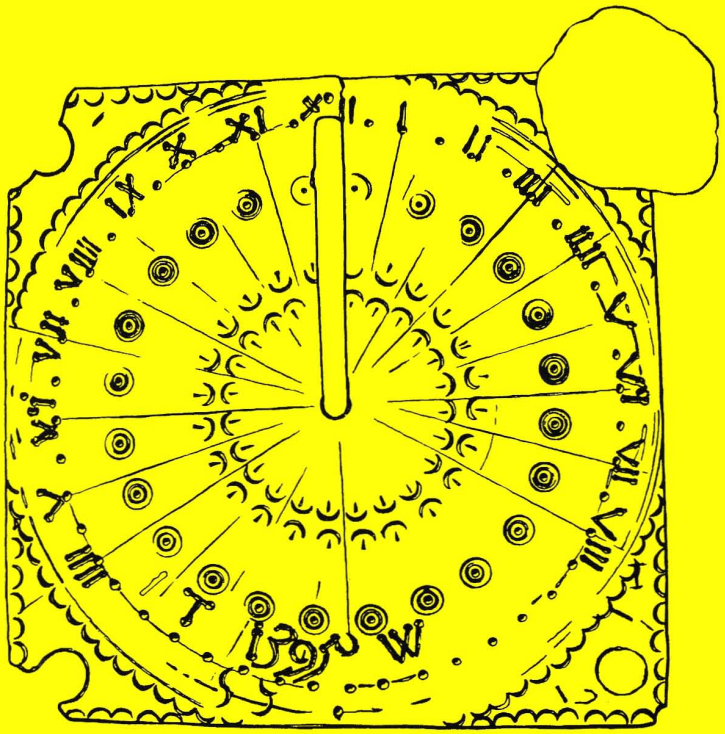
The British Sundial Society



BULLETIN

VOLUME 14 (iv) DECEMBER 2002

Front Cover: *Drawing of reverse of plate, Dinton Church Sundial (Drawing by David Honour)*

Back Cover: *Mass dial, St. Bartholemew, Waltham, Kent (Photo: A. O. Wood)*

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MWS

VOLUME 14 (iv) - DECEMBER 2002

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BULLETIN

OF THE BRITISH SUNDIAL SOCIETY

ISSN 0958-4315

VOLUME 14 (iv) - DECEMBER 2002

EDITORIAL

Within this issue you will find sundials *large* and *small*, *new* and *old*. Among the largest are the 8.4 ton granite carved dial firmly placed in a quiet garden in Marlow; and the 4m x 2m vertical south dial on the church tower of Mathern. At the small end of the range come Barry Waltho's credit-card-dials and Tony Wood's crested china dials at Newbury. As for new dials, members at the Newbury meeting revealed their ingenuity and imagination as ever, and the inventor of 'Helios' in Wiesbaden has a high-tech novelty on offer. The oldest sundial in these pages is perhaps the curious slate dial-plate from Crowan. Of course, there are plenty of sundials in the middle of these extremes of size and age, and for good measure we also have herein a moondial and a clepsydra.

Enjoy them all!

THE ISAAC MORRIS MOONDIAL

TONY BELK

Isaac Morris (1764-1848) constructed a sundial with a circular moon time calculator in 1803. It was installed near Pwllheli in north Wales, has been described by C. Daniel[1] and its use outlined. The BSS Wales 2001 group was shown the dial which is now in private ownership, and Don Petrie's report of the visit[2] states that there are two inscriptions on the dial. One reads "Sun and Moon Dial. The Trigon of Ecliptic made by Isaac Morris." The other reads "Hereon bright sol glorious ray, Points out the minutes of the day, And lunar globe with borrowed light, Will show when the time of night." The report also contains a good photograph of the dial taken by Doug Bateman (Fig.1). The dial consists of a very accurately inscribed horizontal slate sundial with a circular moon time calculator centred on the foot of the gnomon. It is this moon time calculator that is of interest here as it seems to be unique.

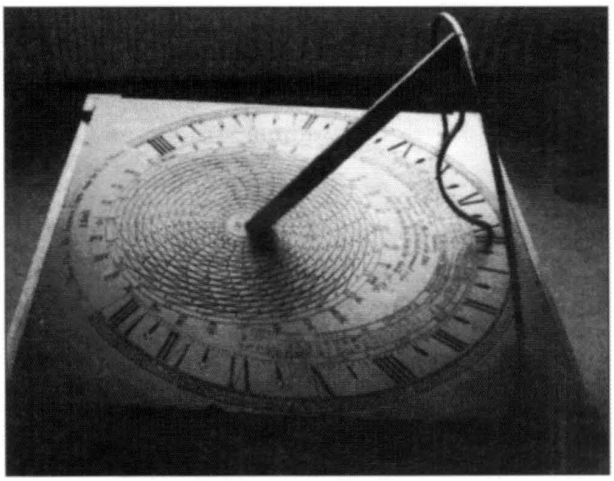

Fig.1 The Isaac Morris Sun-and-Moon Dial [photo:D.A.Bateman]

Isaac Morris realised that the moon traverses the sky about 49 minutes later each night. (The moon takes 29.5 days to repeat its nightly cycle during which it has 'lost' 24 hours, and 24/29.5x60 is 49 minutes.) He conceived the idea of having a 24 hour circular calculator consisting of 14 concentric circular rings. A modern drawing of this is shown in Fig 2. The rings are numbered 1 to 14 from the outside to the centre for the days of the waxing moon, 15 is the central ring for the full moon, and 16 to 29 from the inside out are for the waning moon. The curved rows of dots which occur at the centre of each of the diamond shaped areas enable the age of the moon to be counted easily without repeating the numbers.

At midnight on the day of the full moon the sun is south. On the previous night, numbered 14, the moon would have been south 49 minutes earlier. The upper radius of the disc from 12 to 12 cuts the 14 day ring just to the right of a spiral line. If that line is followed back to the central ring it cuts it at just after 11 pm. Similarly for day 13 if we follow back the spiral curve to the central ring it cuts at just after 10 pm. So for a waxing moon following the spiral back from the apparent moon time for the age of the moon to the central ring gives the local apparent time. For a waning moon the opposite construction applies. To find when the moon is south, that is reading 12 midnight moon time on day 18 of the moon's cycle, follow the 12 spiral from the centre until it reaches day 18. The radius on which that lies is 2.30 am. local apparent time. So at 2.30 am the gnomon will cast a shadow on the 12.

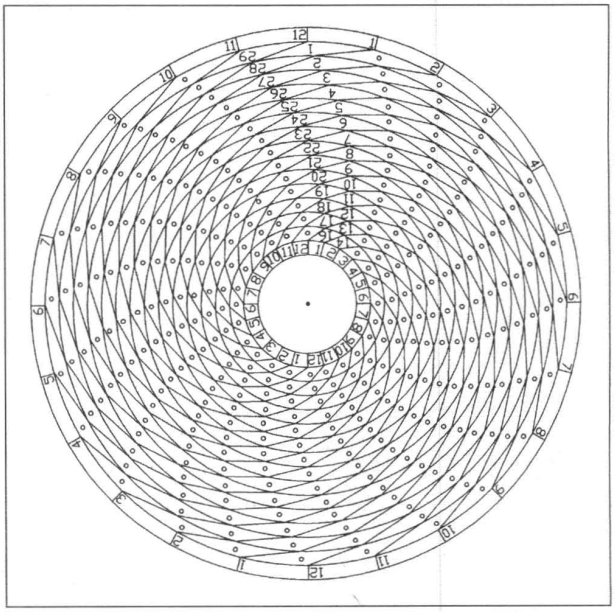

Fig 2. The author's drawing of the Isaac Morris Moondial.

How was the dial constructed? In 14 steps Isaac Morris wanted to advance 12 hours. One can do this by advancing 180/14 or 12.86 degrees each day. Each point on the spiral is drawn to a co-ordinate that is one ring further out and 12.86 degrees further clockwise about the centre than the previous co-ordinate.

In polar co-ordinates the formula for the co-ordinates of the spiral are:-

$$\mathbf{a} + \mathbf{N}\mathbf{x}\mathbf{b}, -\mathbf{N}\mathbf{x}\pi/14$$

where **a** is the radius of the inner ring
b is the spacing of the rings
N is the moon's age from 0 to 14

One such spiral is drawn in Fig 3 as the basic component of the disc. All the spirals are identical, they move in a clockwise direction as the hour increases and each is rotated a further 15 degrees about the centre than its neighbour.

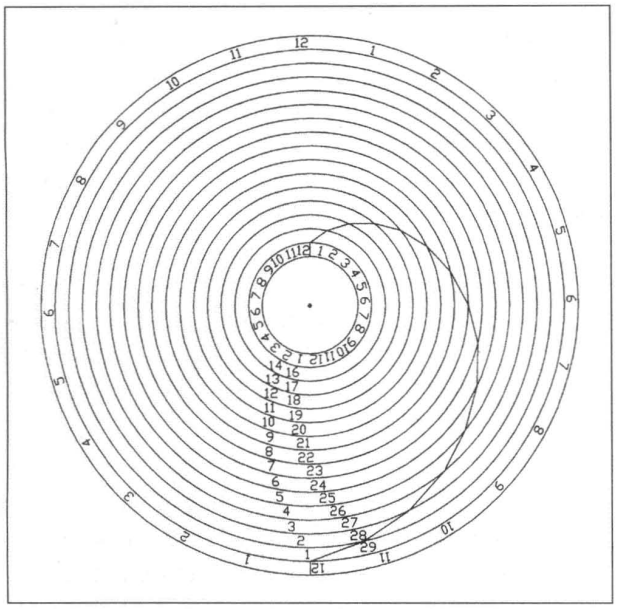

Fig 3. One spiral of the Moondial.

Although there is no indication that Isaac Morris intended this, an alternative use of such a calculator disc is to predict the tide times, knowing the age of the moon. Suppose that at Pwllheli, near where the dial was originally installed, high tide at full moon occurs at 10 pm. High tide is therefore two hours before the moon is south. To find the time of high tide four days earlier, when the moon is 11 days old, set the radius 10 to 10 and mark the 11th day. Follow the spiral back to the centre and the high tide is predicted at 6.30 local apparent time. If the high tide time on day 22 of the moon is required, start at 10.00 on the inner circle and read out along the spiral until day 22 is reached. This point is seen to be 4.00 am for high tide on day 22.

This suggestion that the disc was used as a tide predictor also accounts for the two spirals each day and allows the use of the whole of the disc rather than just the small portion where the moon's shadow is discernible either side of full moon. This might only be for about three hours either side of the moon's transit while the moon is 9 to 21 days old – that is 12/29.5x6/24 or about 10% of the time. The moon dial disc could be used at any time every day to predict the tide times if the age of the moon is known together with the delay between high tide and the moon's transit, known as the port's establishment. It is also worth noting that this moon time calculator is universal in its application and is not restricted to a particular latitude or longitude. It can be used as a tide predictor anywhere as long as the time of high tide is known at some particular age of moon.

Finally, I would like to propose an alternative, and arguably simpler way of correcting a moon dial. Lunar time, read on a sundial by the light of the moon, can be corrected using the diagram in Fig 4. Select the lunar time across the top. Drop vertically down to the age of the moon, read either from the left or right hand side. From that point follow the diagonal line either up or down until it reaches the top or bottom line of the diagram. That is the local apparent time or true solar time.

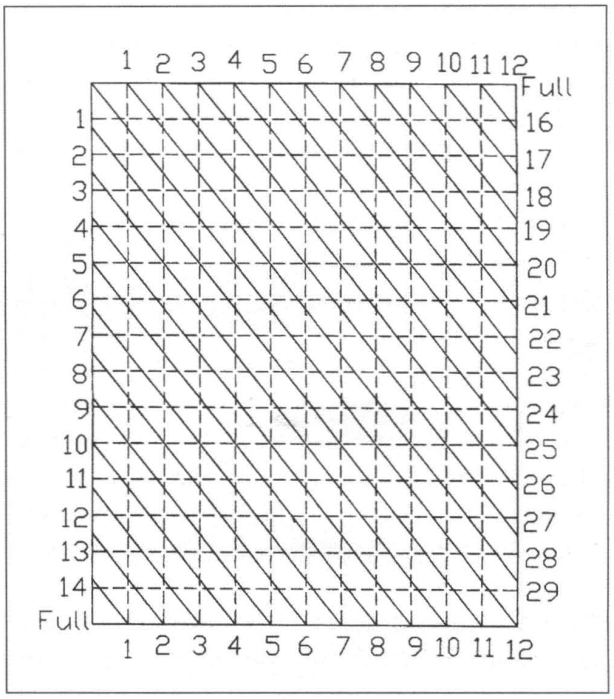

Fig 4. Proposed lunar to solar time correction diagram.

There are some slight errors in this correction as there are in that of Isaac Morris in that it takes the lunar month as 30 days rather than 29.5 (1.7% error). As recently pointed out by M Cowan[3] all moon dials also suffer from error because on the day designated as full moon the moon can south between 11.36 pm and 00.24 am. Comparing the corrections from Fig 3 with Queens' College, Cambridge Moon Table (C Aked[4]) they are exactly the same as they are both calculated on a 30 day lunar month with moon transit 48 minutes later each day.

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1. C Daniel: "The Remarkable Sundial and Moondial of Isaac Morris" *Clockwise Round Wales* ed Paul Parker. Vale Books, Denbigh 1995
2. D Petrie "Wales 2001" *Bull BSS* **13(iv)**, 147-153. (2001)

3. M Cowan: "Telling the Time at Night" *Bull BSS* **14(ii)** 76-79. (2002)
4. C K Aked: "The Queens' College Dial, Cambridge" *Bull BSS* **94.3** 2-6. (1994)

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BOOK REVIEW

TIME IN RUTLAND
A History and Gazetteer of the Bells, Scratch Dials, Sundials and Clocks of Rutland

Robert Ovens and Sheila Sleath, *Rutland Local History & Record Society*, Rutland Record Series No 4 Hard covers 400pp publ. 2002 £24.00

Cassington in Oxfordshire may seem an unusual place to start a review of a book about Rutland but whilst visiting the church there I heard the hour strike and only later realised that there was no clock face on the tower. A local inhabitant told me that the village, after three hundred years, was still undecided about whether one was desirable or not.

