory dial by Paul Reinman, 1588.

DIAL	DIAMETER	CASE	NUMERALS	GNOMON	MAKER'S MARK
MR80 A0942	33.5mm.		Same punches used as A0420.	Partial.	
MR80 A1669	38mm.	Flat lid with mirror.	Filled with wax. 4 & 8 not annotated.	Marked 'IR'.	
MR81 A0420	33mm.		Same punches used as A0942.	Little remaining.	
MR81 A0730	35mm.	Flat lid.	4 & 8 not annotated.	Marked 'M'.	Acorn.
MR81 A1992	27mm.	Spherical, with mirror in lid.		Plain.	
MR81 A2026	32.5mm.	Lid.		Marked 'M'.	Possible acorn.
MR81 A5681	32mm, (set into case 103mm x 80mm).	Leather book-type case.	4 not annotated, 8 line missing.	Fleur-de-lys decoration.	
MR82 A5076	27mm?	Spherical, lid missing.		Plain.	
ML A3891	Estimated 33mm.			Marked 'IR'.	Acorn.
ML 78.283	Half dial only.		8 not annotated.	Marked 'IR'.	
Bury 1992-1-227	Estimated 33mm.		4 & 8 not annotated.	Nuremberg token?	

TABLE 1. Comparison of dials.

marking wood (and ivory) because the fibres remain uncut, being merely crushed, preventing surface flaking. Their copper alloy gnomons were made from thin triangular pieces of metal sometimes decoratively shaped at the back edge and some were embossed on one side. Three have a large letter 'M' on them and two 'IR', the 'I' having a small cross bar at its mid position. Another dial seems to have a fleur-de-lys. Due to corrosion it is difficult to determine if these patterns were cast or stamped on the gnomons. The Bury St. Edmunds dial is reputed to have a gnomon that re-uses a Nuremberg token, but this has not been verified.

Three of the dials have a maker's mark punched on their undersides. Two have a definite acorn mark, Fig. 9, and on the third the mark is unclear, but could also be an acorn.

Fig. 9. Acorn mark from the Worship Street Dial. Reproduced by kind permission of the Museum of London.

This mark has not yet been attributed to any of the known makers of that time.

Measurements of gnomon angles, hour line angles and magnetic declination have been made where possible from these dials in order to determine their intended place of use or place of manufacture. There are wide discrepancies between the markings so no definite conclusions can be reached but by taking an average from all of these dials, some apparently sensible figures seem to emerge. The average latitude taken from gnomon angles is 48.9°. The hour lines were more of a problem due to erratic marking, so a full analysis of each line was not at first attempted. Angular measurements were therefore made of the 9am and 3pm lines, (those most sensitive to latitude change), and the average worked out at 50.2° north. Several of the dials still show the original compass declination marks and these are all easterly, averaging 12.6° east.

With such a small sampling quantity the results obtained by this method cannot be guaranteed but they appear to suggest that these little dials were made for a latitude of between 49° and 50° north. London is 51.5° north, suggesting that the dials are not of English origin. The compass declination for London in 1550 was approximately 15° east but it was only about 12° east for Central Europe, although accurate records for this time do not exist.[5] Both the latitudes and the compass declinations fit perfectly for Central Europe and cross almost exactly over Nuremberg. Further evidence is therefore needed to verify these suspicions.

The style of marking the compass with its declination line appears to be peculiar to Nuremberg, having a 'T' shaped end rather than an arrow, and does not seem to have been used on dials from elsewhere. The compass bowl of an ivory dial by Paul Reinman of Nuremberg, dated 1588 is illustrated, Fig. 10, because it has very similar compass markings to these dials. Note how the compass needle is of the same shape as the declination mark. Unfortunately the Mary Rose compass needles did not survive well enough in the salt water to determine their original shape.

Records exist from an old inventory of 1508 in the Germanisches Nationalmuseum in Nuremberg to say that patrician Georg Kress von Kressenstein ordered 48 dozen (=576) of 'compast' for market places in Italy.[6] (The word 'compast' here would actually mean a 'compass sundial' and not just a plain compass). Other records show that Hans XI Tucher should have had 255 dozen (=3060) of these 'compast' in store in Geneva.[7] These records indicate a large trade in sundials from Nuremberg in the early 1500s.

The leather cover to the book form dial has been studied and compared with two similarly covered items found on the Mary Rose, a book and a balance case and the opinion is that all of these are German.

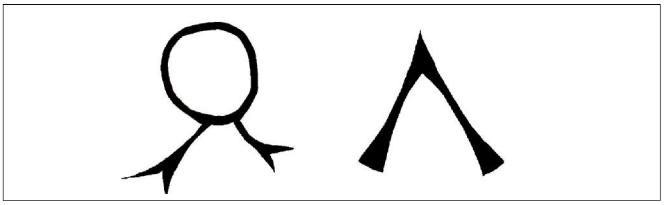

Fig. 11. Numerals '4' and '7' as used on dial A9042.

A study of the numerals used on these dials is of interest. The actual punched numerals on all of these dials have been compared and only two were definitely made with the same set of punches. We can therefore surmise that if from a total of eleven dials only two were by the same maker that there must have been many such makers working closely together. This means that the output of such dials is quite likely to have been in thousands, confirming the records cited above. The fact that certain gnomons are marked with 'M' or 'IR' would suggest a common source as do the acorn maker's marks. Interestingly the two dials made with the same punches do not have the acorn mark or two similarly marked gnomons. Further study of the numerals shows the use of the old '4', which is in the form of an inverted loop[8]. This was discontinued before 1600. In one case the ends of the loop are beautifully cut with a forked type of serif. Fig. 11. The old '7', like an inverted 'V' is also used on these dials. This pattern continued until the early 1600s. The old '2' was frequently made with sharp corners and appears as 'Z' on German instruments until as late as perhaps 1750 but only three of these dials appear to use it. The old '5', something like 'h' turned through 180° has not been used on any dial. This character probably died out around 1500 but was definitely in use as late as 1480[9]. The '8' has been made by punching two separate 'o's and the '6' and '9' have used the same punch simply inverted.

Two of the dials are fitted into spherical cases and one into the recess in a book. However, most of the others show signs of a rebate around the lower edge of the base suggesting that these too were intended to fit into some form of case or holder. Walking stick dials were known in later centuries and we may guess that these dials *may* have fitted into some form of implement, perhaps a sailors' tool. Their lids rule out the possibility that they would have been fitted into a book type case like A5681.

The use of the polar pointing gnomon for equinoctial hours was also a fairly recent innovation when these dials were made and these may have been some of the earliest dials to use this new device. A small quantity of earlier dials are known but the polar gnomon did not generally appear until the late 15th century. Some string gnomon dials of this type had been produced as early as 1451 by Georg Peuerbach and shortly afterwards by Johannes Müller, better known as Regiomontanus. This technology is thought to have come into Europe from the Arabs by those returning from the crusades.

The decoration of the dials shows considerable variation, usually consisting of a series of marks around the edge with some larger figures in the central portion either side of the gnomon. These include a pair of fleur-de-lys, a pair of Tudor roses, a pair of flying birds, a pair of spider-like creatures; and a pair of heads facing towards each other may be found on three of the dials.

The evidence so far is quite strong for the origins of these dials to be Nuremberg. Further research will, I am sure, be able to prove this point. They are naïve dials and relatively crude, but use the new technology of the polar pointing gnomon and as such are a very interesting part of our dialling history. The inaccuracies of their markings, difference in design latitude and compass declination all seem contribute to the fact that these dials were not ideal for use in England. However, by adding all of these errors together it seems that the dials were still capable of being used to an accuracy of perhaps 10 to 15 minutes throughout most of a day, no worse than the errors caused by the Equation of

Time. Their preservation on the Mary Rose has been a great help in dating the other dials that have been found and has led to a greater understanding their uses and users.

Certain questions still remain. Why did these dials have a mirror fitted into their lids? The mirror could have been used for signalling but was probably just for observing and removing facial blemishes, unwanted hairs, warts etc., much like we do today, but it seems unlikely that a sailor in those days would have been too much interested in his facial appearance. It is possible that these dials were little more than status symbols, or perhaps 'grown-ups toys' to amuse sailors on long voyages. The mirrors would probably not have been used for shaving, as the ship's barber-surgeon was there to do this. The ship's dry card compass would have been considerably more accurate, so they were not used for navigation, but could possibly tell the sailor approximately which direction the ship was taking when he was below deck. In the captain's cabin there would often be an inverted 'tell-tale compass' hanging above his bunk so that he could see the direction that the ship was going without having to go on deck.

With the thousands of dials made in Nuremberg in 16th century it seems surprising that so few have been found. They were obviously discarded as relatively worthless items but I am sure that in the future more of them will come to light, perhaps preserved as well of those on the Mary Rose.

I often wonder how these little dials got to be on board the ship. There are many possible scenarios and the following is pure conjecture. The dials probably came overland to Antwerp from Nuremberg along already established trade routes, from where they could have been shipped to Britain. I can imagine the scene on the dockyard at Portsmouth with people, suppliers and general vendors milling in all directions, and one particular peddler shouting out his wares, 'Combs! - Laces! - Ribbons! - Herbs!' - and, of course, 'Dials!.....'

All of the Mary Rose dials are kept on display at The Mary Rose Museum at Portsmouth Historic Dockyard and are worth the pilgrimage to see, together with the many other artefacts that are on display. The remaining hull of the ship is contained in a separate building, very close to Nelson's 'Victory', while it is being treated. It is very impressive, particularly for its size and shows clearly a cross section of the structure of this once great warship. The Museum of London dials are not currently on display. The Bury St. Edmunds dial is on display together with several good pocket dials and an excellent collection of clocks at the Manor House Museum, Bury St. Edmunds.

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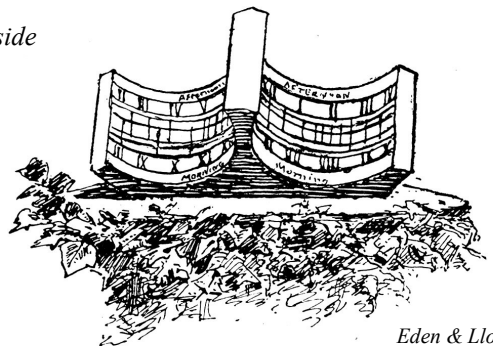
ACKNOWLEDGEMENTS

I would like to thank the following for their help and assistance in producing this article:-

The Mary Rose Trust for allowing me to publish this article, for providing detail drawings of, and allowing me to photograph the dials. Julie Gardiner of Wessex Archaeology who has been co-author of the chapter in the book[4] on the dials of the Mary Rose. Hazel Forsyth from The Museum of London. Pictures of their dials are reproduced by kind permission from the Board of Governors of the Museum of London. Keith Cunliffe from The Manor House Museum, Bury St. Edmunds who have also allowed me to publish the picture of their dial. Roland Schewe of the Germanishes Nationalmuseum who has provided the information about Nuremberg makers. John Davis who has kindly helped with analysing the various calibration lines and has made many useful suggestions.

Fellside



Eden & Lloyd

EQUATORIAL SUNDIAL BY LAKE COMO, ITALY

KEN HEAD

I came across this splendid equatorial dial at Domaso, near Gravedona, which lies at the northern end of Lake Como, during a caravan touring holiday. We found a very attractive caravan site on the shore of the lake not far from the village, so we decided to stay there for several days.

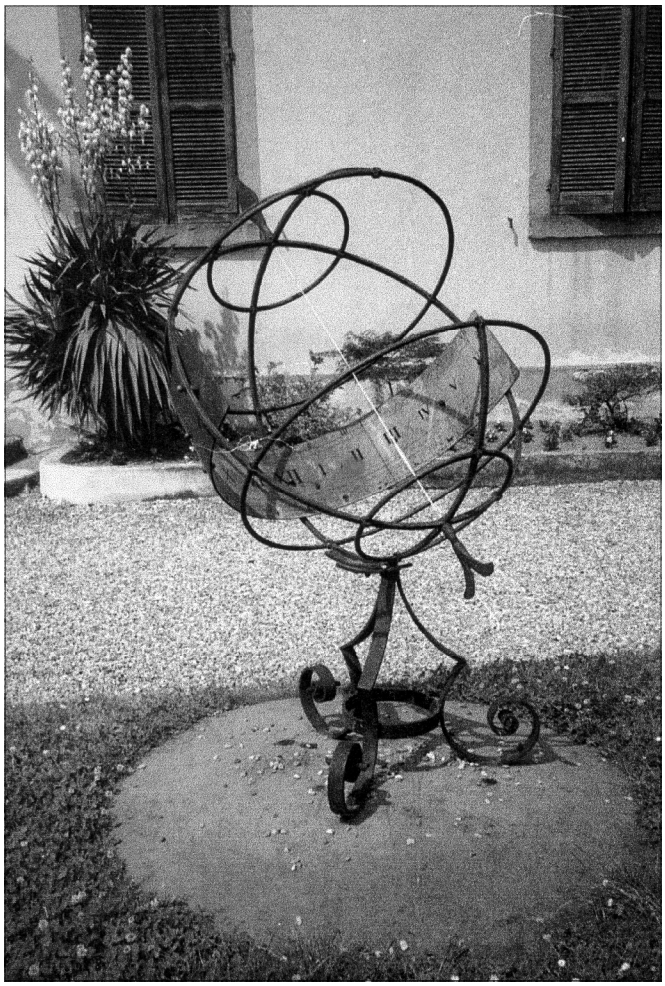


Fig. 1. The Lake Como equatorial dial.

The dial (Fig. 1) is located at the edge of the lawn in front of the Villa Camilla, originally built in the early 17th century and now used as the Municipio ('Town Hall'). It is an elegant building with a splendidly ornate interior, but now has a rather run-down appearance, although some interior renovation work is in progress. The building has an interesting history and has been owned by a succession of families, among them an Englishman named Samuel Hill in the late 19th century.