The introduction of bells into a book about timekeeping results from the fact that a clock dial and hand (later, hands) was an afterthought to the striking of a bell. Having gone down this road the authors decided to do a complete survey of the bells in the county. Consequently a large proportion of the book is devoted to them. The ringing of bells for services is in a sense timekeeping and other bellringing is time related as is explained in the book.

There is a good introductory chapter covering, in order: bells, scratch dials, sundials and clocks and their histories. Following are chapters about bells and bellmakers and then clocks and clockmakers. The treatment is very extensive, every bellfounder is described and the chapter on clocks and clockmakers includes local watchmakers. The gazetteer section describes all the above items in each town and village.

For the bells, each bell is described, including inscriptions and decoration (many hours in dark and dusty bell chambers); additionally a drawing of the bellframe is given for each church and the bells' locations in it.

Similarly the clocks on churches and public buildings are comprehensively described with the occasional extension into domestic clocks.

The comprehensive treatment continues with the descriptions of scratch dials. The authors have decided on a diagram for each dial rather than attempting to provide photographs. The diagrams are annotated with complete measurements and an excellent location diagram is also provided. This is in addition to the annotated church plan for every church. The angle notation is rotated where the dials are mounted upside down. Sixty-two scratch dials on twenty-eight churches are recorded plus one on a house. This is a remarkably complete listing and should help to fill in our knowledge of their distribution.

When it comes to sundials the text appears rather less comprehensive, only a short paragraph covering each dial. However there is a complete listing of past and present dials in an appendix with details of type, location, furniture and mottoes etc. I was surprised to find that sundials were marked on the 25″ to the mile 2nd series Ordnance Survey maps of the early 1900s and wonder for how long this was done. There appear to be no outstanding sundials in the county and perhaps the briefness of the entries reflects this. One intriguing dial is the very Parisian looking one at Hambleton Hall complete with motto in French; which 'art nouveau' artist made that one?

The book is beautifully produced with excellent drawings and diagrams. High gloss paper, good photographs and printing, smallish typeface - helped by lottery funding - it is good value for money and a credit to the Rutland Society.

A.O.Wood

READERS' LETTERS

TWENTIETH CENTURY INNOVATIONS

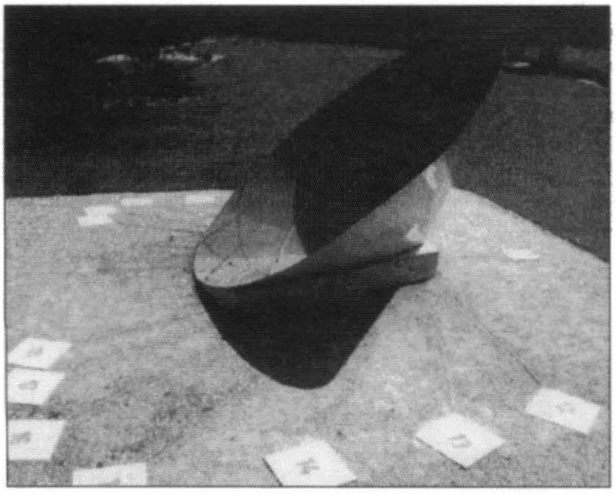
Your initiative to give in the Bulletin of the British Sundial Society a survey of the contributions to the art and science of dialling in the twentieth century is to be praised very much. I have read it with interest.

You forgot to mention two new designs of sundials ..in the Sundial Park at Genk in Flanders, (Belgium)..... The two designs are of great significance in the evolution of the art and science of dialling.

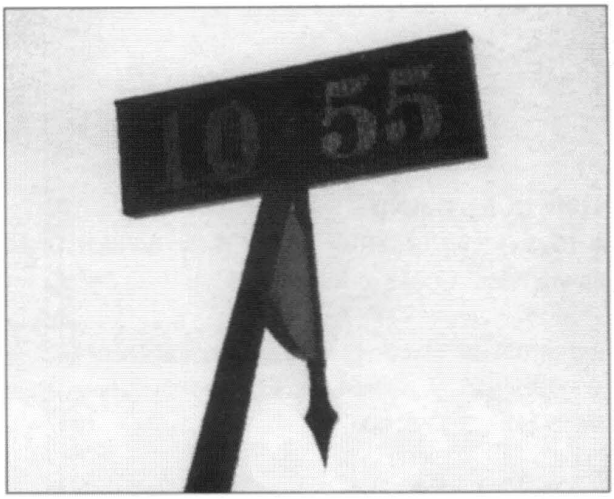
The two designs are: the *digital sundial*..... and the *conical sundial*, the world's first horizontal sundial with a conical gnomon. The two shadows of the cone indicate Babylonian and Italian hours respectively. This sundial is an invention of Javier Moreno Bores, of Madrid, Spain. The conical sundial is described in "Zonnetijdingen", the periodical of the Flemish Sundial Society, No.1998-09. It is mentioned in the Bull.BSS 97.3 page 53. Information about all the sundials in the Genk Sundial Park may be found on the website of Frans Maes:
www.biol.rug.nl/maes/genk/welcome-e.htm
I enclose a photo of the conical sundial.

Willy Leenders
Kloosterlaan 60
B-3500 Hasslt
Belgium

[The writer's description of the digital sundial has not been included. This is not in fact a novel sundial design, but rather a convenient technical adjunct to make the reading of a conventional dial quicker and more accurate.-Ed.]



Conical sundial in Genk, Belgium



A digital sundial

ANCIENT SUNDIALS

The Ancient Sundials of Israel by Shaul Adam (September 2002 Bulletin) describes several Byzantine hemicyclium sundials and quotes the Greek numerals visible on two of them. Fig. 7 shows the second one quoted. The sixth letter is not Φ (Phi) but F (Digamma) which was the sixth letter of the old Greek alphabet but was dropped at some stage when the more common later alphabet of 24 letters was in use. Fig. 7 has one version of this letter in the top right hand corner of the drawing; the lower listing of letter numerals in that picture gives Ξ (Xi) at the sixth position - should be digamma again!

Schaldach's article in the October 1996 Bulletin shows a similar sequence of letter numerals on a 7th century dial but the 'sixth hour' symbol is now Z ? (Zeta?) with the 'seventh hour' symbol an insert into the Greek alphabet sequence. Whether this is a later form of digamma or not I don't know; I'm sure some classical scholar can clarify matters.

A.O.Wood
Churchdown, Gloucester

LINES OF COINCIDENCE

My wife is a Saint.

She not only tolerates my sundial clutter, but also plies me with ego boosting questions for me to answer. Recently, she invited me to explain about the lines on dials that commemorate family events, such as birthdays or weddings.

I told her that they were declination lines, and that each day of the year had its own individual line. Well, not quite. Each day shares a line with a different day. I took, for example,

my wife's birthday May 8th, which falls between the spring equinox and the summer solstice. There would be another day, lying between the summer solstice and the autumn equinox when the sun's declination was the same, and a person born on that day would share the same line as her.

Warming to the theme, we extracted Waugh from the clutter, and found that the sun's declination on May 8th is 16°55'. We then searched the table (on page 206) for an equivalent declination, and found it occurred on August 6th. For me, this was one of dialling's more exciting moments. August 6th, believe it or not, just happens to be my birthday.

It was hard to resist the belief that this might have been pre-ordained and not simply coincidence. For sure, the spiritual buzz provided by this revelation was only equalled by the realisation that the cost of engraving our next sundial would be appreciably reduced

What are the odds against this occurrence? Well, assuming your partner does not share your *actual* birthday, the chances that your birthday lines are coincident are 1 in 364. This means that amongst the current membership of the BSS there is a fair chance of at least one other couple sharing the same line. So, out with those declination tables and let's see if it's *you*.

John Moir
Wanstead, London

DEFINITIONS IN THE GLOSSARY

In general the Glossary is very helpful. Nevertheless I want to object to the meanings given to the terms "gnomon" and "style". It was difficult enough for me to find out without the help of the Glossary about the ways the word "analemma" is used, about its origin and the often unnecessary changes in its meaning.

In Greek sundials the gnomon carried the materialization of the *point* whose sha-dow showed hour and date. I think "gnomon" was also used for the plate with the eyelet for the sunrays in hollow spherical or conical sundials. A style marks the hours with the shadow of its entire length. In German the word "Zeiger" is used, perhaps to be translated as "pointer". If the meaning of "style" is to be reduced to the name of a straight line one should perhaps use "axis of the style", or "edge of shadow".

The work of the "node" as described in the Glossary is often done by a hole or by a notch. According to my dictionary "node" resembles a knot. Another name should be found, for instance "indicator of the moment" or, shortly; "indicator" So far I could not find any term in the Glossary equivalent to a clock's dial-plate.

I am well aware of the difficulties in finding definitions. Would it not be helpful to use Greek names in connection with antique sundials, English names in connection with modern sundials? In my opinion new terms should be used for new ideas. We should take care that gnomonical science is not turned into a secret doctrine.

Walter Hofmann
Wien, Austria

The editor has received a letter, printed verbatim below, from a correspondent who supplied an address which was inadequate for any formal reply or acknowledgement. It is not clear whether the sender is a member of our Society or a regular reader of the Bulletin The letter, which purports to come from the Department of Gnomonics, University of Wales, is printed here in the hope that some reader may draft, and send to the editor for publication, an appropriate reply

Madam,

May I through your columns alert the members of your Society to the activities of some who would usurp their mystery? A band of idle fellows have of late found an art to dispatch sundry sounds and likenesses to distant places. Having caused a tall Tower or Pinnacle to be erected, from this vantage point they daily issue, as I understand, aërial "waves".

My learned neighbour has intercepted these atmospheric disturbances, and informs me that they are of little moment, conveying for the most part such tittle-tattle and coarse roundelays as may be the more readily discovered in any tavern He is disquieted however, and I believe with no small justification, at the sciolism of these rude mechanicks, who impropriate unto themselves the role of Regulator. For frequently throughout the day they call the time, and not alone the half and quarter hours, but all such odd minutes as take their fancy. They appear to believe that their Clock is truly regulated. But my neighbour has a tine old Dial fashioned for him by a master of the gnomonic art, and he informs me that the time disseminated by these ruffians is by no means to be trusted. He has studied their announcements of Noon and has found that they diverge at times by so great a span as the quarter of an hour from the instant of superior transit of our Sun.

If these waves were to become more widely captured, many households would be drawn into error. My sole comfort is the certain knowledge that few are so able as my ingenious neighbour, and that the undulations will for the most part wash unperceived across the populace, who may with confidence continue to adjust their clocks by the shadow of our one true Heavenly time keeper. Nonetheless your members would do well to defend their authority at every stand, lest erroneous simplicity should triumph over truth.

I have the honour to be, Madam, your most obedient servant,

David Allis-Wright

SUNDIAL AT ST. KATHARINE CREE CHURCH, LEADENHALL, LONDON
Sundial Trail Competition 2001: Prize to be spent on Sundial Restoration.

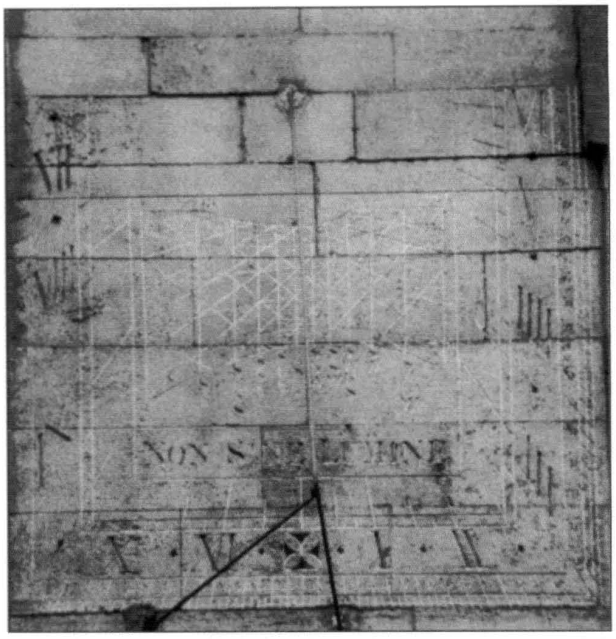
We were delighted when our City of London Sundial Trail won the annual competition set up by Sundials on the Internet (SOTI). The team's initial marathon reconnaissance was led by Max Wiseman. This was expanded and refined by various BSS members walking many miles in all weathers from the Temple to Tower Hamlets.

And we were more than delighted when one of our group, Peter Tompkins, suggested to us that, instead of several bottles of champagne, we should put our winnings towards the restoration of the beautiful dial at St Katharine Cree Church in Leadenhall. ' Yes' we agreed unanimously.

Kevin Barrett announced our intention during the Annual Conference of the British Sundial Society at Exeter in April 2002, when he received our prize. He was very pleased when over the next few days handfuls of coins and notes were slipped into his hand to swell the fund.

Graham Stapleton gives us detailed information on the dial. The dial at St Katharine Cree is about 3.5m high on the south wall, declining to the west by some five degrees. Six feet square, it is incised directly into the wall, with all of the lines gilded. The gnomon is an iron rod, and is clearly not the original, judging by how it has been fixed, and the absence of a nodus.

Apart from showing the time down to five minute divisions, its furniture consists of the seven declination lines, azimuths expressed as compass points, and Italian and Babylonian hour lines.



Vertical Dial, St Katherine Cree Church, London

According to the church archivist the dial dates from 1662. However a print in the church of 1736 shows two dials, one of them looking rather like the present one but dated 1706. There are similarities to an illustration in Wilson's "Leybourn's Dialling Improv'd" of 1721, which is suggestive of an eminent maker.

Peter has suggested the idea of dial restoration to the to the Church administrator who is very keen for us to go ahead with this project. When permission through a Church Faculty is agreed, we will commission a survey with a report, so that the churchwardens can apply for Lottery funding.