The frame of the dial appears to be of wrought iron, supporting a style in the form of a flighted arrow presumably aligned towards the celestial pole, and an engraved semi-circular scale about 940 mm diameter and 250 mm wide. Both the arrow and the scale appear to be of stainless steel. Figs. 2 and 3 show the left-hand and right-hand halves of the scale in more detail.

The main scale of hours across the middle of the dial is marked with bold Roman numerals, and is subdivided into half- and quarter-hours. Above it is a similar scale with smaller numerals, one hour ahead of the main scale. The XII (noon) mark is exactly in alignment with the style.

The upper inscription to the left of the scale of hours is presumably the name and address of the manufacturer, and reads:

MERIDIONE & OROLOGI SOLARI
via della Moscova
20121 MILANO

My interpretation of the lower inscription is that the shadow of the stylus moves 2mm every minute, which is consistent with the scale diameter of 940 mm.

L'ombra della stilo si sposta di 2mm ogni minito primo

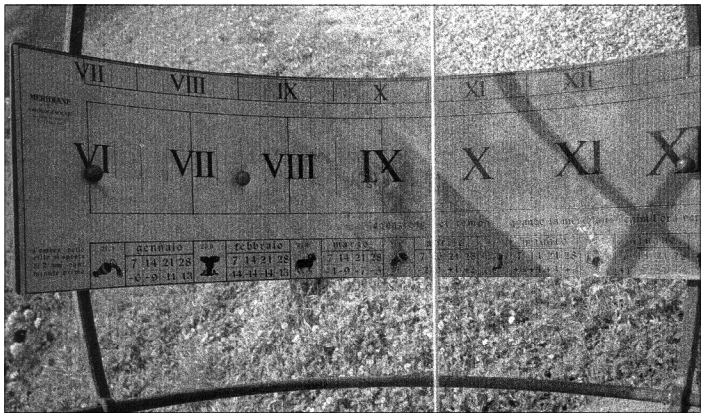
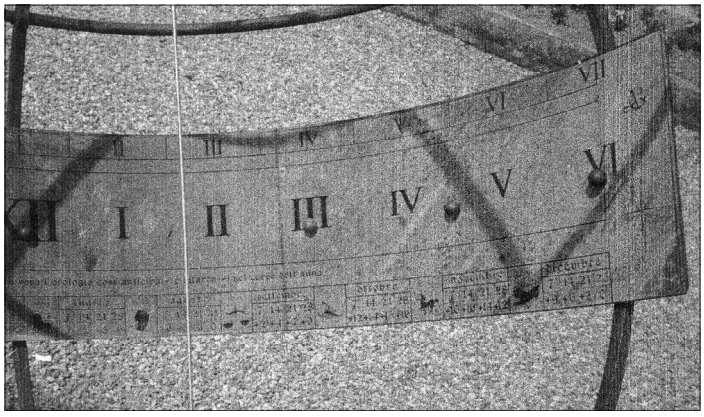
Below the hours scale are monthly tables for deriving the equation of time, with instructions above them. Each table includes a representation of a zodiac symbol, above which is a Roman numeral representing the month (I to XII), although some are scarcely distinguishable. The numeral is preceded by a number, which probably indicates the day of the month on which the sun enters that zodiac constellation, as follows:

21. I	20.II	21.III	21.IV	21.V	21.VI
23.VII	24.VIII	23.IX	24.X	23.XI	21.XII

The 'instructions' read :

equazione del tempo : quando la meridiana segno l'ora vera l'orologlio cosi anticipa (+) o ritarda (-) nel corso dell'anno :

(I apologise for any mistakes in copying the inscriptions).

Figs. 2 & 3. Two views of the hour ring, instructions and Equation of Time table.

To the right of the scale is what appears to be ornate letters AG intertwined. Below that is an eight-point star symbol.

I was puzzled to observe that the shadow of the style on the upper scale indicated the correct clock time, as far as I could tell without an accurate time check, the ET correction in early June being no more than 2 minutes (Waugh[1], Table A.1). According to the Michelin map of North-West Italy[2], Domaso lies at N 46° 09', E 09° 20'. Solar noon at Domaso is therefore 37 min 20 sec ahead of solar noon at Greenwich. European summer time is 1 hour ahead of BST, so the upper scale of hours should indicate about 23 minutes behind local clock time. I was never there to observe the reading at local solar noon (1.30 pm being after-lunch siesta time!). But it was apparent that the dial does not face true south, but has been aligned to read clock time at mid-day.

I wanted to observe readings in the early morning and late evening, which would probably exaggerate the out-of-alignment effect. On two occasions when I was passing by, at 8.15 am and at 6.30 pm, surrounding trees made observation difficult. (There ought to be a 'tree exclusion zone' around every sundial.) I could not establish a north-south line by viewing across the lake with the aid of the map (those trees again). However, at 6.30 pm it was evident that the shadow of the style did not lie at a right angle to the scale, but was noticeably inclined, and the time reading differed from clock time by about 4 minutes. This seems to be consistent with the dial not being aligned to face due south. So I came to the conclusion that the dial has been deliberately set out of the true north-south alignment by about 5° in order to indicate clock time around mid-day, thereby introducing discrepancies at other times.

While I was in Domaso I tried to find out more about this sundial. The local Tourist Office knew nothing about it, but they had an illustrated A4-size book (in Italian) on Domaso[3]. I bought the book, which includes seven pages on the Villa Camilla but no mention of the sundial. I called in the Municipio, and was eventually introduced to an English-speaking official. All he knew was that the dial had been donated by one Galli Aureliano, but he did not know where he is now. I left my address so that he could write to me if he discovered any more details, but I have heard nothing from him. When I returned home I wrote to the address engraved on the dial, and after three weeks the letter was returned with a Poste Italiane label indicating 'Indirizzo Incompleto', which I suppose means that they couldn't find the address.

I would have liked to find out why the dial has been set out of alignment with the noon meridian. If the intention was to enable it to indicate clock time, not solar time, then surely the hour scales should have been suitably offset by 37 minutes. Perhaps the dial was made to a standard design, and when installing it a bodily rotation was the easiest way of making it indicate clock time. I would be pleased to hear from anyone who can offer any suggestions.

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NEW SUNDIAL AT THE SCOTS HOTEL IN TIBERIAS, ISRAEL

SHAUL ADAM AND FRED HIBBERT

The Scots Hotel is owned and managed by the Church of Scotland on the shore of the Sea of Galilee in Tiberias. Tiberias is in the Great Rift Valley in the north of Israel, 200 metres below sea level at latitude 32° 48' N, longitude 35° 32' E.

Dr David Torrance, a young surgeon from Scotland, started medical work in 1885 and a hospital was opened here in 1894. The hospital served the people of Tiberias until the 1950s when it was replaced by a more modern hospital. It was then used as a guest house until 2000, when it closed in order to be redeveloped. Now it has re-opened as an international standard hotel with a new building containing 50 rooms and the old hospital and two houses from the same period lovingly refurbished to a very high standard. Rev. Fred Hibbert supervised the work on behalf of the Church.

Fred had the idea of placing a sundial in the extensive gardens, but unfortunately knew nothing about sundials or their designers. He went into the BSS website in search of information and was pleasantly surprised to find that the first name that he came across was an Israeli (me [S.A]). He contacted me and we arranged to meet at the hotel in Tiberias. I showed Fred and his wife Diana, who was an active participant in the process of deciding on a design, photographs and drawings of various types of sundial. Eventually Fred suggested that we use a basalt boulder as the body of the sundial. The old buildings of the hotel are constructed from basalt, which is a local stone, as are many of the buildings in Tiberias. The sundial would therefore look very much a natural part of its surroundings.

The next decision that we came to was to have two sundials on the boulder – one horizontal on the upper cut face and the other vertical on the southern face (either natural or cut). This meant that we had to find a boulder with at least one face as flat and vertical as possible. The plates were to be made from brass. After a couple of fruitless efforts to find the right stone we were fortunate at Gazit Stones in Hatzor to find one that was nearly perfect. It was of a rather pyramid like shape with one face straight enough to serve as the southern face. It was quite high so the top and bottom were cut in parallel to provide a secure base and a horizontal face for the upper sundial.

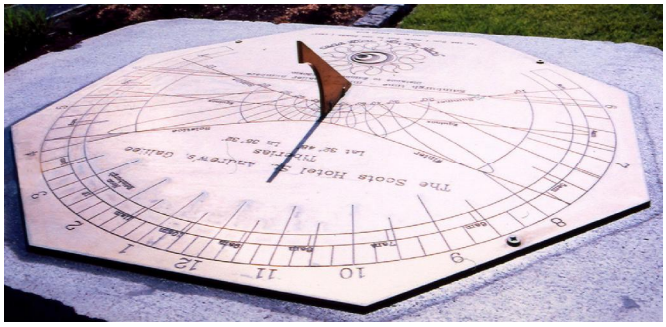
The basic designs were carried out using the ZW2000 programme of Fer de Vries. They were than transmitted as DXF and finished in AutoCAD. The horizontal sundial

shows Local Apparent Time, with a full analemma for each full hour, with divisions for half and quarter-hours. An inner circle marks the numerals of full hours in Edinburgh. Also displayed are arcs for the sun's altitude from 10° to 80° in 10° increments, together with declination lines for solstices and equinoxes.

A short inscription draws the observer's attention to the inner circle and marks for Edinburgh time and also shows the distance from Tiberias to Edinburgh in kilometers. A stylised sun decorates the bottom part of the dial plate, partly surrounded by a Hebrew motto with an English translation.

The vertical sundial is somewhat simpler. It shows Local Apparent Time with full analemmas for full hours, divisions for half and quarter-hours, and declination lines of solstices and equinoxes.

The dial plates are 3mm thick and the gnomons are 4mm thick to give the necessary strength. Engraving was done by Moti Ashkenazi and his son Meir from 'M.ASH. Fine Mechanics' in Pethakh Tiqva. They showed much patience with me and coped with the difficulty of transferring the AutoCAD files to their Nibbles program, doing so with great skill and accuracy.



The boulder was finally put into place and the sundials fixed to their faces on Tuesday 12th October 2004.

Authors' addresses:

Fred Hibbert
The Scots Hotel St. Andrew's-Galilee,
Tiberias, Israel

Shaul Adam
Cokhav Yair,
Israel

THE DANDELION – NATURE'S SUNDIAL

CHRISTOPHER S^{T} J H DANIEL

My leaves are green and lushly spread,
My stem stands tall with a 'gilded' head,
My petals fan in yellow gold;
But I am a weed, or so I'm told.

Towards the sun, I gaze and smile:
Some say that I am Nature's dial;
But if I have such natural powers,
I only count the sunny hours!

More do I mark, when I turn grey,
A sphere of seeds in soft array,
Each tiny parachute a seed,
Born by the wind as another weed!

****

Inscribed by the author in the cover of his Shire book on 'Sundials' to ***John Maddock****, friend and former colleague, once the learned Clerk to the Honourable Company of Master Mariners, this short piece of light-hearted verse reflects the recipient's supposed understanding of the subject! Written in a railway carriage, whilst waiting for the 1008 am train to leave Faversham station for London, on Wednesday, 26th January, 2005.*

EAST OF EVESHAM

TONY WOOD

In Worcestershire's market garden region lies the village of Badsey. It might be that the church of St James there has the largest mass dial 'in the world'; 'yet discovered' if we are being cautious. Its size can be gauged from Fig. 1 where on tiptoe and outstretched arms just span its diameter. Mass dials do vary in size and a few large ones occur in Gloucestershire at Leckhampton, Kemble and Westbury-on-Severn (800 mm, 620 mm and 305 mm respectively) with another large one not too far away in Oxfordshire at Shirburn (600 mm). (Shirburn is probably a Saxon dial however.)

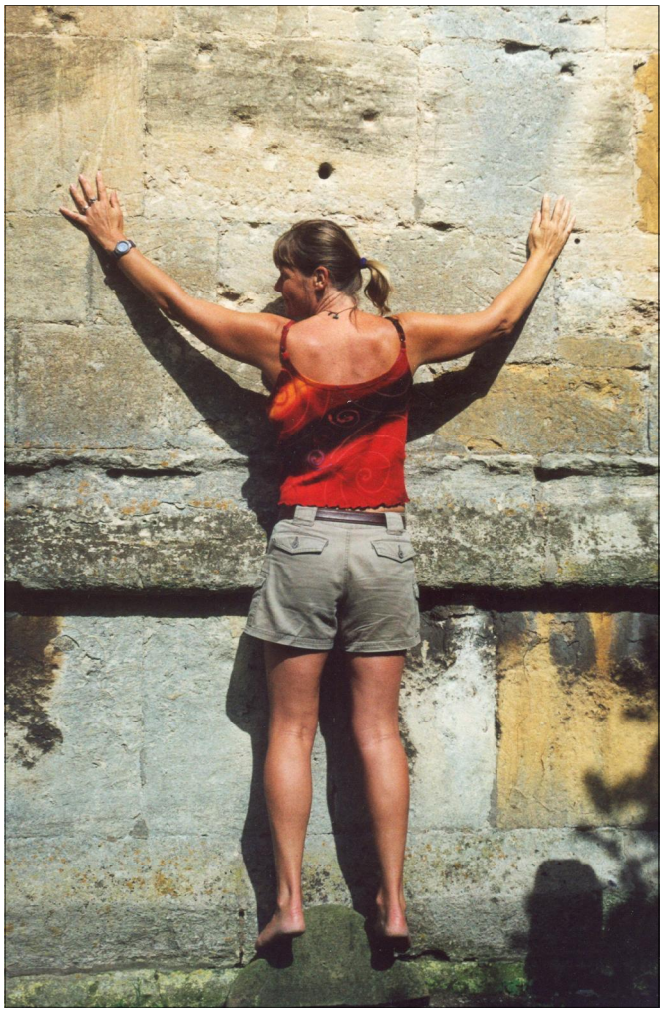


Fig.1. The extent of the mass dial at St James, Badsey.