More news from us at a later date, and we welcome your interest and questions

Katherine Hallgarten
khallgarten@waitrose.com

SUNRISE DIAL

HEINER THIESSEN

While most sundials are 'untouchables', this model invites some active participation from its observer by moving its mobile parts towards the sun. Only then can the time be read. This is considered, by some, to be a more satisfying educational approach, especially for the young, and a better way to communicate the astronomy behind the time-honoured art of dialling. The instrument is a scaled model of the northern hemisphere of our planet, rotating in real time, with planet Earth itself, around its own axis, as the day progresses. The dial consists of:

1. The dial face, positioned parallel to the equatorial plane, so that its rim resembles the equator ring of Earth. It is therefore slanted to the horizontal at an angle equal to the co-latitude.

2. The gnomon, which will not only point to the celestial pole but will also lie parallel to the real axis of planet Earth stretching from north- to south-pole.

3. The local latitude disc whose rim represents the latitude circle of the observer. This local latitude ring (here 51° North) is parallel to the equatorial dial face (at a latitude of zero degrees).

4. The meridian arc is positioned on top of the local latitude disk and describes the longitude line of the local meridian from the observer's position to the north-pole and beyond.

5. The day/night separator is the moveable semi-circular blade, showing the distribution of daylight on the planet at the time of observation and in relation to the observer's position on its local meridian line.

6. The indicator arm attached at 90 degrees to the moveable axis of the day/night separator. It will be pointed by the observer towards the sun.

The layout of the dial is shown in Figs 1 and 2.

What can this dial do?

The dial can read local apparent time (LAT) as well as the times for sunrise and sunset applicable on the day of observation. Furthermore it reads the declination of the sun and thereby, if only approximately, the date of observation itself.

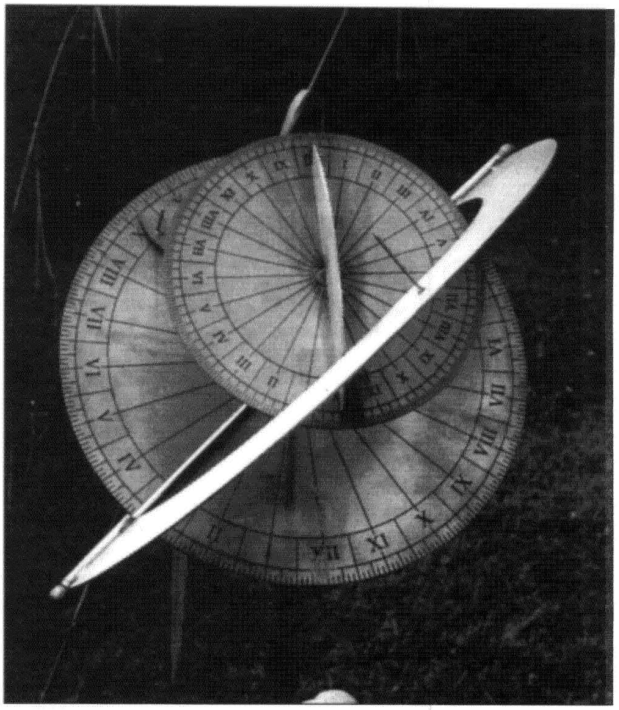


Fig.1 Photo of Dial

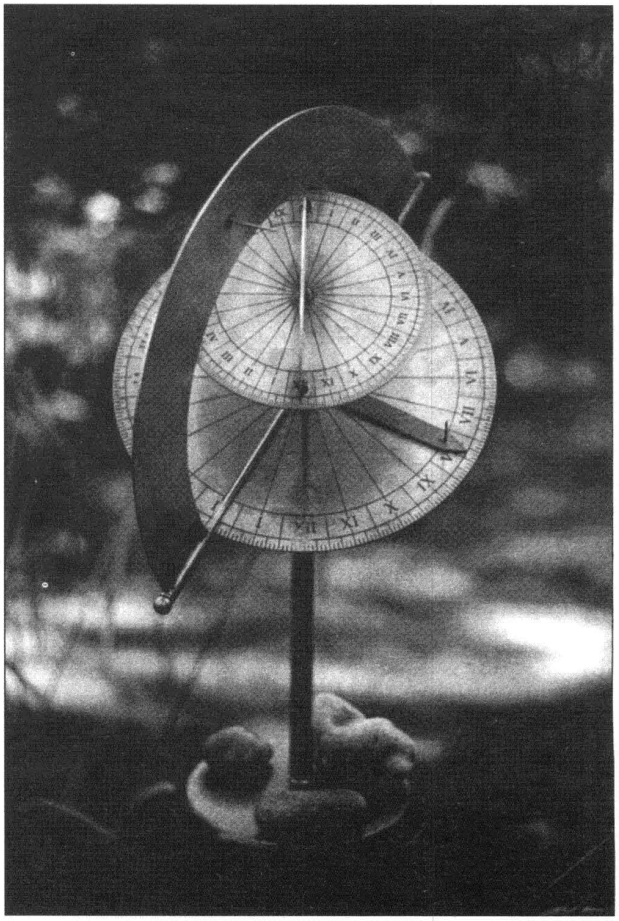


Fig.2 Photo of Dial on its stand

How does it all work?

In order to read the time, the observer points the perpendicular pin on the day/night separator directly into the sun. If pointed correctly, the pin will not cast any shadow at all. The observer can now look at the indicator arm on the dial face and confirm that its own style (in parallel to the gnomon) casts its shadow directly onto a centre line on the indicator arm (in summer) or onto the gnomon (in winter). In that position of alignment to the sun, the time can be read off on the outer rim of the dial face. Although sundials were traditionally designed to read local apparent time (LAT) the modem observer may prefer to read GMT or even BST. This can be achieved by rotating the equatorial dial face in order to align it to a number of markings on its support disc, thus taking into consideration corrections for local longitude and the daily changing equation of time (EoT). This feature is not built into the existing prototype.

The daily changing times for sunrise and sunset can be read off the local latitude ring at local noon. With the indicator hand correctly pointing at 12.00, and the pin on the day/night separator blade focussing into the sun, the inner edge of the semi-circular blade will intersect (almost make contact) with the top of the rim of the local latitude disc. The two points of intersection provide readings for sunrise and sunset on the day of observation.

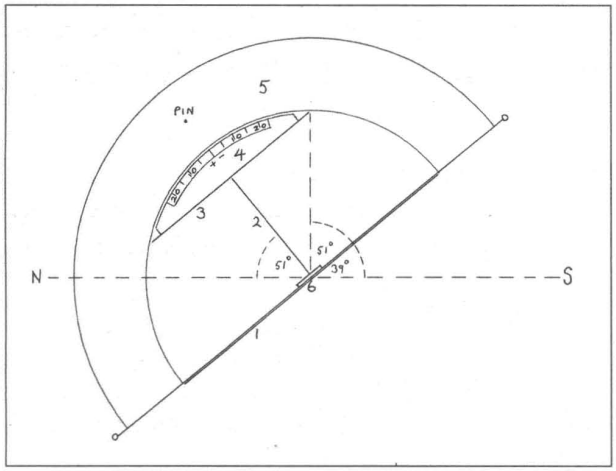


Fig 3 Geometry of dial, looking East at 6 p.m. LAT at the equinox. The pin on day/night separator points to west. Indicator arm (6) reads 6PM

At the same midday point in time the observer can also read off the declination of the sun. This is the point of intersection between the separator blade and the meridian arc. For the day of the spring equinox (21 March) when the sun appears to cross the equator, the day/night separator will be crossing the north pole. Therefore the correct declination of Zero can be read off where the day/night separator intersects with the north pole mark on the meridian arc.

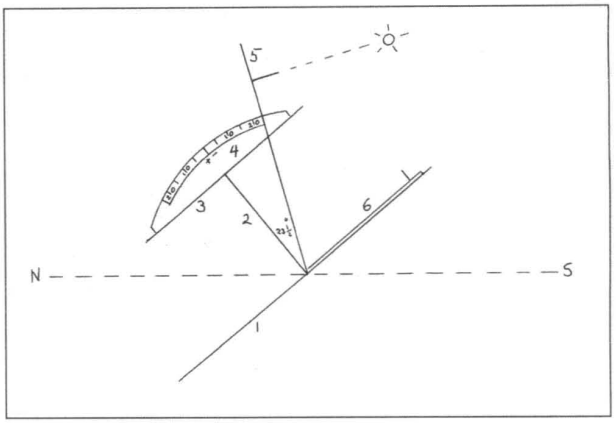


Fig.4 Geometry of dial, looking East at noon LAT at the winter Solstice. The pin on day/night separator points to south. Indicator arm (6) reads noon. Declination -23.5° indicated on meridian arc.

To assess the local geographical position of the observer vis-a-vis the daylight distribution on the planet, compare midday mark on local latitude disk with changing positions of day/night separator as the day progresses. The time difference between the observer's mid-day point and the separator blade indicates the hours since sunrise and/or until sunset. When the day/night separator blade intersects with the local mid-day point, it is either sun-rise or sun-set. For real time satellite images of day/night distribution compare www.fourmilab.ch/earth~iAwIvDlanet.html

How to use the sunrise dial as a moondial: At the precise hour of full moon the dial reads the exact time of the night. At other times, approximately within a range of +/- 4 days from full moon, the following rule applies: for every 24 hours before (or after) the hour of full moon subtract (or add) 48 minutes from your dial readings, i.e. 2 minutes per hour of time difference from observation to exact full moon. The principle of corrections for EOT, longitude and summer time applies. On the days the moon completes its first (third) quarter and appears to us to be at 90 degrees to the Sun, the ball at the East (West) end of the separator axis can be pointed to the azimuth of the Moon. As a result, on those nights the moon can indicate approximate LAT.

And finally, the dial is an attractive mobile sculpture, helping us to see beyond the abstractions of the scaled model and visualising our planet itself travelling in space and continually rotating eastwards while revolving around the only source of light in our solar system: *ex universum lux.*

ACKNOWLEDGEMENTS

All parts of the prototype consist of laser-cut stainless steel plates of 2mm thickness. These were then brushed, engraved and tinted. Its stand, not shown in the photographs, is a mild steel disc, 200mm in diameter.

The assembly was undertaken by artistic blacksmith David Hemsley of Armour Forge, Alexander Farm, Ashmansworth, Hants.

The engravers were R and T Engineering of Havant, Hants.

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NOTES FROM THE EDITOR

BINDERS

Keep your back issues of the BSS Bulletin in good order on the bookshelf by inserting them into a binder. Each binder takes up to 12 issues of the Bulletin. It consists of stiff back and front boards and a spine; inside the spine there are elastic threads, and a copy of the Bulletin can be inserted at its midpoint under each thread. The binder is the usual bright yellow colour, with black lettering 'British Sundial Society' and the logo, on the spine.

Binders cost £6 each, from Margery Lovatt at Parndon Mill: address on back page.

WHERE IS IT NOW?

When you visit a museum anywhere in the country which has a clocks/sundials/ timepieces section, keep a lookout for a sundial inscribed 'John Davis in Bliber'.

This sundial, originally in the parish of Blyborough, Lincolnshire, was deposited with the Lincoln Museum. It is now missing, and the Museum authorities have no idea what has become of it. If you should come across it in any national collection or elswhere, please let the editor know.

CORRECTION

The author, John Singleton, wishes to correct an equation in his article 'A Portable Analemmatic Dial' in Bull. BSS vol.12, page 103. The expression in column 2 should read 1.15t.tan D..... The author apologises for the incorrect version.

FORTHCOMING EVENTS

We have been asked to announce the following events, due to take place in 2003

Antiquarian Horological Society: 50th Anniversary Conference and AGM, 29-30 March, 2003, at Keble College, Oxford.

Lectures and social events are planned; also a small exhibition at Keble College of some interesting horological items. There will also be a special exhibition 'Horological Masterworks' at the Museum of the History of Science in Oxford, 29 March to 31 May 2003. The works of some of England's most famous clock makers will be on view.

National Maritime Museum: Open Museum Course: 'Eclipse'

The NMR Open Museum is running a one-day course on Saturday 10 May 2003 on 'Eclipses', with special reference to the annular eclipse due on 31 May 2003. For further particulars and bookings, phone 020 8312 6747, or email openmuseum@nmm.ac.uk

Other Open Museum One-day courses are: 'Finding Time' on 6 April 2003, and 'Extraterrestrial Life' on 6 June 2003

CUMULATIVE AUTHOR/TITLE INDEX

Members will have received by now the Author/Title Index for the BSS Bulletin, 1989 to 2001, a thirteen-year time span. The pagination of the Index for the first 3 issues of this period refers to that of the 'three-part-reissue' of 1993. Those members of the Society who joined the BSS in its early days, and who therefore possess only the photocopied version of the Bulletin for those issues, may *either* obtain a free copy of the three-part re-issue on request (to Margery Lovatt, address on back cover); *or* make use of the 'Corresponding Pages' list, copies of which may be obtained from the Editor.

DIAL AT HOUSE OF LORDS

A BSS member has sent us the following note, which appeared in the Court Circular column of the Daily Telegraph for 24 Oct 2002:

The Earl and Countess of Wessex this afternoon viewed a Sundial at the House of Lords, given to The Queen by both Houses of Parliament to mark Her Majesty's Golden Jubilee, and attended a Reception.

We would welcome further information about this Sundial. Who designed it? Who made it? Where has it been (or will it be) placed?

ON THE UNRELIABILITY OF CLOCKS

JOHN WALL

(Compared with sundials - of course). It all started with our Teas-made. This is a piece of domestic equipment in the bedroom without which no civilised household is complete. At a preselected time this machine not only makes a pot of tea but simultaneously sets off an alarm to gently awaken one from slumber and advise that the early morning cup of tea is ready to be poured. Alas, a few weeks ago, a malevolent gremlin invaded this device and caused it to run slow during the night with the result that it wakes us up much too late. Our domestic routine is consequently put out of gear. That the cause is a gremlin is clear from the fact that it keeps perfect time in the workshop of our helpful local electrician, but goes awry as soon as it is plugged in by the bedside. I had always believed that all mains-operated clocks were regulated by some mysterious feature of the electricity supply known as the 50 hertz or 50 cycles per second of the alternating current. I am forced to conclude that my confidence has been misplaced, and that the only sure way of ascertaining the time is to consult a sundial that has been correctly set up for its latitude and adjusted to take account of the equation of time and one's longitude in relation to the Greenwich meridian.

So began an illuminating train of thought. I calcu1ate that there are on view in our house no less than 12 clocks of which four have stopped. (This compares with one sundial in the garden that always tells the time with perfect exactitude as long as the sun is shining). In the following table B = battery operated, M = mains, and C = clockwork. These clocks are situated in: the Hall (C); the Dining Room (B); the Utility Room (Boiler - M); the Kitchen on the wall (B) and the microwave (M); the Lounge, on the mantelpiece (B) and the Video (M); the Landing (Cuckoo clock, C), the Study (B); the Guest Bedroom (B); the Master Bedroom on the Teasmade (M) and a Travelling Clock (B). I now conclude that all are to some extent unreliable. The mains-operated clocks are subject to power cuts, the battery-operated ones eventually run down, and the mechanical clocks stop when I forget to wind them. Happy the man, therefore, who possesses more sundials outside his house than there are clocks within. For example, my friend, near neighbour, and master sundial craftsman D Scott-Kestin ('Scotty') sensibly has eight sundials out of doors - twice as many as the four clocks he has indoors. He tells me that they never go wrong.

Some of these reflections came to me whilst sitting on a seat in the garden of Benlngbrough Hall, a National Trust mansion in North Yorkshire which, as everyone knows, is God's own County. I had already photographed the only sundial in the grounds, a magnificent oval vertical specimen on the stable block that bore the edifying inscription TEMPUS EDAX. Thus far Beningbrough matched our more modest home 'Drystones' in possessing one sundial, but how many clocks would be on display in its 34 rooms (not counting the servants' quarters) compared with the 12 in our much smaller modem domicile? On investigation they are far fewer, but what they lack in number - five - they more than made up for in quality and expense. There are two long-case 'Grandfather' clocks, a Louis XV Boulle Bracket clock, a Mantel clock, and an antique Cromwellian Lantern clock. To be fair, all were (more or less) telling the correct time and they were augmented out of doors by a lantern clock in the turret of the East Pavilion with faces to all four quarters of the compass. (There is a book waiting to be written on National Trust Clocks, as indeed on National Trust Sundials).

So Beningbrough Hall and Drystones are alike at least in possessing more clocks than sundials. Can anyone identify the year in which the numbers of clocks for the first time sadly exceeded the number of sundials in this pleasant but often sunless land?

Now we know that sundials continued to be maintained long after the advent of mechanical clocks, especially on the towers of parish churches, to regulate their uncertain movement. Given the unreliability of modern electrical clocks to which I have drawn attention, I wonder, could not a means be devised so as to enable one's outdoor sundial to regulate the time-keeping of one's indoor clocks? Alas, I am not a practical man, and am therefore quite unable to undertake this praiseworthy task myself. May I therefore issue a challenge to our readers to come up with a solution that would at least regulate our erring Teasmade by means of a sundial, and restore harmony to our domestic routine? Perhaps it could incorporate photo-electric cells that, being activated by the shadow of the gnomon, could send a signal to activate in turn a series of bells indoors to tell out the hours, the half-and-quarter hours. What pleasure a set of Westminster chimes would give, were they coupled to a sundial rather than a soulless clock.

There is, of course, a certain irony in envisaging bells responding to a sundial since it is received knowledge that the very word clock derives from cloche, the French for bell. Should the sun not shine the absence of bells telling out the time would at least be an audible confirmation of

the evidence of our eyes that either clouds had obscured its rays or that night had come. Of course, a photo-electric sundial would solve the problem of our time-wandering Teasmade clock if the one could be made to regulate the other at every sunrise.

Finally, there are certain situations (apart from catching a train - abroad) when it is highly desirable to know, precisely, the correct time of day - or night. Readers may know of the excellent 'John Gersham Parkington Memorial Collection of Time Measurement Instruments' (including sundials) housed in the mansion Angel Comer, Angel Hill in Bury St Edmunds. There on the wall of the principal room is this intriguing account: 'The following novel case was submitted to Mr Gurney the Counsel for his opinion: "Emma, the daughter of W. and A.G., was born after the house-clock had struck, and whilst the parish clock was striking, and before St. Paul's had begun to strike twelve, on the night of the 4th January 1815. As there are great estates m the family it may be of some importance to ascertain whether the said Emma was born on the 4th or 5th of January. Your opinion is therefore requested whether the proper evidence is that given by the house clock, the parish clock, or the metropolitan clock."

"Answer - This is a case of great importance and some novelty. The testimony of the house clock is applicable only to domestic - mostly culinary purposes. It is the guide of the cook with reference to the hour of dinner, but it cannot be received as evidence of the birth of a child. The clock at the next house goes slower or faster, and a child born at the next house at the same moment may, according to the clock at that next house, be born on a different day. The reception of such evidence would lead to thousands of inconsistencies and inconveniencies. The parochial clock is much better evidence, and it ought to be received if there were no better; but it is not to be put in competition to the metropolitan clock; where that is present it is to be received with implicit acquiescence. It speaks in a tone of authority, and it is unquestionably testimony of great weight. I am therefore of opinion that Miss Emma G. was born on the 4th January 1815, and that she will attain her majority the instant St. Paul's clock strikes 12 on the night of 3rd January 1836."

So, out of three clocks, two were not reliable. It goes without saying that had all three been regulated by a sundial, towards the end of the day, then all would have been much more likely to chime simultaneously at midnight, and the confusion would not have arisen. If Miss Emma G were born in our day, in this era of power cuts, I wonder how a latter day counsel would resolve the issue? Perhaps, who knows, by reference to a sundial.

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THE SUNDIAL AT ST. TEWDRIC'S, MATHERN, SOUTH WALES

TONY WOOD

In my ever growing files of 'unregistered dials' lay an extract from a book, long ago read, title long forgotten - 'The handsome Perpendicular tower of Somerset type has a huge sundial on its S face'.

Andrew Gardiner, who is responsible for the Golden Jubilee dial at Ruardean in the Forest of Dean told me of Mathern and, having discovered that it was not far away, just south of Chepstow, I went off to change its status from 'unregistered to 'registered'.

As the photograph(s) show(s) it is indeed a huge dial, stretching across the full width of the tower south wall. The delineation is lightly carved onto the stonework and is in-lined in black. (and needs a going over before too long).

The gnomon is a plain iron rod positioned, continental style, by two supports which may be angled to avoid casting confusing shadows. Its offset implies an east declination, confirmed by the Arabic numerals running from 6 a.m. to 4 p.m. but which could have been extended to 5 o'clock at each end were it not for the shadows cast by the buttresses at these times.

The use of Arabic numerals is unusual and the marking of the times around noon becomes a bit of a jumble. The half-hour and quarter hour marks however are correct, in spite of competition from the numerals.

The dial would be dated around 1600 at a guess from the large semi-circle at the gnomon root.

One of the few vertical dials to have buddleia growing on it, at 11½ feet wide by at least six feet high it must rank as the biggest Church dial in the kingdom (always excepting Horsley, Glos. where the tower itself is a gnomon.[1] I promised to let the minister know if he was responsible for Britain's biggest so this article is written in order that someone out there can say 'but I know a bigger one'. Any offers?

REFERENCE

1. A.O.Wood, 'The Noon Day Stone at St. Martin's Church, Horsley, Gloucestershire', B.S.S. Bulletin Vol. 12 (ii) June 2000 p70

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5 Leacey Court
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THE 'AKELER' EQUATORIAL DIAL: RELOCATED IN MARLOW

D. A. BATEMAN

In August 2002, a massive granite and bronze dial was relocated from the outside of a company headquarters to a public garden in the centre of Marlow, Buckinghamshire. The dial was designed and made by Edwin Russell, and has similarities with the Dolphin Dial that he sculpted for the National Maritime Museum, Greenwich, in 1977.

In 1986 Russell was commissioned, by means of a competition organised by the Royal Society of British Sculptors, to create a large dial for the then headquarters of Rank Xerox in Marlow, Buckinghamshire. The dial was hewn from 24 tonnes of Scandanavian granite, with the help of a team of 4 assistants. The project was completed in 1990 and the dial was situated in the front of the building.

Rank Xerox moved from the site in 1999 and the building was taken over for refurbishment by the specialist commercial building developer Akeler. The dial did not fit in with the planned changes to the building and the access, and in 2001 was generously donated to the town of Marlow. Easier said than done with such a bulky and imposing dial. The local authorities had to move the dial, and specialist lifting equipment was needed to lift and transport the dial to a 'holding area' in the unglamorous surroundings behind the Marlow sports centre. The notional owners of the dial were the Marlow Society, and an active member, John Evans, made sure that the dial was not forgotten.

A dial of this nature is not easy to relocate, and many options were considered, such as open spaces near the river

Thames, recreational areas, and a secluded garden in the centre of the town. A consultation exercise was conducted, with the rather negative result that residents did not want the dial in the open spaces that, at first sight, would have been appropriate for such a large dial. The final choice was the garden in the town.

The May Balfour Memorial Garden is a charming oasis of calm in the centre of Marlow. It came about through a gift, in 1980, by Kenneth Balfour in memory of his mother May. Originally the site of a bungalow, the gift stipulated that the building be demolished and the site made into a formal walled garden with lawns, raised flower beds, paved walkways and benches. The garden is 40 metres long and 19 metres wide, and from the entrance, faces south-south-east. The garden is owned and maintained by Wycombe District Council.

Once the garden had been chosen, it was then necessary to place the dial in the best position. The geometric centre, although giving an overall symmetry, was not at all suitable, as it would have spoilt the view of the wrought iron gates of an attractive listed building, Marlow Place. Edwin Russell and his wife were asked to give an opinion, and I was invited to give my views. We all agreed that the most northerly corner would enable the dial to 'see' the sun for at least part of each day of the year, and the Russells recommended the precise location in the lawn, slightly off centre.

Due to what became short time scales between choice of location and installation, Wycombe District Council used large scale plans to determine the bearing of the garden relative to geographic north. A north-south line was laid and used to align the substantial concrete foundation. For the move, two cranes had to be hired. The first, rated at 17t, lifted the dial from its stored position on to a lorry for the slow journey to the road outside the garden. The second lift was by a giant 120t crane to raise the dial over mature lime trees and reach about 15m onto the foundation. The lift was done with amazing control so that the dial could be lowered within millimetres with the centre line of the dial aligned over the thin line marking the north-south meridian. During the lift, the crane load sensor gave the weight of the dial as 8.4t.

From a technical point of view it is a large equatorial dial with the gap between the vertices of two horns to act as an aperture nodus. The markings are at hourly intervals from 9am to 5pm, with 1pm for the summer time noon. However, the markings are all offset 3 minutes in time to give the longitude correction for 0°45'W (The new location is 1' further west, an 'error' of 4 seconds in time.) The position of the nodus is 2.24m above ground level. The overall dimensions of the dial are 2.34m high, 2.71m wide, and 1.9m deep. See Figures 1 - 3.

Fig. 1. At the unveiling ceremony in the new location, from left to right, Lorne Russell, Joanna Migdal (who was responsible for the delineation of the dial), Edwin Russell, and John Evans of the Marlow Society.

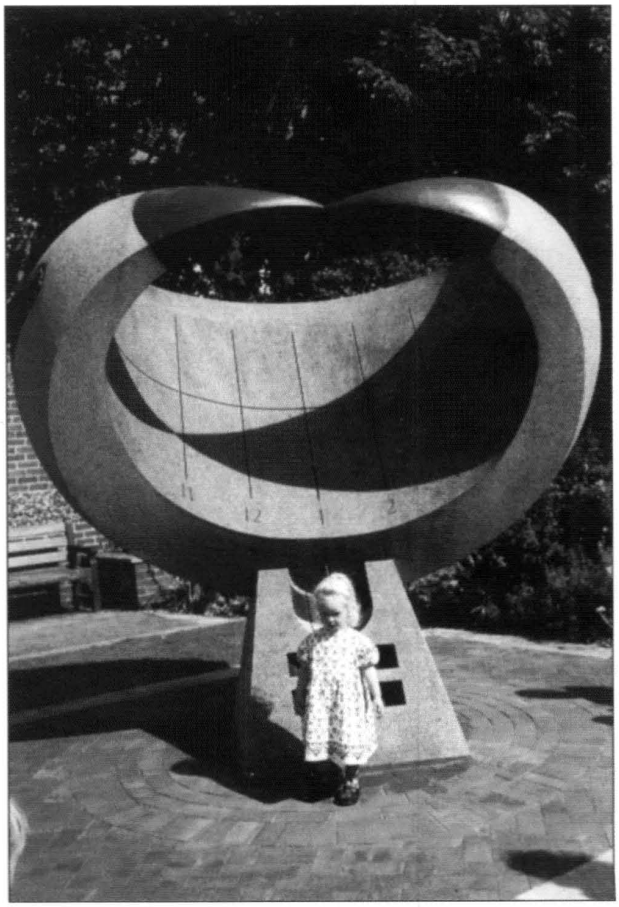

Fig. 2. The 8.4 tonne dial and the Russells' 2 year old granddaughter, Serena.

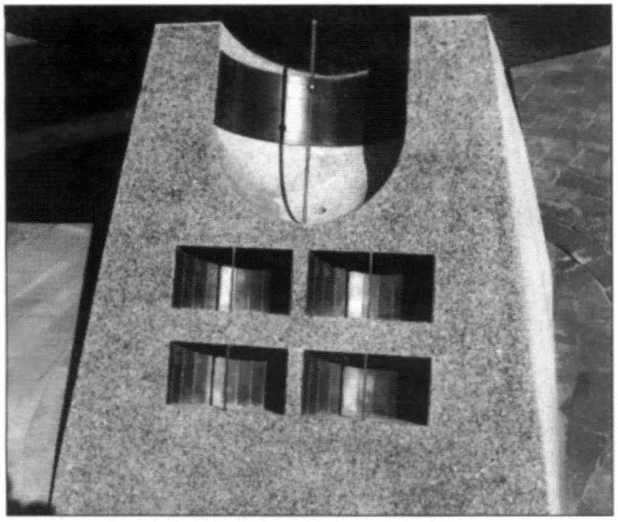

Fig. 3. The plinth with the four polar dials, clockwise from top left, the time in New York, Moscow, Tokyo and Delhi. Above them is the curved plate for the equation of time.