The usual observation that such dials were carved at chest height no longer applies to Badsey's 1100 mm version on the south wall of the tower. It is now rather faint, so much so that some members of the Church Council were unaware of its existence and must have walked past it weekly. As far as its position within the canon of mass dials is concerned it is almost unique in size. A date of 'later', say 16th century might be guessed at owing to the presence of the numbers within the two circles outlining the dial. The Roman numerals are evenly spaced at 15° intervals; together with the circular layout we are firmly in the mass dial tradition. There is a suspicion that some attempt may have been made to install a sloping gnomon but the original gnomon was probably horizontal.

Fig. 2. East side of the Badsey mass dial.

The situation of the dial is such that it is shadowed after around 4:30 pm in summer by the tower south-west buttress and the morning sunlight is also obstructed. Even with the sun round to the west as far as it would go to give decent shadow contrast the numerals are by no means obvious but Figs. 2 and 3 show parts of the dial where the carving is still fairly clear.

Having cheerfully laid claim to the largest mass dial, one might ask "where is the smallest?" – a little more difficult as mass dial hunters frequently come across vague scratchings and circles which may or may not be a 'good' dial. As

Fig. 3. Bottom of the Badsey mass dial.

Fig. 4. The miniature dial at Lynsted.

a possibility however, and still to the east of Evesham (well to the east - in Kent!), I would propose that at St Peter and St Paul, Lynsted (Fig. 4) as it is a well defined dial of recognised pattern but about the size of a man's largish wrist watch at 42 mm diameter.

A previous article[1] laying claim to Britain's largest church sundial was written in the hope that it would be trumped by an even bigger one – I live in hope that 'size is important' may provoke a response to the above claims.

REFERENCE

1. A. O. Wood: 'The Sundial at St. Tewdric's, Mathern, South Wales' *BSS Bulletin* 14(iv), p. 145, (Dec 2002).

Author's address
Churchdown
Gloucester

READER'S LETTER

Redacted

Redacted

A JUST PUNISHMENT?

JOHN DAVIS

On 30 May 1743 at the Old Bailey, William Carter of Finchley was found guilty of Simple Grand Larceny and sentenced to transportation to the colonies for seven years.[1] What had he stolen? A sundial. The dial in question belonged to Charles Hedges Esq. and had been seen in his garden by his gardener and under-gardener on the 9th May but it was gone the next day. John Gregory, a founder of Shoe Lane, reported that Carter had brought the dial to him on the 11th with "the cock (gnomon) off and the arms were erased out". The dial plate weighed 13 lbs 2 oz and Gregory gave "nine shillings and a peny" for its value as scrap brass. Assuming the plate was a typical ¼" thick, this equates to a 15" diameter dial so it would have been a substantial instrument.

The quality of the dial is substantiated by the next witness, no less a person than Thomas Wright[2] (mathematical instrument maker to his Majesty). Wright's evidence was that, "I made this dial for Mr. Hedges and set it up myself: the arms are erased, but my name was engraved so deep, that they could not get that off, though they have been endeavouring at it. It was a very neat one; Mr. Hedges gave me five guineas and a half for it."

After some character witnesses who stated that Carter was a traveller selling Tunbridge ware and keeping irregular hours lodging in several public houses – including the White Hart in Chancery Lane, coincidentally a well-known location for dial makers – Carter was found guilty. What became of him is not recorded.

The story immediately begs the question of what happened to the dial. Did Wright make a new gnomon and renovate the plate? Or did Mr. Hedges order a new dial for the Gravel Walk in his garden? In either case, somewhere there may still be an unrecorded Wright dial, worth considerably more than the £0.45 that Carter got!

Modern diallists must sometimes wish that stolen dials could be recovered and the thieves brought to book within three weeks of the theft, as in this case. However, even the strongest advocates of law and order might think that the punishment was a little harsh!

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2. J. Davis: 'Thomas Wright's horizontal sundials', *BSS Bulletin*, 16(iv), pp. 135-143, (Dec. 2004).

BOOK NOTE (2)

The journal of the Dutch Sundial Society, the Zonnewijzerkring, recently published a review by Jan de Grave of Mike Cowham's book 'A Dial in Your Poke'. We reprint an English Summary of this review.

In this sundial book you will find information you will not find in any other gnomonic treatise, ful of useful information for amateurs of scientific instruments. Many hints to preserve, repair, clean and restore rare pieces. Chapters on calendars, magnetic declination, saint days, replicas and fakes are seldom found in any sundial book, after a more classical description of different types of sundials, all fully illustrated from private collection. It is a joy to read and consult especially on these rainy days we have this year.

MORE ON THE EQUATION OF TIME ON SUNDIALS

JOHN DAVIS

In an earlier paper[1], the development of accurate Equation of Time (EoT) tables by astronomers in the 17th and 18th centuries, and the presentation of this data on sundials, was discussed. Further analysis has now been performed and other examples have come to light. The database of tables[2] currently contains over twenty printed versions and data from numerous dials.

TOMPION AND FLAMSTEED

The earlier paper described an EoT table printed, in Latin and using the Gregorian calendar, by Thomas Tompion in 1690. Although Tompion's earlier 1683 Julian table was widely used on dials by many makers, no examples of this later, improved version were known on dials. It is believed that both tables were actually calculated by the Astronomer Royal, John Flamsteed. More detailed examination has now shown that the underlying numerical values of the 1690 table are essentially the same as those of the (Julian) table calculated by Flamsteed in 1702 and reprinted from his papers by John Smart in 1710 (referred to as the 'Smart/ Flamsteed' table in the earlier paper). However, both the Tompion 1690 and the Smart/Flamsteed tables have a discontinuity of around 7 seconds between the values on 31 December and 1 January, irrespective of the calendar system in use (see Fig. 1). As a result, the two tables show slightly different values from 22 to 31 December (Julian) but are otherwise identical. This allows an insight into the way that Flamsteed calculated the tables. He seems to have had a table for the daily differences in EoT (from one day to the next) which was the same for the 1690 and 1702 tables. For his 1702 table, he started from an EoT value of 8m 59s on 1 Jan (Julian), and then summed the differences each day of the year until he arrived at a value of 8m 29s on 31 Dec. The difference of 30s between these beginning and end values compares to the expected rate of change of 23 or 24 seconds per day at that time of the year: the discrepancy

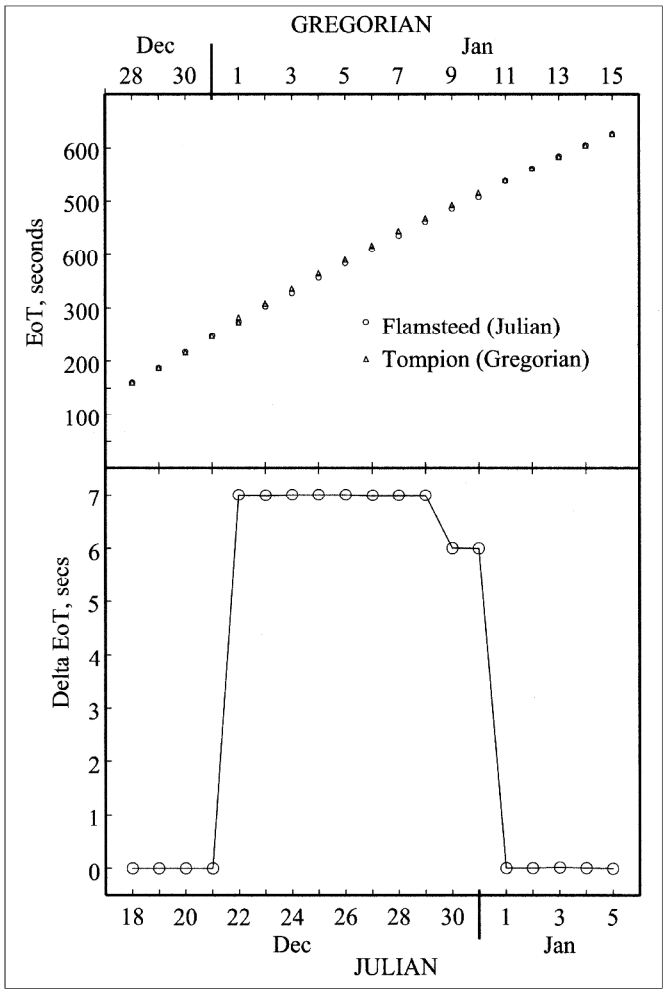


Fig. 1. Comparison of Tompion's 1690 Gregorian and Flamsteed's 1702 EoT values at the year end. Gregorian dates are 10 days different to Julian ones prior to 1700. Delta EoT is defined here as (Tompion – Flamsteed) values.

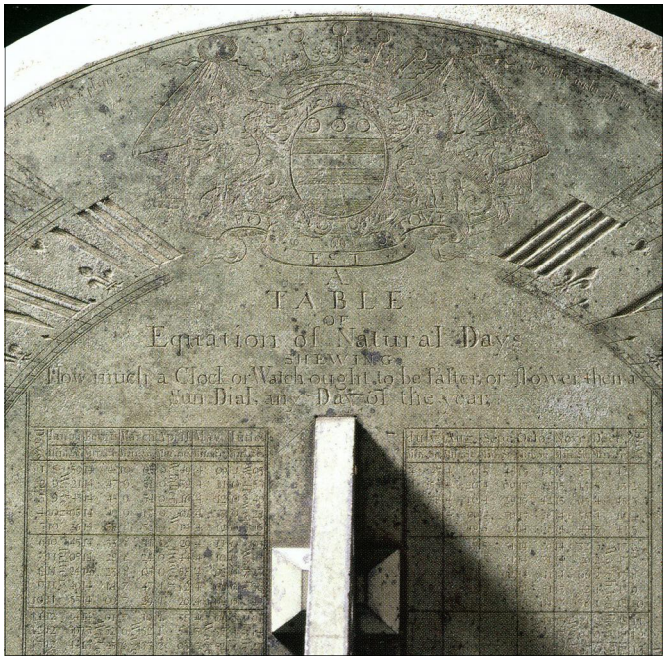


Fig. 2. Part of the EoT table from the Tompion Wrest Park dial, showing the columns for each month of the year. Photo courtesy Sotheby's.

Fig. 3. Gabriel Stokes (1682-1768). Portrait by an unknown artist, courtesy of Trinity College Dublin.

of approximately a quarter of the daily change is due to the slippage of the solar longitude with the leap year cycle. When calculating the 1690 Gregorian table for Tompion, Flamsteed has started with a value of 4m 42s on 22 Dec Julian (1 Jan Gregorian) and then summed the same differences as before. Note that 1690 and 1702 were both LY+2 as 1700 was a leap year in the Julian calendar.

In June 2004, Sotheby's sold a previously 'lost' sundial made by Tompion for Wrest Park, Beds.[3,4] This wonderful dial (illustrated in Fig. 2 and Refs. 3 and 4) includes a full table of the EoT in minutes and seconds for each day of the year. Although not all of the values are now easy to read (and the Sotheby's catalogue description unfortunately has reading errors in some of the key max/min values) enough of it has been tabulated to make it clear that the data is from the Smart/Flamsteed table. This is the only known example of Tompion using anything other than his 1683 table on a dial. Although this indicates that the dial is later than, for example, his "c.1705" dial (Fig. 3 in Ref. 1), it does not necessarily mean that the dial dates to after 1702 as Tompion may well have had access to Flamsteed's results before they were published. Being an English dial, Tompion has not used his 1690 Gregorian table which remains unknown on a sundial.

THOMAS TUTTELL

In 1698 the mathematical instrument maker Thomas Tuttell, one of Henry Wynne's apprentices, published a small book[5] on the analemmatic double dial which he had improved and was popularising. It included an EoT table with the title "A Table of Equation, shewing the Difference of a well Adjust'ned Pendulum and the Sun, every Day of the Year". The columns were listed with the unusual (unique?) labels "Pendulum Gains/Looses" rather than the more common "Watch Fast/Slow". The values of the max/mins in the table indicate that it has been calculated with the same set of orbital parameters as the Smart/Flamsteed table (the only difference is of 1 second to the October maximum). However, there are consistent differences in the daily values of up to 8sec, equivalent to approximately a quarter of the daily change. This points to the table having been calculated, probably by Flamsteed, for the year 1697 which was LY+1.

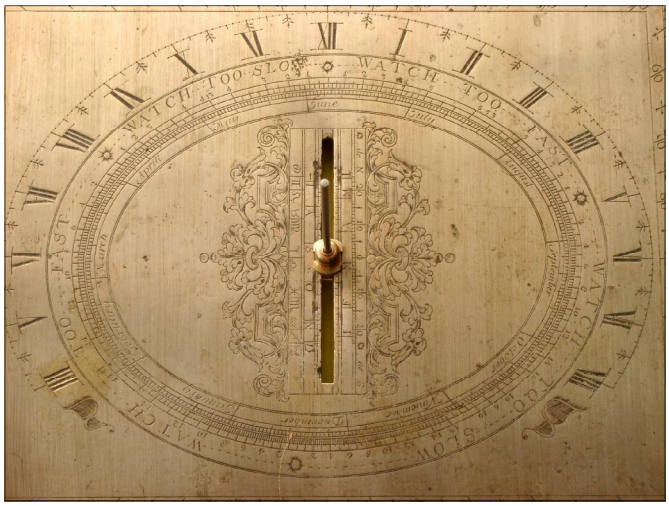


Photo: M. Cowham

Fig. 4. Analemmatic dial by Gabriel Stokes.

PORTABLE DIALS

The recent book 'A Dial in Your Poke' by Michael Cowham[6] shows several portable dials with EoT scales. The earliest and most important of these is a tabletop analemmatic and horizontal combination in silvered brass, in the format described by Thomas Tuttell. The dial has been shown previously in the Bulletin[7] and is by the relatively little-known maker Gabriel Stokes of Dublin.[8-10] Stokes (1682-1768) was the son of a tailor but served his apprenticeship under Joseph Moland, a surveyor and mathematical instrument maker: his portrait (Fig. 3) shows him with a surveyor's cross-staff. Stokes went on to be Deputy Surveyor General of Ireland and to found a dynasty of important British scientists[8]. The name of one of his descendents, Sir George Gabriel Stokes, will be known to *Bulletin* readers through his association with the Campbell-Stokes sunshine recorder. The EoT scale on Stokes' analemmatic dial

(Fig. 4) is remarkable for at least two reasons. Firstly, it is laid out around the elliptical scale and in such a way that the (Julian) date scale is approximately linear; that is, not with an equi-angular arrangement around the centre of the ellipse. Laying this out is a clever piece of geometry.

The actual EoT scale on the Stokes analemmatic dial is divided down to 15s increments of EoT with every 2m numbered. This is an impressive piece of calculation as well as engraving. The max/min values are explicitly engraved as: +14m 51s; -4m 13s; +5m 53s and -16m 6s. These values are not an exact match to any of the published tables (see Table 2 in Ref. 1) although they are entirely consistent with values to be expected for around 1700. The closest match to known tabulations is the 1686 table of Stokes' Dublin compatriot William Molyneux. Molyneux[11] had also been Surveyor General of Ireland a generation earlier and had corresponded with Flamsteed about the confusing number of EoT tables. Thus it is tempting to think that there had been some form of inheritance of the EoT data, possibly through the Dublin Philosophical Society or Trinity College Dublin, where both Molyneux's son Samuel and Stokes's two sons studied. Samuel Molyneux had revived the Dublin Philosophical Society in 1707 before moving to London and working with the astronomer Halley. Stokes is known[9] to have made detailed repairs and modifications to the 'Great Quadrant' at the Trinity College Observatory in 1715 and he clearly had contact with the Professor of Mathematics there. Thus it is quite possible that there is a yet-to-be-discovered early calculation of the EoT by the 'Dublin school' of astronomers waiting to be found.

Photo: M. Cowham

Fig. 5. A mechanical equinoctial dial by Thomas Wright.

The mechanical equinoctial dial by Thomas Wright which Cowham[6] shows (Fig. 5) is similar to one by the same maker originally at the Time Museum and sold by Sotherby's in 2003.[12] Both dials have an EoT scale arranged to be read from the periphery of the dial and using data identified as the Smart/Flamsteed table. However, the scale runs clockwise on the Sotheby's dial but anticlockwise on the dial illustrated by Cowham. Wright[13] was one of the last major makers to adopt the more logical anticlockwise format so, although both dials are undated, this indicates that the Cowham dial is slightly later than the Sotheby's one. This supposition is supported by the signatures: on Sotherby's dial Wright signs himself as "Instrm^{t} maker to his MAJESTY" whereas on the Cowham dial he is "Instrum^{t} maker to y^{e} KING". Another guide to the date of the Cowham dial is the magnetic variation for London of 13.5° W indicated on its compass, a value which is compatible with around 1730.

Photo: M. Cowham

Fig. 6. A magnetic compass dial by Fraser.

Cowham also shows a small magnetic compass dial signed "Fraser, London" which has an EoT scale running around the outside (Fig. 6). The dial is probably by William Fraser who worked from New Bond Street[14] 1780-1805, so naturally the date scale is for the Gregorian calendar. Although the engraving is very fine, with the date shown to every 2 days and the EoT to 1m increments, the actual data is a muddle, especially in July where the maximum value of +6m 46s cannot possibly be right for any date of that millennium. The value of -16m (0)s in December is too small for an 1800 date and the -4m 13s for May is more suited to a date in the 1730s. It appears that there may have been a rather poor attempt at converting an old Julian table, rather than using one from a recent Nautical Almanac.

A similar magnetic compass dial, made for S. America, is also shown by Cowham[6]. It has an EoT table printed on paper pasted into the lid (Fig. 7). The format in this instance is to give the dates when the EoT is a whole number of minutes, resulting in more entries for those months where the EoT is changing rapidly. The general format is that used by the engineer John Smeaton in his printed tables (e.g. in Ferguson's 'Astronomy'[33]) in the last quarter of the

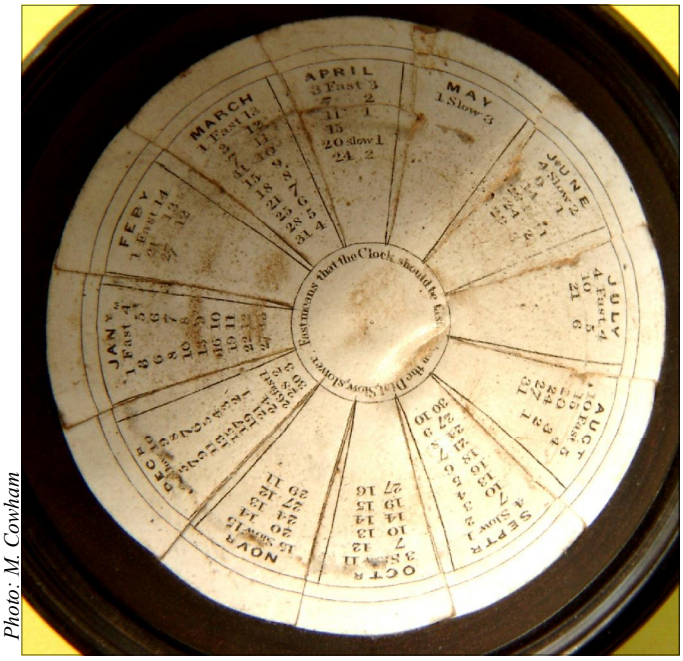


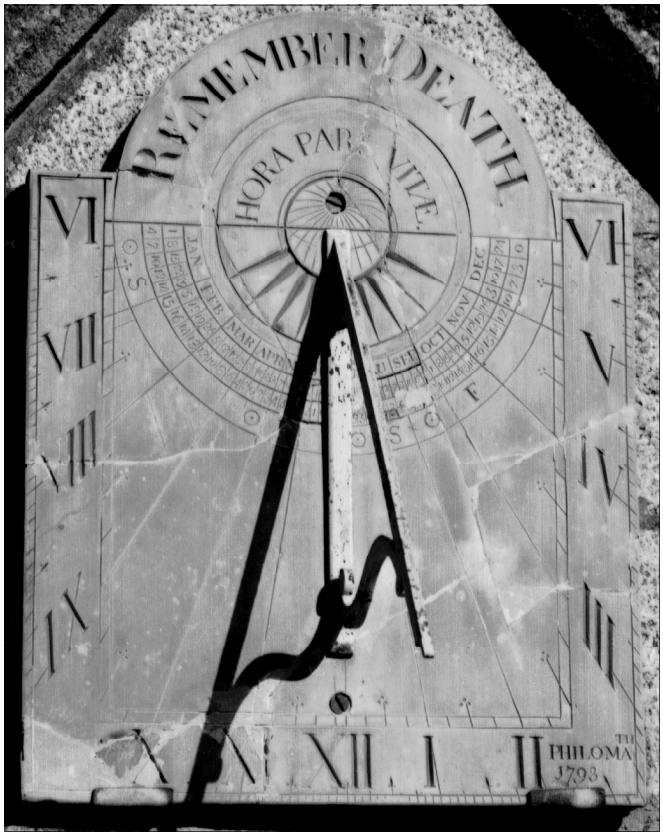
Photo: M. Cowham

Fig. 7. An EoT table pasted into the lid of a magnetic compass dial.

18th century. The table on this dial shows a number of mistakes, such as values repeated at the end of February and the beginning of March, and missing values in May. There are other subtle differences which point to this being a poor copy of a table similar to Smeaton's. Strangely, the table associated with the 1892 vertical stone dial at Sandringham, Norfolk, has the same data with the same errors! This latter dial is by the respected firm of F. Barker & Son, 12 Clerkenwell Rd., London. They were a major manufacturer both of dials and of EoT plates[10] so there is clearly more research to be done in this area.

VERTICAL DIALS

Relatively few vertical dials have EoT scales. This is probably partly because they were generally made by local artisans not familiar with the latest scientific discoveries. A second reason is that the users of the dials would not be using them to set their clocks but simply to get a general indication of the local time. Because vertical dials are normally viewed at a substantial distance, the letter-cutting has to be bold to be legible and so EoT data has to be presented in a condensed format. This is usually done by giving the values, in whole minutes only, either on selected dates or on the occasions when the value changes. For the former method, there is a wide variety of ways to choose the dates: it may be certain days of each month, such as the 7th, 14th, 21st and 28th, or it may be for every fifth (for example) day of the year, giving different day numbers in each month. With this wide variety of methods, it is difficult to make comparisons between the underlying data sources.



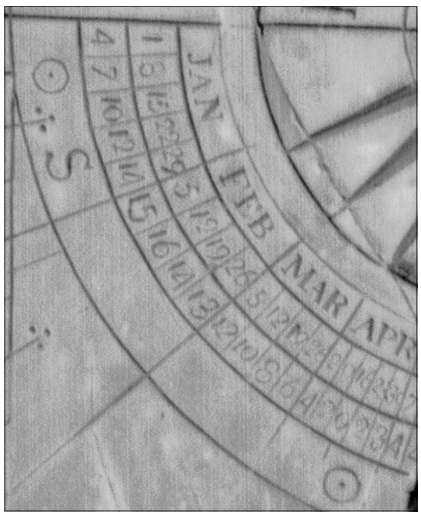


Fig. 8a (above): Camborne church dial, Cornwall.
Fig. 8b (left): close-up of the EoT scale.
Photos: L. Burge.

One quite comprehensive table is that on the vertical south dial at Camborne church as shown in Len Burge's book *Cornwall Church Sundials*[15] (Fig. 8). The maker's name on this 1793 dial cannot now be read but was drawn as "__mes ___er" by Jeannie Crowley in 1957.[16] The maker describes himself as a 'philomath' - a lover of learning – which perhaps explains the presence of the EoT table. The values, for every seventh day of the year, are fairly standard but there is a major error in February where values reaching 16 minutes are clearly shown. This mistake could have been a simple mis-reading of the source data but it may be significant that another Cornish dial has a similar error. This latter case is a brass horizontal dial of 1792 from Helston[15] and it also shows every seventh day from 1 January. Could it be that these makers expected the February maximum to

mirror the November minimum?

Another Cornish vertical dial[15] with an EoT table is at St. Blazey and is dated 1839 (Fig. 9). Here, values are given for four days of each month. The drawback with this scheme is seen by the step of four minutes between consecutive entries in early December, when the EoT is changing at its fastest. The actual values are unremarkable and are accurate for that era.

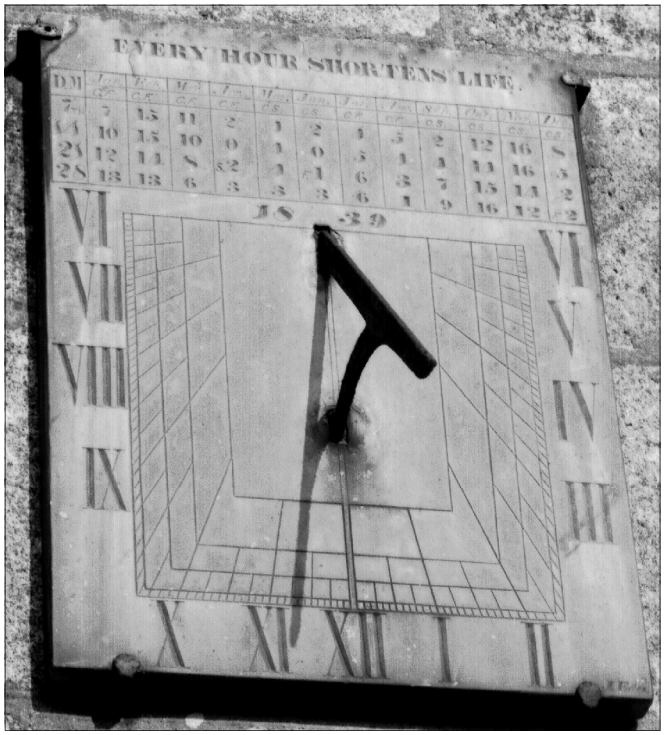


Photo: L. Burge

Fig. 9. St. Blazey church dial, Cornwall.

HORIZONTAL DIALS

In 1819 a good quality horizontal dial made by W & S Jones of Holborn was installed in the tower of the church at Benenden, Kent, for the purpose of regulating the new clock.[17] The dial has an EoT ring which specifies[18] the values of the maxima/minima as +14m 37s; -3m 57s; +6m 7s and -16m 16s. From the data of Fig. 1 of Ref. 1, it can be deduced that these values come from a table calculated for the year 1825 ±15years. Thus it seems that the dialmakers, working to the orders of the clockmakers Thwaites and Reed, have used the most up-to-date table available to them, probably from the Nautical Almanac. What is perhaps surprising, though completely normal for the period, is that no attempt has been made to anticipate the variation in the EoT over the likely lifetime of the dial. Using the tables to set the clock today can result in an error of up to about ±30 seconds, depending on the time of year.