In the plinth there are four polar dials giving the time in New York, Moscow, Tokyo and Delhi. The plinth contains the equation of time, rather ingeniously laid out as if a polar dial with a ball nodus to reinforce the seasonal nature. The shadow of the ball is not strictly necessary, because the time in minutes can be read off against the appropriate date - see Fig. 4.

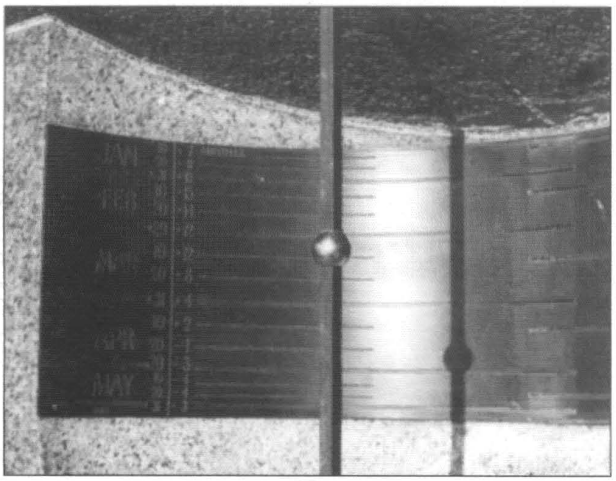

Fig. 4. Part of the 'time-line' of the date and equation of time, with the date spacing to suit the seasonal altitude of the sun.

The sculptural nature of the dial arises from the dramatic and powerful curving granite. To supplement the dial as a means of telling the time, bronze panels give representations of the sun in different cultures - see Figs 5 and 6.

Fig. 5. The east side of the dial showing the depictions of the sun in different cultures: Ahura Mazda, Persian; Helios, Grecian; Eye of Ra, Egyptian.

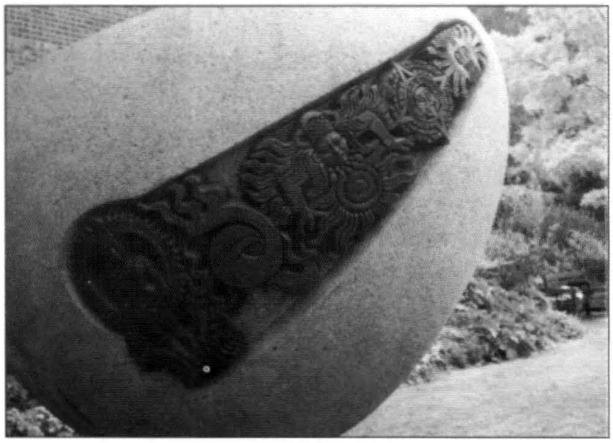

Fig. 6. The west side with the symbolism of Surya, Indian; Flaming Eye, Chinese; Kinich Ahau, Mayan; Xoloti, Aztec; and Nazca, South American.

The final piece of symbolism, Fig. 7, is a fine relief carving on the rear of the dial that depicts the Twins of Gemini. They stand for the alternate appearance and disappearance of the sun, therefore night and day, light and shadow. Being twins they are symbolic of the reprographic process and being composed of light and dark are the basis of printed communication

The dial, as seen when entering the garden, is shown in Fig. 8. To complete the whole setting, Wycombe District Council fitted a plaque, in a similar pink granite, on the wall behind the dial, which states: *Sundial by Edwin Russell FRBS Presented by Akeler to Wycombe District Council. For the people of Marlow August 2002*. To balance the symmetry of the garden, in the centre of a brick paved area (identical to the bricks around the dial), a rose bed with roses, Queen Elizabeth, and berberis, Harlequin. Both were chosen to give a pink effect to complement the dial.

Fig. 7. The Heavenly Twins, Gemini, stand for the alternate appearance and disappearance of the sun. Being twins they are here, symbolic of the reprographic process.

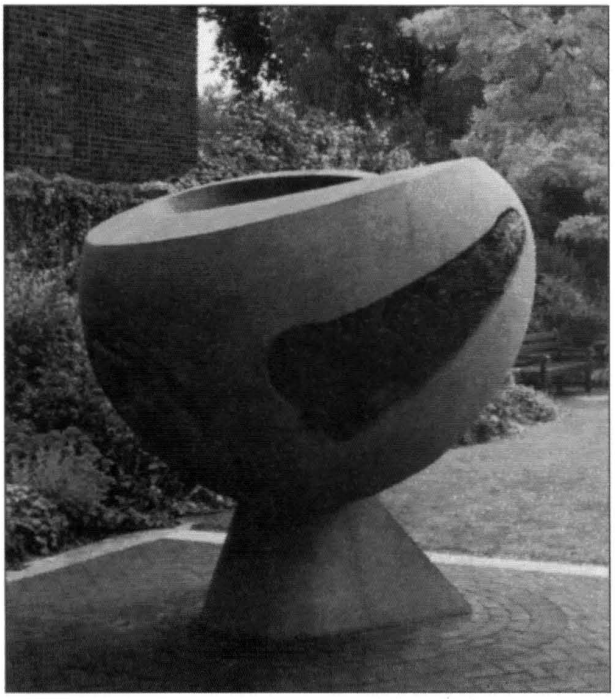

Fig. 8. The dial, the memorial garden, and Marlow Place.

It is worth mentioning again that this magnificent dial is due to the sculptural and artistic flair of Edwin Russell. He is a Fellow of the Royal Society of British Sculptors, has a national and international reputation. Indeed, he has not sought fame, but in many quarters is regarded as one of Britain's foremost sculptors. His commissions have ranged from private collections to large projects that are firmly in the public eye. Sundials have featured in the commissions, with the largest (in association with Brookbrae) in Oman and Dubai, both being equatorial and with solid analemma shapes to correct for the equation of time. In the British Isles the best known of his sundial work is the Dolphin Dial at the National Maritime Museum. Smaller dials are the charming scaphe dial of apple blossom at the East Malling Research Centre and the vertical dial at the Marine Society's headquarters in Lambeth. Both of these dials feature in early editions of Christopher Daniel's Shire Publication on Sundials. The Channel Isles have a 'helios' dial in white marble. A combination of sculpture and dial is at Tower Hill, London, where there is a large bronze gnomon (3m) for a horizontal dial and an outer ring of panels depicting the history of London. A recent large dial, another equatorial, is in the Arena commercial development, Bracknell, Berkshire.

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O gentlemen! The time of life is short;
To spend that shortness basely were too long,
If life did ride upon a dial's point,
Still ending at the arrival of an hour.

Shakespeare: King Henry IV (i)

THE EARL OF PERTH

We are sad to report that our Patron the Earl of Perth died on 25 November 2002, There is to be a Memorial Service on Thursday 23 January 2003, at Westminster (RC) Cathedral London

THE DINTON CHURCH SUNDIAL

CHRISTOPHER ST J. H. DANIEL

[The article below was first published in 'Records of Buckinghamshire' Vol. 42, pp 133-141, 2002, the Journal of the Buckinghamshire Archaeological Society. It is reprinted here by kind permission of the Editors of 'Records of Buckinghamshire' -Ed]

ABSTRACT

The unique palimpsest dial-plate of a horizontal sundial, originally mounted on a pedestal in Dinton churchyard, is described. Numerals resembling 1395 are cut into the underside of the plate; but it is considered likely that this was the work of a 16th century artisan attempting to incise the date 1595. It is understood that the dial has now been deposited in and is on loan to the Buckinghamshire County Museum, for security reasons.

INTRODUCTION

In 1982 or very early in 1983, a local NADFAS Church Recording Group discovered a "sundial plate", described as a "re-used plate", at the bottom of a chest in the recesses of the Dinton parish church of St Peter & St Paul.

The sundial, or what remains of it, takes the form of a roughly square palimpsest dial-plate made of brass (the bisecting measurements being approximately 155mm x 158mm) of a 'common or garden' horizontal instrument. The date cut into the underside of the dial-plate, which is unweathered, has suggested that the sundial might have been made in the 14th century; but it is more probable that this is a late 16th century work. The gnomon is missing and two corners of the dial-plate are broken off. On the upper face of the plate, there are the large, slightly domed heads of hand-made iron clout nails, passing through the two remaining adjacent corners. One of these nails is still attached to a lead plug on the underside of the plate. The sundial would have been 'leaded-in' to the uppermost horizontal surface of a stone pedestal. Thus, it would have been set such that the inclined edge of the gnomon would have been aligned in the meridian, parallel to the earth's polar axis, directed to the north celestial pole.

THE UPPER SIDE OF THE DIAL-PLATE

The upper side of the dial-plate is well delineated with incised hour-lines, correctly but not visibly originating from the centre of the dial-plate, at the base of the gnomon, being the junction of the 12 o'clock and 6 o'clock hour-lines and being the *centre of delineation* in this case. (Figures 1 & 3) These hour-lines are carried out to two concentric

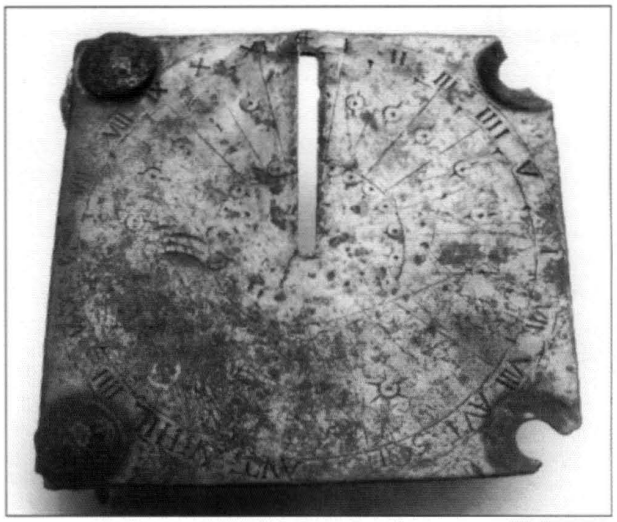

Fig. I: Photograph of the upper side of the dial-plate.

circles, forming a band containing Roman numerals denoting the respective hours (the *hour-circle*, sometimes called the 'chapter-ring'). The small central circle is also furnished with what appear to be blind-stamped roundels, containing a central point, possibly representing the sun or a star, and intended to mark the position of the half-hours. A little more than midway between the small central circle and the innermost circle of the hour-ring, there are similar, but slightly larger blind-stamped circular images that are clearly intended to mark the half-hours. There are also small pointed inward-pointing marks on the innermost circle of the hour-ring, having a thorn-like appearance, that more accurately indicate the half-hours.

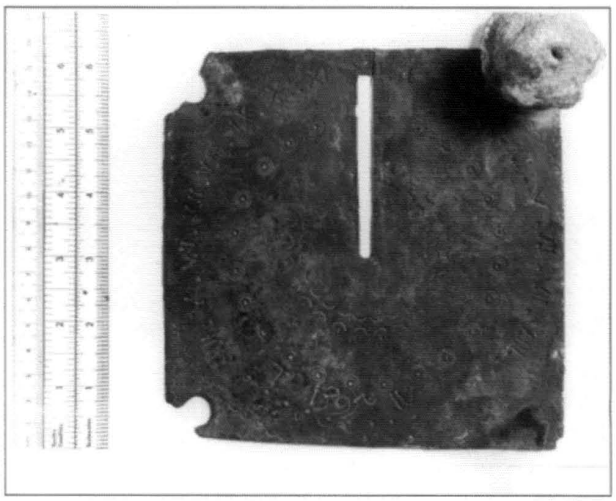

Fig. 2: Photograph of the reverse or underside of the dial-plate.

The hour-lines are delineated and denoted by Roman numerals from IIII (4am) to VIII (8pm) Local Apparent Time, except for 12 o'clock noon) which is marked by a

small cross. This was a customary practice in the *Art of Dialling* (the mathematical art of constructing sundials) in the delineation of sundials, evidently originating from the principal hour of the 'Stations of the Cross'.

THE INSCRIPTION AND DECORATION

On the south-side of the dial-plate within the band of the hour-circle, between the hours of VIII (8pm) and IIII (4am), there is the Latin inscription AVT SOL AVT NIHIL ('Aut Sol: Aut Nihil,' which may be translated as 'Either the Sun, or Nothing,' or 'Without the Sun, there is Nothing'). In the triangular area between the incised VIII and IIII hour-lines there are three small blind-stamped roundels, each containing a central dot, with six spikes emanating uniformly from the circumference of the roundel, evidently representing the sun or stars. One such image is exceptionally clear and well-preserved whilst the other two are quite worn and difficult to discern. The three images form an isosceles triangle, one such image at the apex lying on the meridian line, i.e. the centre line or the 12 o'clock hour-line, which device would seem to be purely decorative. Other stamp-marks, somewhat similar to those on the inner circle of the dial-plate, have also been made along the 12 o'clock line, from the base line of the 'triangle' to the circumference of the inner circle. These, too, would seem to be merely ornamental.

The question as to whether these various stamped images were intended to represent the sun or the stars may be considered in the light of the fact that, in historical illustrations of the heavens, the stars are invariably depicted as devices with triangular 'rays' of four, five or six points, emanating from the centre of the image. They are seldom, if ever depicted as roundels or circular images with spike-like rays, whereas the sun is normally shown as a circle, often with a human face, with rays stemming from the circle of the image. In reality, this is an historical consideration concerning only the intentions of the instrument maker, since the sun is a star, of course, and vice versa.