A well-made c.1825 bronze horizontal dial by A. Adie of Edinburgh[19] has a traditional 'Watch Faster/Slower' EoT scale running in an anticlockwise arc, as had become standard by that time: see Fig. 10 . Close examination shows that each minute mark on the EoT scale corresponds exactly to a day on the date scale. The scale also has, for example, only one mark for 16mins in Oct/Nov where a pair of marks, one either side of the minimum, is required. This indicates that the source of the data was an as-yet unidentified simplified table, in minutes only, in the form published by Smeaton. This shows how the importance of sundials as scientific instruments had declined since the 18th century, where the integer-minute values of EoT were carefully interpolated to fractional days from daily tables giving the values in minutes and seconds.

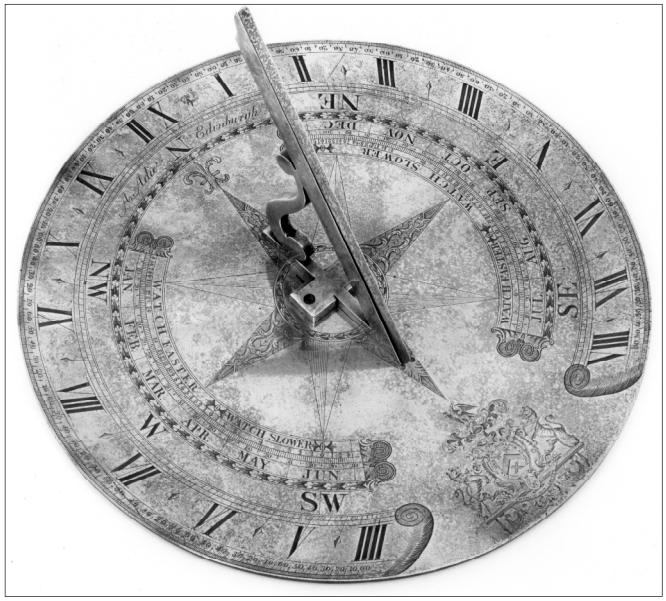
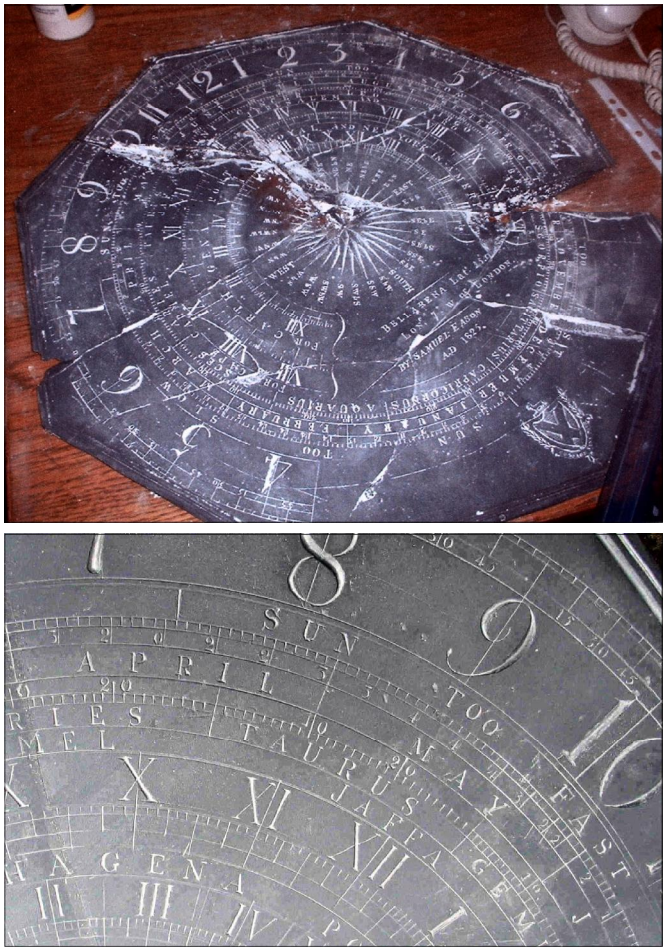


Fig. 10. A. Adie dial. Photo © The Trustees of The National Museums of Scotland.

The very fine dial by Troughton & Simms at St. Michael's Mount, Cornwall[20], has a ring which is actually engraved with the legend "Equation of Time" rather than the older "Æquation of Natural Days". The working dates for this company are given[14] as 1826-1922 and the EoT values on the dial, in contrast to those on the Adie one, are properly interpolated to fractional days. The combination of 11 days in July with an EoT above 6mins and 13 days in Oct/Nov where it is above 16mins, dates the data, if not the dial itself, towards the beginning of this period. As makers of astronomical instruments, Troughton & Simms clearly took the EoT seriously.

SLATE HORIZONTAL DIALS

A recently renovated 1825 Irish slate dial by Samuel Eason has an unusual EoT scale (Fig. 11). The completely circular inner ring gives the names of the constellations and is evenly subdivided into one degree increments of solar longitude, numbered (0), 10, 20, (30). The next ring has the



Photos: Harriet James

Fig. 11. An 1825 slate dial by Samuel Eason:(top) prior to its recent restoration;(bottom)part of EoT scale in degrees of solar longitude. Courtesy of David Harber Sundials.

names of the months but these are not subdivided at all. They occupy slightly variable angular spaces to correspond to the zodiac ring. The EoT values are then shown, numbered in minutes. The intervals between the minutes are divided into five but these are not 12 second increments as there are the same number of divisions even when the consecutive minutes numbers are the same (e.g. at the maximums and minimums). Instead, it appears that Eason has simply divided the gaps evenly, giving a false impression of the resolution of his scale. The source of his data is unknown: although Flamsteed's first printed EoT table in 1672 was calculated for degrees of solar longitude subsequent tables all give the values as a function of date. Eason is definitely using a Gregorian calendar so he has not simply used the old Flamsteed table. There are other anomalies in the scale which indicate that Eason did not fully understand the properties of the EoT.

Another Irish slate dial, of similar date but by Robert Connell, was sold[21] in 2002 and is shown in Fig. 12. It has a wealth of engraved detail including an EoT table in a four-days-per-month format. In this case the choice of days is

Photo: M. Cowham

Fig. 12. An 1815 slate dial by Robert Connell.

the 1st, 8th, 16th and 24th of each month, suggesting either a different source to that used for the St. Blazey dial or an extraction from a full table.

The most prolific maker of slate horizontal dials was Richard Melville.[19,22] He seems to have first introduced EoT tables into his multiple-gnomon dials in the 1840s. An example is shown in Fig. 13. He generally gives values starting on 10 January and then for every tenth day. The layout depends on the number of subsidiary dials on the plate and is usually either in two or four arc segments. Not surprisingly, the same data is used on many dials but an exception is the value for 20 May which is variously given as 3 mins or 4 mins (the correct value is 4 mins). Two dials which show 3 mins for 20 May are the 1843 'Dunmore'[22] dial and

Photo: Harriet James

Fig. 13. Part of the EoT ring on a multiple-gnomon slate dial by Richard Melville. This Sussex dial, from relatively late in Melville's career, has the correct value of 4 mins for May 20.

an 1848 one in a private collection, suggesting that he later corrected this particular error. Melville also has serious trouble with indicating the sign of the EoT in cases where it changes during a month. In addition to the EoT, later Melville dials also sometimes specify the time offset from Greenwich; a useful feature for finding the original design location.

Photo: M. Cowham

Fig. 14. The EoT graph on the west side of the Abbey Gardens, Bury St Edmunds, pillar dial.

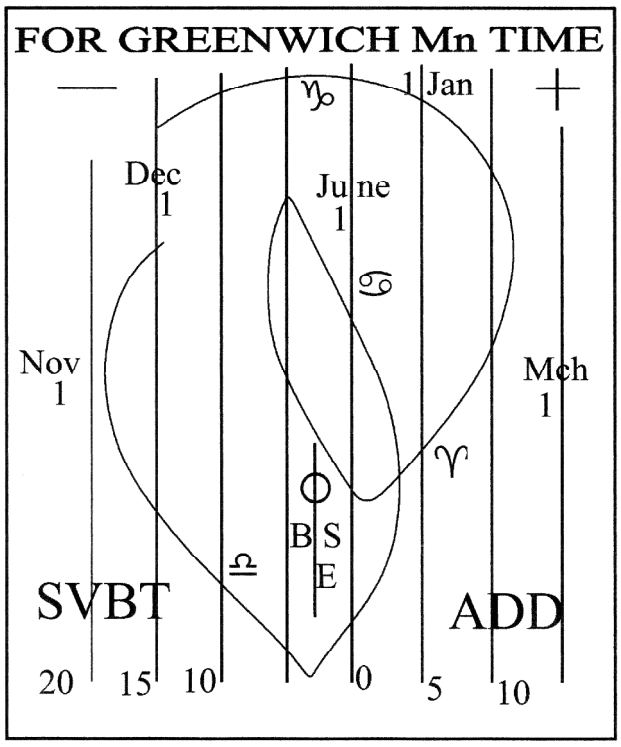


Fig. 15. An interpretation of the EoT graph on the Bury St Edmunds pillar dial.

GRAPHICAL PRESENTATIONS

The 1870 pillar dial[23] in the Abbey Gardens, Bury St Edmunds (Figs. 14 and 15) features a single, direct south, dial-face with inscriptions of the other vertical faces of the cuboid. That on the west face is a most unusual representation of the EoT, appearing at a first glance to be a 'folded analemma'. Although not a proper x-y cartesian graph of the EoT, this representation must rank as one of the earliest graphical forms other than true analemmas. The horizontal axis is the time difference but the vertical axis seems to be arbitrary, with the curve being discontinuous at 1 December. The local longitude of 0° 43' E gives a time offset of 2m 52s fast compared to Greenwich solar time. This offset is actually shown on the engraving so the curve really shows the total correction of EoT + longitude.

A presentation in a more standard cartesian form was shown on the 1936 cast concrete dial by Robert McClintock (see Fig. 5 of Ref 22). In that case, however, it can be seen that the data used only had values for the beginning and middle of each month and simple straight-line interpolations between these values have been used.

CLOCKMAKERS

Some clockmakers followed the lead set by Thomas Tompion and printed EoT tables to be pasted into their longcase clocks. Usually this was only done by the best London makers but one example of a country maker with an EoT table is John Calver (c.1695-1750) of Woodbridge, Suffolk.[24] Working prior to 1751, his table showed the value, to minutes and seconds, for just six days each month. The values follow those of the 1702 Smart/Flamsteed table very closely although a significant percentage of the values show a 1 second difference, perhaps the difference between rounding and truncating values from a table calculated to tenths of a second. Calver printed a lengthy introduction to his table, transcribed in Appendix 1, which gives a good flavour of the wordiness of the time but which is, nevertheless, remarkably accurate. It also gives the good advice of trying to compare the clock with a sundial near to noon to minimize errors due to refraction or to errors in the layout of the dial.

The clockmaker John Ellicott jnr., working at the Royal Exchange, London, around 1740, had a trade card which included a full EoT table (Fig. 9). The data came from Tompion's 1683 table and so was very out of date especially in contrast to Calver's use of more recent data. Its continued use indicates the esteem in which Tompion was held. Ellicott probably inherited the printing plate ("J Mynde Sculpt") from his clockmaker father.

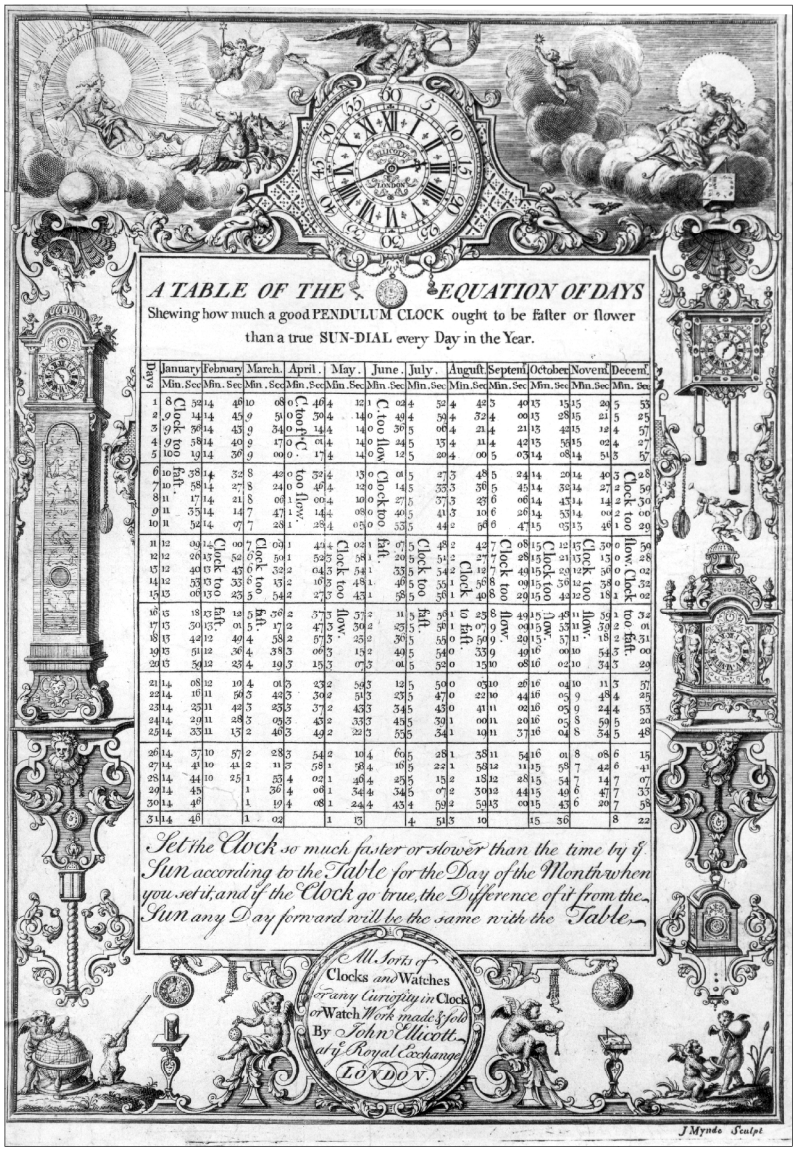


Fig. 16. John Ellicott junior's trade card. Note the cherub checking his watch by the sundial in the lower border, enlarged above. (Heal Collection, courtesy of the Trustees of the British Museum.)