THE FORM OF THE GNOMON

The dial-plate itself has an oblong section, measuring approximately 72mm in length by 6mm (1/4 inch) in thickness, cut out along the centre of the dial-plate, along the 12 o'clock noon-line, to allow for the gnomon. The gnomon, evidently, was either 'free-standing', i.e. separately 'leaded-in' to the stone-work of the pedestal, (which would seem to be unique, there being no known dial extant having these characteristics), or brazed to the underside of the dial-plate by some means. The dial-plate appears to have been constructed for a latitude of approximately 50-52 degrees (north), according to the best measurements obtainable from the respective hour-angles. Thus, it may be assumed that the gnomon took the form of a solid bronze right-angled triangle, the angle of the base at the centre of delineation (the centre of the dial-plate) being equal to the latitude, and the angle nearest to the cross marking 12 o'clock noon) being a right-angle. Given the latitude as being 52 degrees and the length of the base as 72mm, the height of the gnomon (above the surface of the dial-plate) may be deduced to be 92mm and the length of the inclined edge of the gnomon to be 117mm.

THE UNDERSIDE OF THE DIAL-PLATE

The underside of the dial-plate appears to have been the work of another, earlier hand. (Figures 2 & 4). It has not

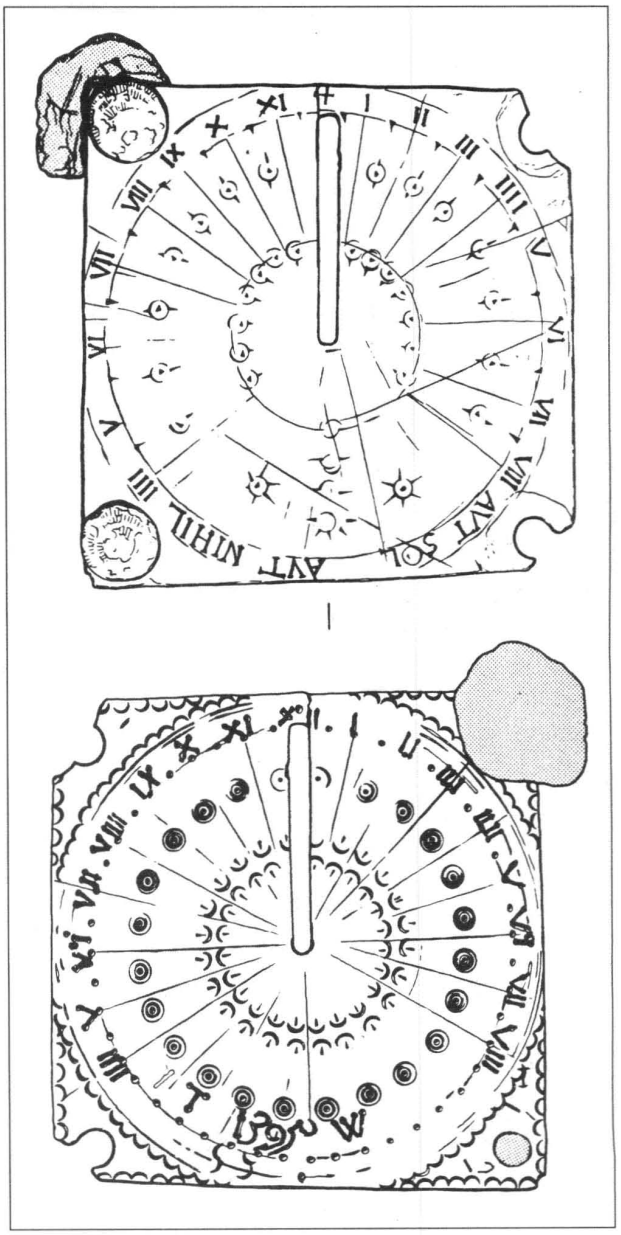

Fig. 3 Top: Drawing of the upper side of the dial-plate. (Drawing by David Honour.)
Fig. 4 Bottom: Drawing of the reverse of the plate. (Drawing by David Honour.)

been delineated with hour-lines in the same fashion as the upperside of the plate, although it can be seen that some attempt has been made at delineation, since there are a number of faint lines scored from the centre of the dial, notably the 6 o'clock line (VI), 4pm (1111) and 7pm (VII). Otherwise there is a crude circle of Roman numerals, 'blind' stamped or punched above a circle of punched dots, 46 in number, no doubt intended to be 48, but with one missing at 12 o'clock (Noon), where the perpendicular edge of the gnomon would have been situated, and one concealed by the punch mark at the base of the numeral V (5 pm). These dots represent the hours and half-hour points in the 24 equal-hour system (two periods of twelve hours) as used today. The underside of the dial-plate is decorated with ornamental scalloping around the edges of the plate, and similarly as two small concentric circles around the centre of the plate. The latter have the appearance of small crescent moons. Midway between these two circles and the outer ring of Roman numerals, there is another ring of small circular punch marks, or, possibly, drilled decorative circles, 23 in number being visible, but probably intended to be 24 all told. (It would seem that one such circle has been obscured where the plate has been cut away to take the gnomon.)

THE INITIALS AND DATE

On the south side of the underside of the dial-plate, between the numerals VIII (8pm) and IIII (4am), between the ring of small circular punch-marks and the punched ring of hour and half-hour dots, there are what appear to be two punched, but possibly incised, letters T and W. These probably represent the initials of the would-be maker, being placed on either side of a crudely cut date, which has the appearance of being 1395, in Arabic numerals (Figure 5.) The initials and the date would appear to have been added at the end of the construction.

Fig. 5: Close-up photograph showing the detail of the punched initials 'T.' / 'W.' and the numerals '1395' chiselled into the underside of the dial-plate. The initials may be those of the original maker, diallist, or patron. The date is probably an error that caused the instrument to be reversed and engraved on the other side.

Whether the workmanship on the underside of the dial was a preliminary trial for the delineation of the upper side of the dial-plate is uncertain; but the apparent difference in style suggests otherwise. Nevertheless, the upper side of the dial-plate and the underside may well have been laid out within a few years of each other. It is the date, however, that arouses curiosity and some excitement.

THE ARGUMENTS

The argument that the date 1395 is valid for the instrument is that Arabic numerals, in the style of those cut into the dial-plate, were in use in Europe in the early 15th century, if not before. Contrary to this, an authority on the Chaucer period has stated that the numerals are not consistent with the period.[1] Analysis of the metal indicates that the sundial matches the average for Flemish brass before AD 1560.[2] Thus, the analyses of the sundial are not incompatible with it having been made in 1395 in England from imported Flemish brass. However, neither are the analyses incompatible with it having been made from brass that was imported in the mid 16th century.

The argument against the date being a valid one is that English craftsmen experienced difficulties in the use of the 'new' Arabic numerals, introduced into this country, before and throughout the 16th century.[3] Antiquarian authorities view the date as being suspect and consider that it was an unsuccessful attempt by the metal-worker to incise the date 1595. This may be one reason why the underside of the dial-plate was not completed and used for its intended purpose.

THE 'SCIENTIFIC SUNDIAL'

It would, of course, be an exciting discovery if this could be proved otherwise. The dial-plate of the Dinton sundial, as already stated, is that of a horizontal instrument that can be described as a 'scientific sundial.'[4] Sundials take many different forms and are placed in various classes, i.e. horizontal, vertical, polar and equinoctial. Anglo-Saxon vertical sundials and medieval 'mass' dials, carved into the walls of churches, employed an horizontal gnomon[5] to indicate the 'hours' of the church services; but they were inaccurate except at Noon. The 'scientific' sundial is generally accepted as an Arabic invention[6] in which the gnomon was inclined parallel to the polar axis of the earth, directed to the north celestial pole. In this manner it indicated *equal hours*. This invention, sometimes called the 'Moorish' sundial,[7] is thought to have made its first appearance in Europe about the end of the 14th century or the beginning of the 15th century, in Germany.[8] Certainly, by the end of the 15th century, the scientific sundial had become an established instrument for use in the determination of time by the equal or equinoctial hours

system. Probably in the latter part of the 15th century, the scientific sundial was introduced into England from Europe. The earliest dials of this kind, still extant, of which there are few, chiefly date from the second half of the 16th century, mostly made by London instrument makers, such as Humphrey Cole.

CONCLUSION

One must conclude that the Dinton church sundial was likely to have been made by an artisan or 'country' metal-worker, probably a blacksmith, under the direction of an educated gentleman with a knowledge of mathematics, at the end of the 16th century. This in no measure detracts from the importance of this instrument, which, so far as it is possible to ascertain, is unique.

NOTE: The author was not aware of the existence of the pedestal (Figure 6.) until recently, when provided with a photograph of Dinton churchyard by Mr George C Lamb. The pedestal seems to be referred to in church literature as a cross; but it would appear to have been 'stumped' i.e. cut down, almost certainly during the Reformation in the reign of Queen Elizabeth. The horizontal surface of the stump evidently contains two lead plugs inserted with iron nails

Fig. 6: Photograph of the pedestal of the sundial in the churchyard of St Peter & St Paul, Dinton. (Photograph by Joan Lamb.)

that match those of the dial-plate.[9] This would seem to confirm the date of the sundial as being of the late 16th century.

In a very recent letter,[10] Mr Lamb has informed me that: "There is a gnomon, but detached from the dial. I enclose a crude sketch (Figure 7.), but the dimensions are pretty accurate (and extremely close to your calculations). It is made of iron but very corroded at the lower end and there is no surviving trace of brazing/lead/solder to show how it could have been fixed in to the dial. Moreover, it is 34mm thick and the slot cut in the dial is 6-7mm." He goes on to say that Dinton church has a total of nine monumental brasses, that were examined and restored in 1949. Several of these are palimpsests. One, in particular, is the monument to Francis Lee (d 1558)..." a brass, one piece of which is a palimpsest of a Flemish memorial engraved c 1380. So the sundial might be made of metal brought to the village at various dates during the sixteenth century by craftsmen installing one of the memorial brasses... [The full description of the palimpsest brasses is contained in an Article in Records of Bucks by D. C. Rutter in 1949 (Vol XVpt.3]". This latest information is of much interest as it tends to confirm the possibility that the gnomon (which I think is likely to be the original) was 'free--standing' and probably separately 'leaded-in' to the pedestal, having been aligned in the meridian first. This also provides further weight to the argument that the sundial was made in the 16th century.

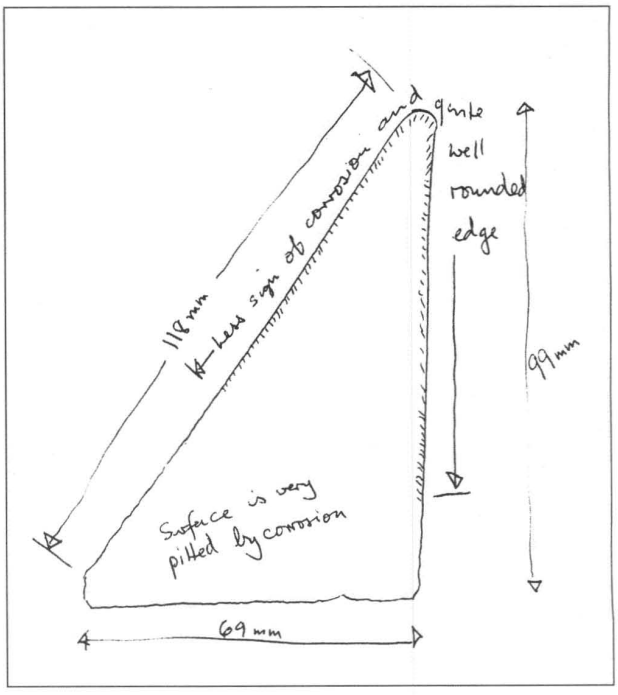

Fig. 7: Sketch of the gnomon by G. C. Lamb

ACKNOWLEDGEMENTS

The author is greatly indebted to Mr and Mrs E V Wright of Hall Place, Wycombe End, Beaconsfield for bringing this unique sundial to his attention, following the survey of Dinton church undertaken by Mrs Jane Wright and others of the local Church Recording group of the National Association of Decorative & Fine Arts Societies; to the Reverend D J Cooke, the Rector of Stone and Dinton, for the kind loan of the article so that it could be studied and recorded; to Dr A M Pollard of the Research Laboratory for Archaeology and the History of Art, Oxford University, for his work on the analysis of the metal; to Mr David Honour, especially, for his excellent and meticulous drawings of the instrument; and to Mr George Lamb for specifically suggesting that the author should write a note on the Dinton sundial for the *Records of Buckinghamshire* and to his valuable contribution to this resulting article.

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5. J. Hovedon, (d. 1275.) *Practica Chilindri*, a short treatise on the use of the pillar or cylinder dial, invented by Herman the Lame, AD 1050, in which Hovedon likens the right-angled guomon to those that jut out from the walls of churches.

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8. E. von Bassermannn-Jordan, *The Book of Old Clocks and Watches*, translated from the German by H. Alan Lloyd, (London,1964), 358.

9. G. C. Lamb, Private letter referring to the stump of a cross, in the churchyard of St Peter & St Paul, Dinton, which has been sawn off and where there is evidence of two lead plugs, containing iron nails, matching those still affixed to the dial-plate of the sundial, (2001).