In contrast to Ellicott, William Graham "clock and watch-maker at the Dial in Lombard-Street" printed[25] an EoT table which followed the Smart/Flamsteed data very closely: other than two obvious typographical errors there were just four days where the data differed by 1s. The table, dated 1725, is laid out in exactly the same format as Tompion used for his 1683 table including very similar titles and general wording.

By 1836, the chronometer makers Webster and Hunter of Cornhill, London, were able to print an "Equation Table (for the information of our scientific friends)" which gave the EoT to a resolution of 0.1s for every day of the (leap) year.[24] They neglected to specify, though, at what time of the day the values were for: since the value might be changing at a rate of well over a second an hour, this would have been important if the full accuracy of the table was to be employed. It mattered, for example, whether the value was for (solar) noon at Greenwich or for 12 o'clock.

As an aside, there was an interesting case[26] at the Old Bailey on 7 December 1743 when Thomas Jones was sentenced to transportation for the theft of numerous articles from his employer, the clockmaker Francis de la Balle. Amongst the items found hidden in Jones's room was a copper plate for printing an Equation Table, valued at 8s. What is perhaps surprising is that the plate was held by the clockmaker, rather than a printer. It would be good to find a copy of the printed table.

20TH CENTURY TABLES

The four most commonly read sundial books (Mayall & Mayall[27], Waugh[28], Cousins[29] and Rohr[30]) all give daily EoT tables. Mayall & Mayall and Rohr both give the values in decimal minutes so that the resolution is only 6 seconds which is sufficient for most sundial work but makes accurate comparisons difficult. The values in the 1994 (3rd) edition of Mayall & Mayall are "compiled from the American Ephemeris" and look as though they have not been updated from the 1938 first edition. Rohr specifies that his values come from the 1963 Ephémérides Nautiques and are for true noon. Waugh states that his are "averaged values" but he includes a value for 29 February which results in a 10 second discontinuity in ordinary years. Cousins gives his source as "JGP" and has an optional value for 29 February: the values are appropriate for the 1969 publication date. Of the four books, three use the sign convention of EoT = mean time - solar time used in the BSS Glossary[31] whilst only Cousins adopts the opposite convention now favoured by professional astronomers[32]. The use of any of

these 20th century sources in the first half of the 21st century can typically give errors of up to 10 seconds.

PRINTERS' ERRORS

A surprisingly large number of printers' errors have been found while examining various historical EoT tables for this study. These can usually be detected as a deviation from the smooth change of EoT from day to day, often caused by a single digit being wrong, such as when the number of minutes does not increment as the seconds increase above 59. The misreadings between '3' and '5', and between '6', '9' and '0' are the other most common errors. These errors often persist even in tables which go through many editions, such as Ferguson's 'Astronomy Explained'. The frustration of Charles Babbage, who strived so hard to remove human involvement in the printing of mathematical tables, is easily understood. Modern readers are warned to take care when using old tables. On the other hand, the errors could prove useful in the future when trying to establish if an author or dialmaker copied an early table.

CONCLUSIONS

Continued study of the history of the Equation of Time has shown that a surprising amount of information can be extracted from tables which appear superficially similar. As the records of tables in both printed form and engraved on dials increases, so the value of existing records will grow.

ACKNOWLEDGEMENTS

It is a pleasure to thank the many people who have supplied the data, photographs or other information which have made this study possible. They include: Mike Cowham, Andrew James, Jeff Darken (AHS), Catherine Southon (Sotheby's), John Foad, Alan Midleton, John Milburn, Michael Sandford, Michael Harley, Harriet James, Marcella Senior (Trinity College Dublin), Allison Morrison-Low (National Museums of Scotland), David Harber, Len Burge, Peter Ransom, Alison Wright (British Museum), Fred Sawyer, Patrick Powers, Ian Butson.

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john.davis@btinternet.com

APPENDIX 1
Transcription[24] of the introduction to an EoT table on the door of a longcase clock by John Calver of Woodbridge, c.1720.

A SHORT Account of the Equation of Time, and Directions for adjusting Pendulum Clocks, &c.

True or absolute Time, called also Duration, constantly flows equally, and in the same Manner; but its Quantity cannot be measur'd but by Motion; for if all Things were as rest, we could by no Means know the Flux, or Quantity of Time; and the Duration of all things would go on without Perception. The Diurnal and Annual Revolutions of the Sun, as having been from the beginning of Nature, suppos'd constant, regular, and universally observable by all Mankind, are generally made use of for the Measure of Duration; But although they seem design'd by the Author of Nature, for Signs, and for Seasons; for Days and for Years; yet the nice Enquiries of Astronomers have found Irregularities in the Sun's apparent Motion, which are by them clearly accounted for, and proceed from a double Cause, (to wit) the Obliquity of the Ecliptick; that is the Circle wherein the Sun moves lying obliquely, or making an Angle of 23 Degrees 29 Minutes with the Equator, or the Circle wherein equal Time is Measur'd, equal Arches of the one cannot answer to equal Arches of the other; And from the Eccentricity of the Earth's Orbit, that is, the Earth moving in an Ellipsis (or Oval), and describing equal Arches in equal Times, those Parts cannot agree with the equal Parts of a Circle. Hence proceeds the Difference between a well regulated clock and a Sun-Dial; the one being suppose'd the true or mean Time, and the other the relative or apparent Time; which Differences are called the Equation of Time, and are calculated in the following Table to every Five Days, which will be found of good Use for the better regulating of Clocks and Watches. The first and last Column shew the Days of the Month; then against the Day you want, and under each respective Month, your have how many Minutes and Seconds your Clock or Watch ought to be faster or slower than the Sun-Dial. In observing the Time by your Dial, it is best to do it near Noon, by reason of the Refractions, or some error of the Dial, and if by Observation you find your Clock have got or lost more than is express'd in the Table, you must alter the Pendulum by the Screw at the Bottom, raising the Bob to make it go faster, and letting it down when you would have it go slower.

Here followeth The TABLE of Equation of Natural Days

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BRITISH SUNDIAL SOCIETY
2004 Accounts
3/1/2004 to 31/12/2004
Income and Expenditure

	INCOME	2003	2004	EXPENSES	2003	2004
General						
	Subscriptions (1)	£12,588.09	£12,465.40	Bulletin (5)	£8,056.62	£10,783.35
	Gift Aid (2)	£4,094.82	£1,642.85	Publications (6)	£4,732.00	£1,115.00
				Officers (7)	£3,611.55	£3,040.17
Events						
	2003 events (total)	£24,777.41		2003 events (total)	£28,212.58	
	Oxford 2004	£5,815.19	£29,584.00	Oxford 2004	£42.10	£29,300.42
	Italy 2004		£21,564.00	Italy 2004		£21,264.51
	Holloway 2005		£1,899.50	Holloway 2005 (8)	£989.34	£0.00
	Durham 2006		£0.00	Durham 2006		£1,033.00
Sales etc						
	Sales (9)	£1,689.77	£2,697.25	Sales costs (9a)	£400.12	£2,224.57
	Auction (13)	£801.00	£0.00	Auction (13)	£348.00	
	Advertising	£106.00	£457.68	Advertising	£24.87	£199.75
	Donations (Somerville)	£328.00	£634.00	Donations (Somerville) (14)	£130.00	£630.00
				Library (10)	£136.00	£100.00
				Internet (11)	£146.88	£393.88
Finance						
	Interest	£1,025.98	£1,393.66	Banks/Insurance (12)	£649.84	£1,179.51
Special						
	Awards 05	£30.00	£790.00	Awards 05	£33.30	£48.00
Other						
	Offprints	£89.00	£48.75	Offprints	£89.00	£48.75
	Misc	£38.40	£0.00	Misc	£0.00	£71.35
	St. Katherine Cree Fund (4)		£68.42	St. Katherine Cree Fund (4)		£0.00
TOTALS		**£51,383.66**	**£73,444.79**		**£47,602.20**	**£71,631.54**
Surplus (Income - Expenditure)		**£3,781.46**	**£1,813.25**			

Notes for 2004

1. Amounts paid in US dollars have been converted to sterling at the exchange rate in force when balances have been repatriated, or at the rate on 31/12/2004 for the balance held in the USA.
2. The amount for 2003 is for the 2002 and 2003 subscriptions and the amount for 2004 is for the 2004 subscriptions less the repayment to the IR for overclaimed amounts in previous years.
3.
4. These donations, held on behalf of the St. Katherine Cree Sundial Restoration Fund, are **not** part of the BSS assets.
5. Five editions paid for in the year (3 with Fieldfare, 2 with Doppler Press). Includes postage costs of c. £500 per issue.
6. Printing of the two publications "BSS Glossary" and "Ancient Sundial of Ireland". Now part of sales stocks.
7. Includes postage, leaflets, travel, computing sundaries, meeting room costs etc.
8. Advance deposit for the 2006 Conference.
9. Sales of booklets, sweatshirts, slides, ties etc by Margery Lovatt, Jane Walker & David Young

9a Expenses for sales, inc. postage and purchases of new stock

10. Subscription to the Bromley House Library (Nottingham) and purchase of books (none in 2004).
11. Hosting of the BSS website and SOTI costs.
12. Bank costs (inc international), credit card costs, Society liability insurance.
13. No auction in 2004

14 The Andrew Somerville Memorial Fund now contains all donations to the BSS and its reserves are part of the general BSS Assets. Expenses include the annual Somerville Lecture and grants.

General Notes.

A. The accounts are prepared on a payments and receipts basis. That is, money is booked when it is received or spent (i.e. when cheques are written, not presented). This is in line with the Charity Commission's guidance.

B. The year-end funds are held mainly in approved investment accounts as well as current accounts.

C. Events are priced not to make a loss, with a nominal contingency of 5%.

D. Stocks are valued at nil as they are unlikely to have any value if the Society were to be wound up. This does not impact our cash flow.

	2003	2004	
Current account balance	£3,333.34	£7,075.83	
Deposit account balance	£16.35	£16.43	
BSS USA current account balance	£610.37	£1,287.47	
Charities Office Investment Fund	£31,298.46	£28,692.04	
TOTALS	**£35,258.52**	**£37,071.77**	
Change in funds during the year	£3,781.46	£1,813.25	
Income received during the year	£51,383.66	£73,444.79	
Expenses incurred during the year	£47,602.20	£71,631.54	
Excess of income over expenditure	£3,781.46	£1,813.25	
Andrew Somerville Memorial Fund	£1,069.14	£1,073.14	Included in above amounts (note 14)
St Katherine Cree Restoration Fund	£1,080.00	£1,148.42	Included in above amounts (note 4)

ROLE	NAME	DATE	SIGNATURE
Treasurer	J Davis	7/2/2005	
Auditor	G Parsons	10/2/2005	
Chairman	C Daniel	2/4/2005	

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BSS PHOTOGRAPHIC COMPETITION 2004

Congratulation to John Foad, First Prize Winner, for his excellent photograph *'Springtime'*. He has been awarded a specially engraved glass paperweight, made by David Gulland. In second place is Mike Shaw's *'Reflections in a Chalice'*. This is an imaginative and daring idea that our judges really liked showing the reflections of a group of BSS members around a silver chalice. Another entry from John Foad, **'***Kaleidodial'*, takes third place. His imagination in putting this interesting idea together has created a wonderful picture, worthy of any photo competition.

Runners-up were Fiona Vincent for her quite charming *'Hidden Garden Sundial'*, John Lester for his *'High Summer for St Nicholas'* and John Davis for his *'Sundial in Stained Glass'*. Mike Cowham's entries could not be included in the marking, (as he was organising the competition), but two of his pictures**,** *'A Multiple Choice Sundial*', and *'Far from the City's Bustle'* were highly commended by the Judges.

The entries for this competition, the first year that it has been held, have shown some interesting ideas and pretty locations for sundials. It should give us all ideas for what we should be doing in our own sundial photography. They are not just pictures of sundials but delightfully composed portraits with a sundial usually as the focal point. Compare these results with the age-old idea that no rose garden is complete without a sundial at its centre; one complementing the other.

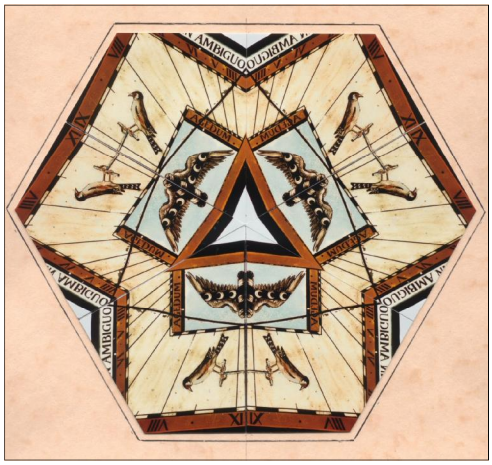
We would like to thank the six judges who carefully scrutinised each picture and gave us their opinions. They were Tony Ashmore, Patrick Powers, Angela Robb, Graham Stapleton, Jill Wilson & Tony Wood.[†] In most cases the judges closely agreed with each other showing few violent likes or dislikes. Marks ranged from 80% at the top to 36% at the bottom of the list, with the majority clustered around 60%, so a good effort from all entrants.