10. G. C. Lamb, Private letter, dated November 24th, (2001).

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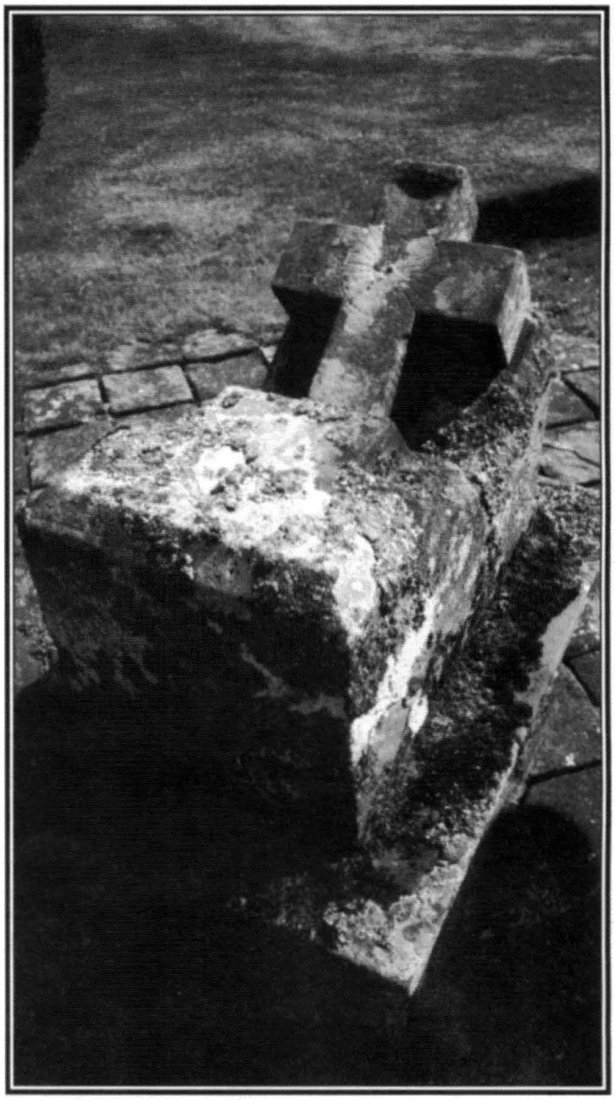

IDEAS OF AN AMATEUR: MOUNTING A STYLE ON A WALL

WALTER HOFMANN

(A modified extract from "Rundschreiben" Nr.23, May 2002),

It is comparatively easy to fix a style with ball and socket in its right position. If styles are parts of stiff constructions as shown in Figure 1 good results can be achieved by using supplies made of ply-wood, at its best when this has been produced with the help of water-resistant glue. Care should be taken that all parts of the construction carrying the style are sloping so that the water would be led away from the wall.

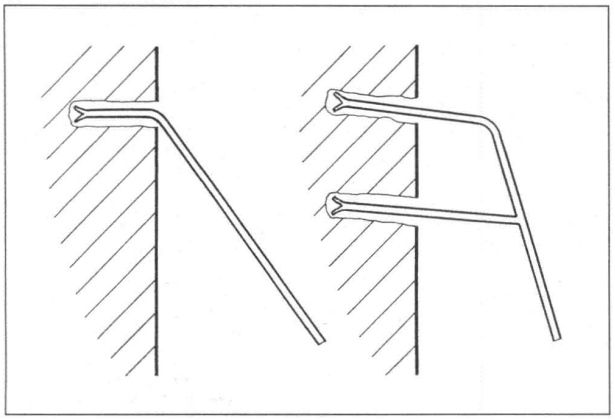

Fig. 1.

Only vertical walls are now being considered. At first the direction of the wall is to be measured, for instance by marking the shadow of a plumb-line on a horizontal plane near the wall. According to declination and hour-angle of the sun, the sun's azimuth can be calculated and thus the direction of the wall.

For walls with directions from SE to SW structures can be used as illustrated in Figure 2. A rectangular plate is connected by joints with a plate in shape of a rectangular triangle. The angle at the base of the triangle opposite the joints equals the latitude of the stand. The rectangular plate has to be fixed at the wall, usually by screws, so that the axis of the joints is vertical. The sloping sectional area of the triangular plate should point a little beneath and alongside the spot where later the axis of the style will meet the dial-plate.

Call the triangular plate the "wing". When the sun is exactly in the south the wing has to be turned so that its shadow on the wall is narrow and vertical. At this moment the wing is pointing directly towards south and is to be fixed in this position with a stay. The style can be fastened along the

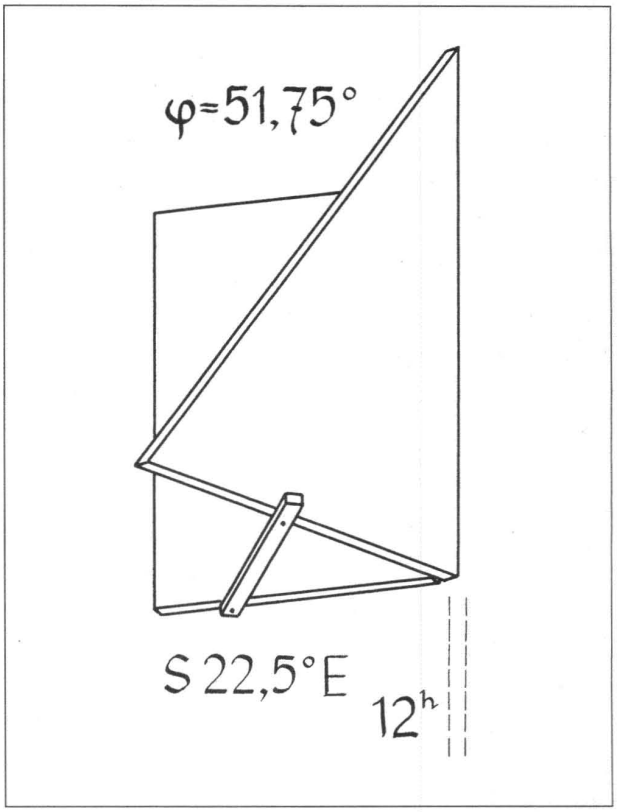

Fig. 2.

sloping sectional area till the plaster, cement or some adhesive substance is firm enough to carry the weight of the construction.

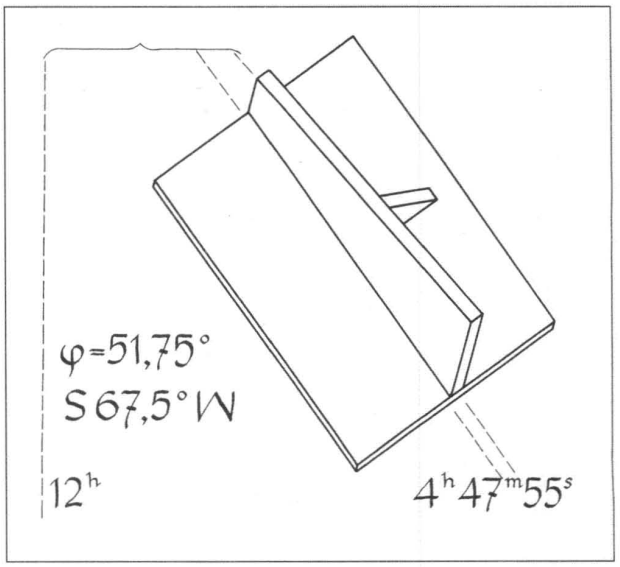

Fig. 3.

For walls directed more to the east or to the west another structure can be used, as illustrated in Figure 3. Both plates are firmly connected. The rectangular plate is to be fixed to the wall; the sloping sectional area of the plate having the shape of a rectangular trapezoid should be parallel to the axis of the earth. Before calculating the angles of the trapezoid, and for the fastening to the wall, the direction of the wall should be known exactly. If shadows show that a correction is to be done, the fastening to the wall and the angles of the trapezoid must be altered.

Declining walls must be treated in a somewhat different way. According to the author's experience three elements are needed to achieve good results when working at a sundial: theoretical knowledge, practical skill and creative imagination. So the construction of a sundial in most cases will depend on good team-work

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TENTERDEN TIME

JOHN FOAD

An extract from "Amusing Reminiscences of Victorian Times and of Today" by John Neve Masters MBHS, June 1921

(Alderman John Neve Masters was a native of Tenterden in Kent, but resided at Rye, where he was a senior member of that Corporation. Like his father he became a clockmaker.

The dial referred to is the vertical on the porch of the Parish Church of St Mildred's in Tenterden (SRNO 0626). It was made by the surveyor John Adams in 1836, and so would have been quite new at the time described. In 1921 it was re-painted and re-gilded at the expense of Mr Masters.)

When I was a boy in the eighteen-fifties there were two clockmakers in Tenterden, and part of their business was to ascertain the exact time occasionally, which in those days was taken from sun-dials; so my father and the other "clock-smiths" (as they were called then) used to go to the church porch, on which was a sun-dial, to "take the time."

So once a month, just before "high noon" on a sunny day, they met, gave one another a friendly nod, stood at attention, each with a watch in his hand, looking the sun-dial straight in the face, watching the shadow of the stylus on it to decide on the exact moment that the shadow fell on the figure XII. They didn't both say "Now" at the same moment, as a racing man does with a centre seconds watch in his hand, because you can't tell the time by the sun-dial to the fifth of a second; but I suppose they always agreed on the correct time at Tenterden for I never knew them adjourn till next day, or, like Joshua, order the sun to stand still.

... There was always a friendly rivalry between the two watch-smiths as to whose watch had kept best time since the solar time last month. I often saw this done in the eighteen-fifties, and I was always cocksure that my father's watch went best.

... My father would say, "Come along, John; we are going to find out the exact time to-day from the sun-dial on the church porch." Of course I went with him - ain't youngsters anxious to learn something fresh?

Well, when the two local watchmakers had agreed on the exact time, they went to their respective shops and set their regulators right, and people who came from the adjoining parishes would set their watches, and go home and say, "There, that's Tenterden time."

To-day, when the time is telegraphed daily, we say, "That's Greenwich time," poor old Tenterden time is done for. It was very necessary a hundred years ago to use the sun-dial, for one clock set right will do to set many by; but one clock that was wrong would, in those days, mislead a whole neighbourhood.

... Sun-dials were in use more than two thousand years before watches were invented, so sun-dials "go one up"; but a centre seconds watch that tells the time to the fifth of a second is a record that no sun-dial can enter into competition with. But when we think that sun-dials have told some of the inhabitants of the world the time for 2663 years, and are still "on duty" in many countries, we may well say that, though they do not strike like a clock, they have been useful in their time through many centuries, and are still being erected to-day, more perhaps for ornament than use. But "Long live the sun-dial!"

(Earlier in the piece is a digression on the characteristics and makers of watches of the day. It would be interesting

to any student of the history of watchmaking, but it is not appropriate for this Bulletin. I would be glad to send a photocopy to anyone who would like to see the whole article - just drop me a line or an email.)

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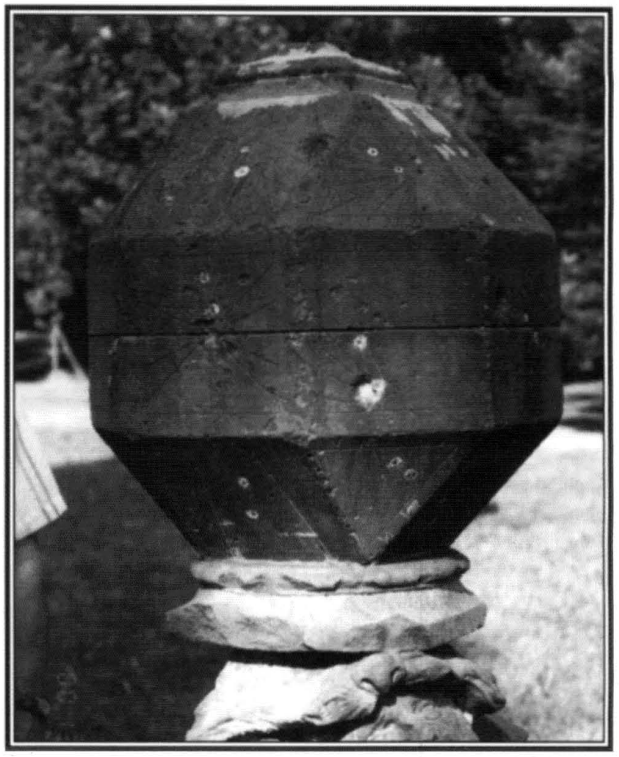


NEWBURY 2002 - A PLACE IN THE SUN

JOHN MOIR AND PETER RANSOM

Never mind the Costa Brava, - Newbury once again showed that it is unequalled in providing fine weather on demand. Well over 40 members (45 actually signed in), old friends and new, spent much of the day on September 28 enjoying gossip and sundial chat outside, only coming indoors for the short talk sessions.

The first of the talks was given by Tony Baigent, who described his quest to get his younger visitors involved in making an accurate and worthwhile dial to take home with them. He amusingly demonstrated how he made hemispherical moulds from soup ladles and bank tills, using string to mark hour and declination lines. The

The sun shone on the dials and delegates at Newbury

youngsters would then be allowed to pour in quick drying cement, stick a rod gnomon in the middle, and depart as the proud owners of a *real* sundial - "All my own work, Mum!"

Next, Peter Ransom described how he uses "Dynamic Geometry" software to teach 11 to 13 year olds such things as reflection symmetry, using the distinctive image of Bart Simpson to show how mirrors work. Peter then showed us how he has integrated the historical dial constructions of John Blagrave and Peter Nicholson with the software, resulting in a very neat method of delineation. By changing the parameters such as latitude with the cursor, the hour lines, etc., take up their correct positions. Demonstration disks of the software, Cabri Géomètre II, are available on request. Contact info@chartwellyorke.com or phone 01204811001.

We were then whisked away to the French Alps where, the next speaker Martin Jenkins explained, there is a profusion of painted wall dials. The tradition stretches back to the 1600's but is still strong, in that the more wealthy folk commission artists to produce dials for them in the modern vein. Most villages have several painted dials, but the record seems to be held by Saint-Veran, where Martin has counted an astonishing number of 23! Strangely there does not appear to be many garden dials.

After a pleasant break lounging in the sun and/or viewing exhibits, we were given a demonstration of the astrocompass by Michael Maltin. Using a large home made equatorial mount fitted with a laser beam, he simulated movements of the sun and stars, proving that square walls work just as well as a planetarium (with some imagination). Having had first hand experience in using the astrocompass as an Air Force pilot, Michael was just the person to explain its mysteries.

Penultimately, David Brown showed an incredible bargain that he'd bought for just £20. It was a spirit level/angle finder fitted with laser beams, with a graduated 360° mount and tripod thrown in. After some light discussion it was decided that, if mounted to a gnomon it could be used as a trigon for laying out dials on rough surfaces, but it was probably sold as a loss-leader and unlikely to re-appear at such a silly price again.