The competition will run again in 2005 and entry forms will be sent out with the September Bulletin. Rules will remain much the same as for 2004, with a maximum of three entries per member, but we expect to make a few small changes to improve the marking system following their experience in this first competition.

[†] Mike Cowham is also to be thanked and congratulated for organising the competition – Ed.

FIRST PRIZE ***'Spring Time'*** **by John Foad**

SECOND PLACE ***'Reflections in a Chalice'*** **by Mike Shaw**

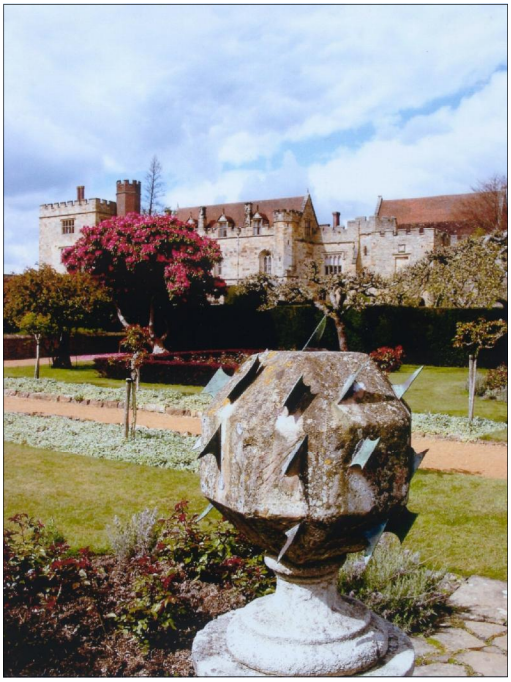


THIRD PLACE *'Kaleidodial'* by John Foad

***'High Summer for St Nicholas'* by John Lester**

***'Sundial in Stained Glass'* by John Davis**

***'Hidden Garden Sundial'* by Fiona Vincent**



***'A Multiple-Choice Sundial'* by Mike Cowham**

***'Far from the City's Bustle'* by Mike Cowham**

BSS ANNUAL CONFERENCE
ROYAL HOLLOWAY COLLEGE - 1-3 April 2005

MARGARET STANIER

The Founder's Building at Royal Holloway College.

The Arts Building at the Royal Holloway College was a very satisfactory venue for our Annual Meeting. We found on our arrival in the foyer the register table with our files and name-labels. Nearby there were comfortable chairs and a sofa and tea (or sometimes coffee); and the entrance to the lecture-theatre; also there was a large display-board where the best 10 or 12 photographs entered for the Dial Photograph Competition were on display. Here too was the door to the exhibition room, a spacious well-lit room where members' dials, designs, metal and wooden objects, gadgets and other toys were on view. The exhibits are always a prominent feature of our meetings. And this room provided browsing, and sources of inspiration, and talking points throughout the weekend.

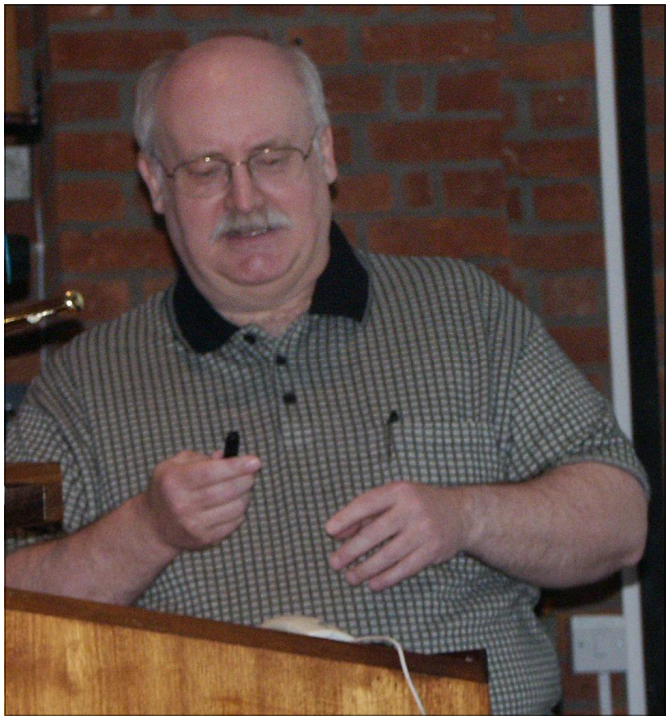
Mike Shaw was the first speaker.

Meals each day were eaten on the dining room in the Founders' Building, the prominent red-brick pinnacled building visible from the main road; this was a 4-minute walk though the shrubbery from the Arts Building. After dinner of our first evening, we had two lectures: Mike Shaw's 'Universal Diallist's Companion', in which Mike showed

David Cook explaining the metre.

us how all you needed for laying-out a dial could be compressed into a neat little job on one and half sheets of A4-sized paper; and David Cook shook our faith in linear measurements. Don't believe in metres, or in feet either, when you see them. At one stage, the measurement called a 'foot' had ten different meanings in different parts of Europe. And we went to bed that night with cheerful grins, thinking how arbitrary and inconsistent we all were. One quaint idea David Cook suggested was measurement of the entire north-to-south length of France, Cherbourg to Toulon, by a piece of string. Well, why not, if you know the length of the string? This lecture made a light-hearted starting point for the weekend.

After a hearty breakfast on Saturday (food at Royal Holloway was good, and ample with plenty of choices) we had the strength to deal with a learned Fred Sawyer lecture. We

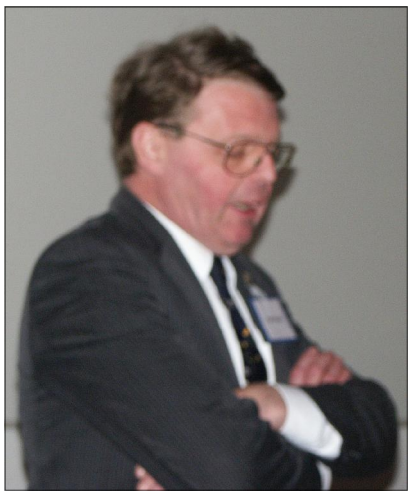


Fred Sawyer usually has a new dial design for us.

Tony Belk made equations interesting.

kept up with him all through: an activity which does not always happen with this speaker; not that this lecture was less learned than previous ones, but perhaps more of us are slightly more learned than heretofore. The subject was 'A hectemoral sundial design': the hectemoral angle being the angle between the sun's present position and due west.

Then Tony Belk's talk had the title 'Tired of trigonometry? Substitute some algebra'. Lots of people offer beginners (such as me) easy short-cut methods for laying out hour lines, but I always go back to the long difficult way, because it is familiar. John Davis spoke interestingly about the 'Evolution of the English Horizontal Dial'. I would not have supposed that simple straightforward horizontal dials had about them enough variation to show 'development', but they do; from now on, I will look more closely at any garden-ornament type, and try to place it in its right 'era'.



Next Peter Hingley, the librarian of the Royal Astronomical Society, to which the BSS is now affiliated, spoke about the history of the RAS, and the amenities of its library, built up over the years. We are sure of a welcome if we go these and use it.

Next, the results of the photographic competition were given. The winner was John Foad, for a photograph of the vertical wall dial on St. Clement Danes Church. The dial is not specially interesting in design, but it made a charming picture among the wall creepers. Another photograph by John Foad came in 3rd place. All the top ten photos were of a high standard and the judges must have had difficulty in coming to a decision.

Chairman Chris Daniel (right) hands the engraved glass trophy to the Photographic Competition winner, John Foad —now our new Membership Secretary.

(Left) The replica Thomas Tompion dial at Hampton Court Palace: the original was also on display inside.

(Above) Members mingle in the Picture Gallery before the Conference Dinner.

After lunch we set off on outings. One bus took people to Hampton Court, the other to Kew Gardens. The weather was perfect: active sunshine but not oppressively hot. The bus ride through west London suburbs took almost an hour. The Hampton Court people probably had the best choice of sundials. Kew Gardens have two: a fairly ordinary but good horizontal, and an armillary sphere, designed and made by Joanna Migdal. Though the daffodils were over, there was still plenty of colour in the Gardens. What I liked best was the herb-garden behind Kew Palace. The herbs have name-labels and on each label is a quotation from Gerard, or Culpepper, or Parkinson, giving medical advice about what this herb can be used for. There were several 'for knitting bones'; and some for 'easing pain of joints'. We took tea at the Orangery at Kew, and watched many children playing on the grass; it was the last weekend before the children will be returning to school for the summer term, and many families were Making a Day of it.

Then back to Royal Holloway and preparations for the conference Dinner. The evening's entertainment took place in the Picture Gallery. Thomas Holloway was a wealthy collector, mainly of late 18th and 19th century pictures; and the picture gallery, occupying half of the first floor in the front wing of the College, houses his collection. We gathered here, for drinks and a musical entertainment provided by pianist Aaron Davies, and wandered round looking at the remarkable collection. (The most famous is probably Frith's 'Railway Station'.) When we sat down to dinner, we all found at our places a small strip of stiff paper inscribed with a set of hour lines and month-letters: this strip, when bent and fixed into a circle, became a ring-dial: it worked, too! This was the gift of Géza Marton, a member and participant from Hungary. We enjoyed these little toys: another talking point, in addition to the pictures around us on the walls.

We dined and drank well, and drank a few toasts proposed by the chairman. Then Richard Williams, curator, gave a talk about Thomas Holloway, and about the pictures in the gallery around us. He mentioned that one of the paintings, showing two young polar bears in arctic scenery, was covered up for some years: when the College was for women only, some of then complained that this painting frightened them. Present-day students are made of sterner stuff.

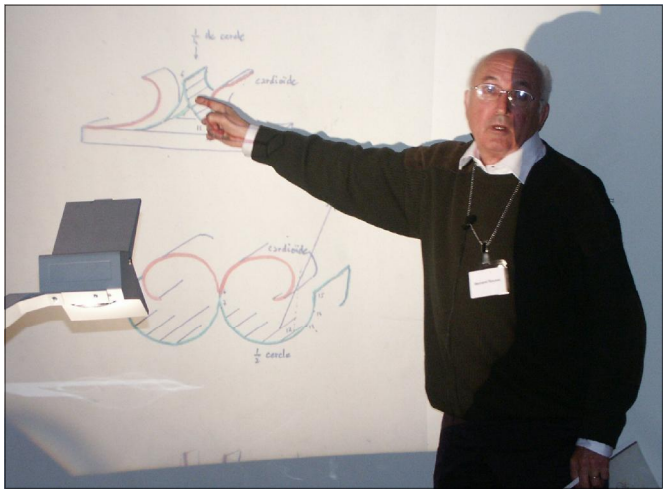
The first Sunday morning talk was an extremely enjoyable and well-illustrated lecture on the sundials of SE France, the Provence region and beyond. Alain Ferreira's title was 'The bird and the set-square'. He showed how all the dials included an ornamental bird and a triangular feature which fitted a set-square, but yet there was great variety in these simple themes. It whetted our appetites for going to see them for ourselves. Some of the dials, as for instance one painted on the smooth rock of a cliff face, are now presenting problems for restoration; it is difficult even to find

Alain Ferreira, one of our members from France, showed the colourful dials by Zarbula.

sources of the pigments for matching the original colours.

Next came an interesting talk by Allan Mills. Large dials casting large shadows cause problems of reading because

Allan Mills demonstrated how the eye fools the brain.



Bernard Rouxel shows that curved gnomons can work.

of the penumbra, all such dials need a shadow-sharpener, in order that they may be accurately read. Yet many ancient cultures have made large dials. Then, Bernard Rouxel told us about geometric tools which could be used to generate new dial designs: one such, a hypocycloidal, was shown in a photograph on the screen in the lobby.

Then, after morning coffee, David Young gave us some reminiscences of Andrew Somerville, a founder of our Society, whose name is commemorated in the lectureship; we heard part of the recording of an interview with Andrew Somerville.

Then came the Andrew S lecture itself, by Professor Karl Hofbauer. The title came from a line of a poem by the 6th century Greek poet Sappho: 'The moon is set, and the Pleiades… Time Measurement in cultural history'. The next line of the poem mentions midnight. How did the poet know that it was midnight? The last line is simply 'I lie alone'. The speaker showed that the setting of the moon and Pleiades would have given the poem the atmosphere of gloom and bleakness associated with winter darkness and loneliness. He explained that Sappho was one of the first poets to write poems of atmosphere and feeling, rather than mere records of 'battles long ago' and narratives of the doings of heroes and soldiers. He explained too that references to stars, celestial events and constellations were quite common in ancient poetry. Our ancestors were much better sky-watchers than we are: clocks and printed calendars have made us less conscious of our dependence on the heavens and celestial events for our time-keeping. But the poet Hesiod, in his poem 'Works and Days' told his readers how to tell, from constellations, when to reap and when to sow.

This lecture, combining literature, history and astronomy was indeed a brilliant exposition. I feel sure that Andrew

Invited speaker Prof. Karl Hofbauer enthralled the audience.

One of many high-quality dials by Tony Moss on the Lindisfarne Sundials stand.

Somerville himself would have enjoyed it as much as we all did.

The brief AGM which concluded the morning's activity was a formality, devoted to the election of the next Council which closely resembles last year's. Then we all went over to lunch, and dispersed - till next year.

Photos: J. Davis and C. Lusby-Taylor.

SEEN AT KEW

Above: the 1952 replica of the Hampton Court Tompion dial, made to commemorate a visit of the Queen. Note the large EoT table and the azimuth scale centred on the vertical back edge of the gnomon.

Left: our hard-working Secretary Doug Bateman takes time out from organising the conference to examine Joanna Migdal's fine armillary sphere.

Photos: courtesy of D. Bowyer.

MINUTES OF THE 16TH ANNUAL GENERAL MEETING THE ROYAL HOLLOWAY COLLEGE, EGHAM, 3 APRIL 2005

1. The meeting was opened by the Chairman, Christopher St J H Daniel, at 12:45 pm. About 70 voting members were present.

2. Apologies were received from Roger Bowling, Richard Thorne and Michael Lowne.

3. The minutes of the 15th Annual General Meeting held at St Anne's College, Oxford, on 18 April 2004, had been circulated in advance and were taken as read. There were no matters arising and the minutes were adopted, as proposed by David Young and seconded by Chris Lusby Taylor.

4. The reports of the Honorary Secretary and other members of Council had also been circulated. The only point raised from the members related to the valuation of the books in the Society's library at Nottingham. It was agreed that an annual re-valuation was not required, and that the valuation would be adjusted each year by the value of any added material.

5. Council member's reports

Secretary: Doug Bateman.

Liaison. Since the last AGM I have dealt with 35 enquiries by letter, quite a number by e-mail, and a few by telephone. Many have sought advice about setting up dials or information about dials in their possession. Whilst we are therefore helping to 'educate the public' as part of our charitable status, few of the enquiries have led to membership. The number of enquires is less then half than were made in the previous year.

After extended discussions, the Royal Astronomical Society has granted us the status of an affiliated body - see also the March 2005 Bulletin.

Conference 2005, 1-3 April. At the time of writing 100 have booked and we have a very good programme. It is gratifying that members offer to give lectures so readily.

Conference 2006, 21 -23 April. Collingwood College, University of Durham, has been booked.

Advertising: Mike Cowham.

An advertisement in the journal by the National Association of Decorative & Fine Arts Societies. Similarly for the Vintage Garden Society. Unfortunately neither has produced many new members, and articles about sundials are the most productive.

Advertisements within the Bulletin or Newsletter have been very few, and can hardly be counted as a source of revenue.

Reference Library: Graham Aldred.

A further 40 books and documents have been catalogued and delivered to our Reference Library Nottingham. (September 2004). This includes the first batch of bound Dial Reports. One old book is in the repair loop and there are no books currently waiting to be catalogued. Some catalogue publication options have been considered by Council and it has now been agreed to publish a hard copy version of the Catalogue, listing by author and subject. The preparation for this is in hand.

Restoration: Graham Aldred.

Enquiries regarding the restoration of the dials on the Clowne Market Cross, nr. Bolsover, and Guisborough Market Cross have been received recently and extensive advice has been offered. The dial maker's list was supplied. Reports of progress or difficulties have been requested but both projects are in their initial stage. It is encouraging that these requests came from local authorities who both recognise the significance of the dial geometry and requirement to have any dial restoration carried out with expertise. Both Crosses are Grade 2 listed and therefore will require a well-documented case prior to approval. The process is necessarily slow.

An excellent restoration has been completed on the dial at Market Lavington, on the Church of St Mary. (SRN 1921). Work is in progress on the Church Dial at Blandford Forum. Two requests for advice re making new dials have also been received, one at Green's Mill, Sneinton, the other for Alexander Park, Oldham. The dialmakers list was supplied with requests for updates of progress or difficulties, where the Society could be of further help.

Mass Dial Group: A.O.Wood.
There has been a trickle of reports from NADFAS and our 'local reps' have responded by contacting the recorders. Enquiries from Mario Arnaldi (octaval dials) and Harriet James (Dorset dials for Churches Conservation Trust) have been dealt with. As a result of an article in 'Best of British' magazine one mass dial was reported - which turned out to be an unregistered 'scientific' (Norton-on-Tees). Edward Martin has promised to forward the Norfolk archive. The task of entering data into the Mass Dial Register has begun.

Museums Survey: A.O.Wood.
The results of the Museums Survey will be published in a booklet of similar format to the 'Biographical Index'. Ian Butson has agreed to undertake this. It is estimated that a further eighteen months are required to complete the Survey and Jill Wilson has agreed to act as an advisor.

Editor: Margaret Stanier.
During the early part of 2004, we changed the Bulletin printer from Fieldfare of Cambridge to the less-expensive firm of Doppler in Brentwood. This firm, after small initial hiccoughs, has been doing a satisfactory job for us. Our treasurer John Davis has continued to be a very helpful editorial assistant, and has carried out a detailed design-and-layout of each issue before its submission to the printer; this has minimised possible errors and reduced the work of the printing firm.

Any credit for the quality of the Bulletin must go to those who have contributed articles and other material for inclusion. The editor is grateful for all who have maintained the supply of written and pictorial contributions. Keep it up! You who are now reading this, put pen to paper, finger to keyboard or camera-shutter, and produce something for the next Bulletin. I feel sure that BSS members must be continuing to make, design, restore, observe, enjoy and record sundials, whether in their own back gardens or on holiday trips world-wide. What do you do, or say, when your neighbour buys a second-hand (or even a junk-shop) sundial but hasn't any idea how to set it up; but, knowing that you have an interest in sundials, asks for your advice? One or two articles "From the Amateur to the complete Novice" might be a valuable item for the Bulletin! Think of it.

Membership: Kevin Barrett.
I shall be resigning as from this AGM due to increased work load from my normal job restricting the amount of effort I would like to give to the Society to make this position more effective. No doubt a new membership secretary will be taking over the reins from the AGM. I wish them well for an interesting position in the society which I have found most rewarding and I am sure they will too.
State of Membership. Membership numbers have decreased slightly again this year and I would expect this to stabilise this year as the 5 yearly membership is drifting away. Expiry of the 5 yearly membership has been a significant effect on membership as they expired. Current membership is 494 down from 512 last year, and 528 and 609 in previous years.

* 33(27 last year) new members have joined during the year.
* 28% of the membership resides outside the UK (slightly up from 26%)
* The geographical split is UK 358; Europe 74; America 45; Australia 8; Asia 4; Middle East 3; Africa 2.

The introduction of the credit card payment scheme and the direct payment scheme for members in the USA is gathering pace in its effectiveness at attracting members and assisting overseas members who would otherwise find it difficult to make the money transfers.

Fixed dial register: Patrick Powers.
Data entry for the next Register has now been completed - slightly later than originally planned as a result of a late influx from Recorders clearing their desks! Since the third Edition was published over 3000 more dial sightings have been sent in and more than 1400 more dials discovered.
Those members who have sent in expressions of interest to purchase one or more of the editions of *Register 2005* will be contacted shortly and asked to confirm their orders.

Following Anne Somerville's death last year it has proved necessary to change the way in which the Society's archiving is carried out. This change was approved by the Council at its last meeting. The implemented approach requires no archivist, does not involve the Registrar in more work and is cheaper for the Society to implement. It is working well.

The Mass Dial Register is still in use with Tony Wood in Version 1. There is one outstanding reporting problem which remains to be fixed. Data entry is not however affected.

Exhibitions: David Young.
The Society continues to maintain a presence at various events such as the National Science week at Greenwich in March.

BSS Web Site: Chris Lusby Taylor.
Since taking over the Web site last year, I have updated its content while keeping the appearance and navigation almost unchanged. Practically every page has been modified. New and updated pages are signalled by small signs to guide frequent visitors.

New content has been added regularly to the Dial Makers, Newsletter, Register Ramblings and Conference pages. I have reorganised and added to the Contacts and Links pages. New pages include the Table of Contents of the Bulletin (only back to 2003 so far) and a real-time ephemeris calculator (giving the sun's declination, EoT, Alt, Az, etc.). I am working on updating the Glossary to the second edition. The text is complete (except some appendices), but will need splitting into manageable Web pages.
Plans for the near future include completing the Glossary and adding articles on the photographic and design competitions. I propose to investigate indexing the Bulletin and reinstating the 'Dial of the Month' feature.

Our Internet host company has not responded to my request for visitor information, and I have no idea how many visitors the site has. I could add a hit counter if this information were thought valuable.

Newbury 2003: Another successful event which was reported in full in the December 2004 issue of the Bulletin.

Tours: The 2004 tour to Italy was a great success with 39 members attending. Originally conceived and planned by Sir Mark Lennox Boyd and David Young, the final arrangements and hosting were done by Mike Cowham, Sir Mark and Lady Arabella Lennox Boyd. A description of the tour appeared in the March 2005 Bulletin.

6. Treasurer's Report: John Davis.
The Accounts for 2004 are shown separately; they have been audited by Geoff Parsons who stood in when John Moir was unavailable. BSS finances remain in a healthy state. As predicted, the accounts show a smaller surplus than last year, at around £1.8k. Turnover was higher than previous years due to the longer Oxford conference and the Italy tour but the core activities are generally in line with earlier accounts. The general position remains secure with the margins small but positive. Note the following points:

* we paid for 5 issues of the Bulletin in 2004 (3 with our old printers , 2 with new ones), compared with only 3 in 2003 and an expected 4 in 2005.
* the move to the new printers for the September Bulletin onwards resulted in a saving of c. £700 per issue.
* we have made an advance payment of c. £1k for the 2006 Conference in Durham.
* events (Oxford conference and Italy tour) made small profits in 2004. (Oxford made an overall substantial profit in 2003 which inflated that year's figures.)
* we received the benefits of the entry fees to the Awards Scheme 05 during the year – the resulting expenses will come in the 2005 accounts.
* we had the benefit of a £500 legacy from Anne Somerville in the year. The overall income and expenditure from the Andrew Somerville Memorial Fund balance almost exactly.
* The primary accounting system is now in MS-Excel and allows real time semi-automatic generation of the current status of the funds.
* A significant financial contribution comes from sales of publications and back numbers of Bulletins by Margery Lovatt. In 2004 the sales turnover was £2700. The Glossary continues to be our 'best seller' followed by Oxford Sundials, Make a Sundial and Ancient Irish Dials. Back issues of the Bulletin have given storage problems and John Davis, Piers Nicholson and David Young are kindly looking after a large stock so that Margery has more manageable quantities.

7. Election of Officers.
Chairman, Secretary and Treasurer. The Chairman (C Daniel), the Secretary (D Bateman) and the Treasurer (J Davis) had been proposed by Ian Wootton and seconded by M Shaw. There being no other nominations the Chairman declared those proposed duly elected.
Members of Council. M Stanier, P Powers, A Wood and J Foad were proposed and seconded by the same members. There being no other nominations the Chairman declared those proposed duly elected.
Membership Secretary. Kevin Barrett stepped down due to pressure of work. A vote of thanks for his work in this role was proposed by C Daniel. The position has now been taken over by J Foad.

8. Any Other Business
J Davis proposed a vote of thanks to Geoff Parsons for stepping in at short notice to audit the accounts.
Sales. Margery Lovatt, who manages the Society's sales of publications and other materials, wishes to stand down. Any member willing to take over the work should please contact her directly. David Young proposed a vote of thanks to Margery for her work over the last six years.
There being no other business, the meeting was closed at 12:45 pm.

READER'S LETTER

At the recent BSS Egham Conference an unscheduled item, with no follow-up discussion, invited, nay instructed, BSS members to report any non-functioning item for sale bearing the label 'sundial' so that action might be taken through local Trading Standards Officers on the grounds of an illegal description. A fair-seeming proposition perhaps until the possible consequences are given serious thought so I am left wondering if this is in fact an official BSS policy?

Speaking only for myself, and as a commercial sundial maker of perhaps some standing, you might expect me to welcome such a move so that I might advertise 'Get Your Real Sundials Here!' – 'The only Legal Sundials in Town' or some-such, but not so. Such seemingly-mild restrictions I believe would antagonize the general public, lead to unforeseen serious difficulties and might even bring our society into disrepute. I can well image the scornful disbelief in John Humphreys' voice while doing the Radio 4 interview about it. "Isn't this is just an attempt to boost sales of your own products masquerading as professional concern?"

Fundamentally I am disturbed by the idea of anyone taking any such action, apparently on my behalf as a member of BSS, because my 'silence gives consent'. Indeed I personally sometimes advise would-be clients that their particular needs would be best fulfilled by a simple garden-centre 'garden ornament sundial' as they are not the least bit interested in its functional worth but merely want a budget item to complete a vacant space in their plans: anything more would be a waste of their money. Then there are the horrendous logistical problems arising, to say nothing of the costs in precious Trading Standards time which might be better directed to REAL problems affecting public health and safety.

Faced with the deluge of dubious brassware coming in from the Far East and India labelled as all sorts of things, 'sundials' included, I believe King Canute's problem pales into insignificance beside any serious attempt to have this flood of harmless junk re-labelled at source. Even worse there must be tens of thousands, if not millions, of potentially

After all that the worst is still to come. The complainant says "That is not a sundial, although labelled as such!" "Yes it is!" says the merchant, who has 500 in stock and more on the way. How will this be resolved? By a BSS arbitrator perhaps? Where will even ten such individuals be found without a commercial bias? What will their qualifications be? Who will appoint them etc. etc. Even one per county would be asking the impossible and, if coverage is not national, then unfair discrimination will be the charge.

We know that there are probably about 600 of us in the UK who might have valid objections to this misnomer but do we really think that the remaining 60,270,108 ever give it a thought, and if they don't, does it matter one jot to anybody but us?

Tony Moss
43 Windsor Gardens
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Northumburland

Response from D Bateman, Hon. Sec.:
Whilst we all deplore the sale of garden ornaments that are sometimes sold as sundials, even though they cannot possibly tell the time properly, Council policy is that such miss-sold goods should be taken up on an individual basis with local Trading Standards Officers. We are not a trade organisation and we believe that is inappropriate for the Society to become embroiled in any sort of trade dispute.

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