It was the time for a bit of society business. Kevin Barrett, the Membership Secretary, spoke about the membership and encouraged any non-members present to join! Margaret Stanier, the editor of the Bulletin, put in a plea for some pictures of dials to include in the Bulletin whenever there is some space. She always welcomes articles for the Bulletin! Doug Bateman, our Secretary, mentioned next year's annual conference and thanked the organisers of this Newbury conference for their time and efforts in making it a great day out.

After a short break we regrouped at the Rogers Turner bookstall to go round the exhibits. As usual, the standard, craftsmanship and ingenuity of the exhibits were high. There were too many to report on in detail here, so the following list of exhibitors and a brief description of their work must suffice.

Barry Waltho
Credit card sun compass and window dials with adaptor bars to adjust for latitude, neatly made in plastic, set on adjustable base. Can be purchased from Barry.

Bill Hitchings
A 19th century horizontal dial by Cary, made of lead with a brass or bronze surface.

Donald Bush
1. Horizontal dial with neat mechanism for rotating dial face around gnomon (longitude adjustment), with two polar dials on gnomon, set to provide better coverage of hours.
2. A nice Foster-Lambert dial (After Fred Sawyer). This double gnomon device is "self-Northing"

Heiner Thiessen
The "Sunrise" dial, in essence an equatorial, is a "tour de force". It shows the time, declination, sunrise and set times

Heiner Thiessen demonstrates his dial.
Michael Maltin looks on.

and much more. Heiner is also into solar power. His article on the sunrise dial appears in this issue, so is not elaborated here.

John Moir

1. Armillary Octahedron, made in brass by John Davis. (Combined horizontal/vertical).
2. Book of Hours (combined double cycloid and double polar) -uses bookmarks to simulate the polar gnomons
3. A "poor man's" copy of the sunrise dial (above), with no equator disc

John Moir with his armillary octahedron, made in brass by John Davis

Mike Shaw

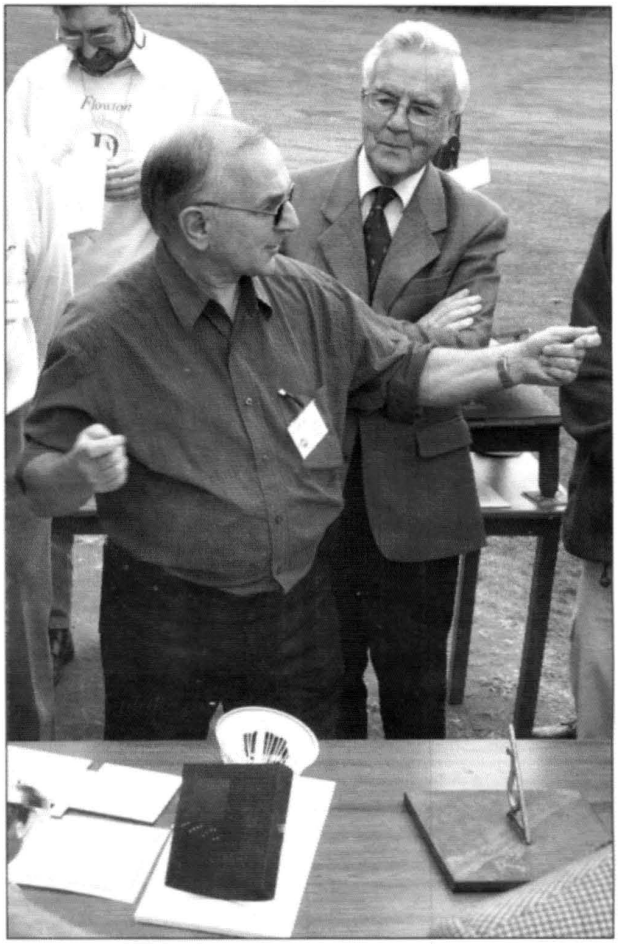
1. An equatorial remote-sensing fibre optic dial. Cleverly avoids using a light-slit (which gives problems at low angles of incidence.) Written up in the June 2001 Bulletin (vol. 13 (ii))
2. A neat device for finding E.O.T and Longitude adjustments. It changes the scale axis for the required location. All diallists should have one-Mike can supply.

David Ellis-Jones

A 19th century Richard Melvin dial in slate with a bronze gnomon.

Silas Higgon

The improved azimuth dial, described in the June 2002 and September 2002 Bulletin, was demonstrated. A larger version, 50 centimetres diameter and 1 metre high, is planned.



Silas Higgon talks about his improved azimuth dial. David Brown's Berossos dial and John Davis' horizontal dials can also be seen.

David Brown

A stone-carved Berossos (or Hemisphericum) dial.

Berossus dial carved in stone by David Brown

John Davis

1. A large horizontal based on a pattern by the Grocers Company with locations of noon around the world marked at the appropriate (corrected from the original) positions.

John Davis showing his horizontal dial

2. A double horizontal dial using different colours to help with the reading of the two gnomons.
3. A small vertical pair of east/west dials based on a design by Harriet James.
4. A selection of small portable dials.

David Young

The BSS's trip to Cornwall next September was promoted.

Martin Hinchcliffe

A display of his '1034 miles by sun compass' journey that he sailed from Pitcairn to Marquesa. The captain decided that to sail in Polynesia by sextant and compass was too easy!

Tony Baigent

1. His instrument box, demonstrated last year.
2. A machine for finding the declination of a wall.
3. Concrete dials

Tony Wood

1. A coloured print of the Pelican sundial in Oxford
2. Two crested china dials
3. A folder of the Elmley Castle multiple dial, restored in 1971

Peter Ransom

1. French posters that include sundials in their designs.
2. Various pieces of sundial literature.
3. Sundial ephemera, including a jigsaw and sheet music.
4. A folder on the construction and design of his millennium waistcoat that features his family's timepieces.
5. A framed cross stitch picture of a sundial.

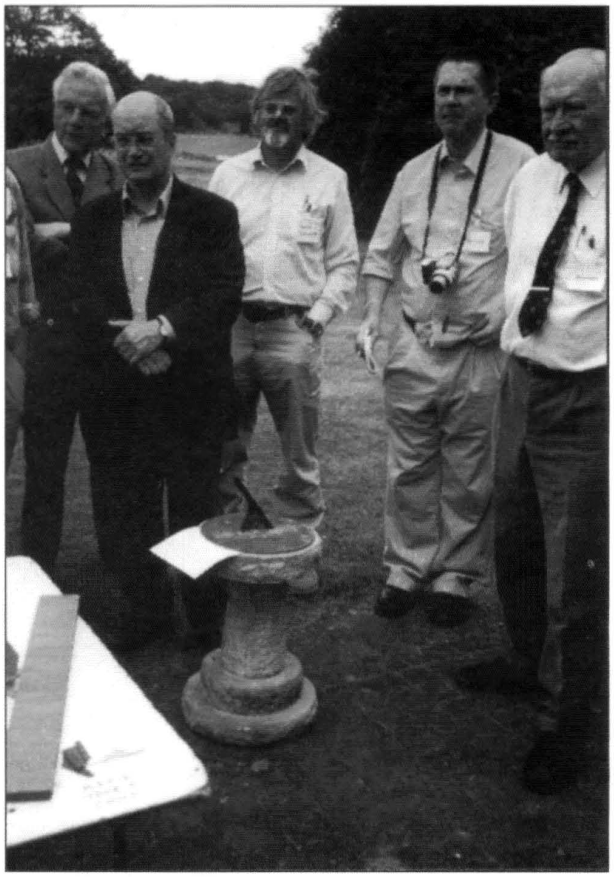
Pat Briggs

A Meccano equation of time machine from the bottom of a large astronomical clock.

The Astrocompass Display

Some members had brought their astrocompasses to form what is thought to be the largest display of astrocompasses. This had been coordinated by David Pawley who had collected the serial numbers in advance and had prepared appropriate labels.

Though not among the items placed on exhibit, an old and eroded copper double-horizontal dial plate was shown by its owner and aroused interest. The name of the maker John England could just be made out, on the badly eroded surface.



The Syndics of the Sundial Guild, after Rembrandt 1662

David Pawley is the inspiration behind and organiser of the Newbury meeting. We cannot thank him enough for all he does in getting this show on the road, so we are not going to try!

John Moir, Wanstead, London
Peter Ransom, Rownhams, Southampton

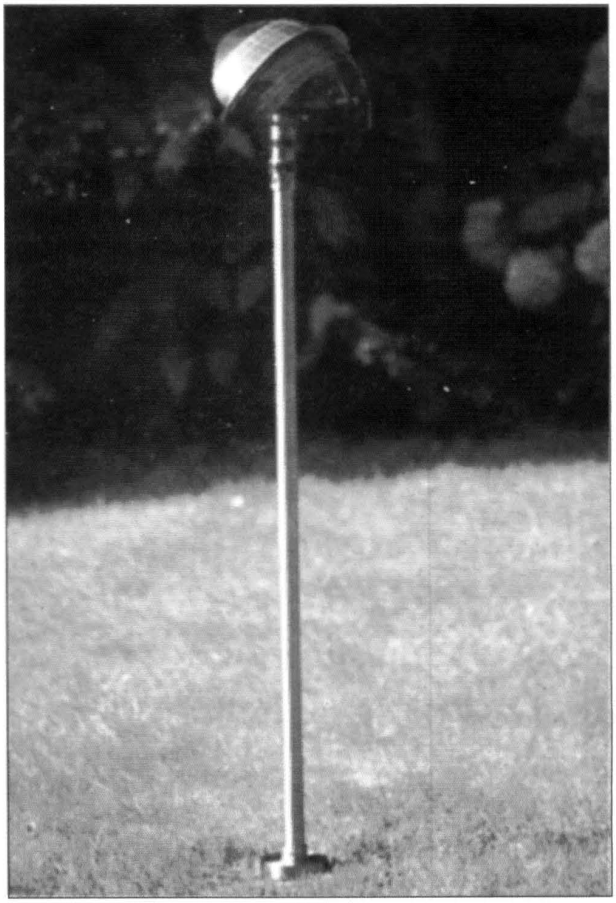
[The photographs have been contributed by Peter Ransom and by Mike Cowham, to whom we are very grateful]

HELIOS

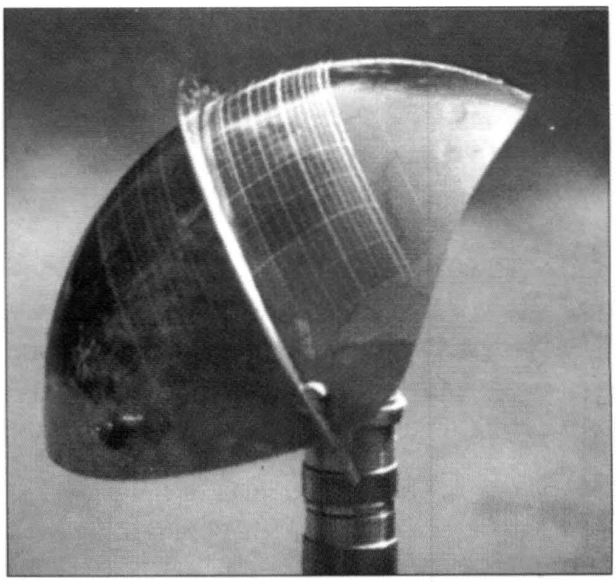
We have received particulars of an interesting type of Sundial, called by its designer 'Helios'. The design, by Carlo Heller of Wiesbaden, is based in the 'reflected ceiling dial' The mirror is inserted into the top of a narrow stainless-steel column placed vertically in the ground, and the screen receiving the reflected sunbeam is fixed above it. The screen takes the form of a world globe, the northern hemisphere from the Tropic of Capricorn northwards. It is made of transparent plastic material and inscribed with the outline of continents and oceans, and with lines of longitude and declination lines. The designer's leaflet tells us:

Helios, showing mirror in upper end of steel column

"The operating principle of the Helios sundial—the projection of sunlight onto a globe-shaped screen—enables the simultaneous display of Time, the date, and apparent migration of the sun, with the highest possible degree of precision. The zenith position, daily migration, seasons, tropics, equinox—the sun itself makes these phenomena



Helios in position on a lawn



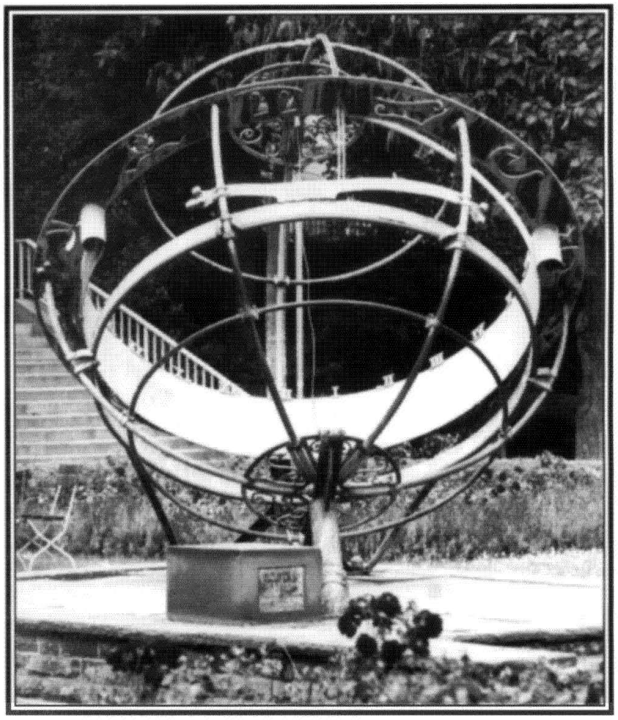
Helios dial-plate

visible on the screen……The pointer is the sunlight, which is arriving from a different direction every single moment. The beams of light meet the mirror of the sundial and project the image of the circular sun as a point of light on the screen……The luminous point wanders across the globe and shows us at which place the sun is at this very moment vertical to the earth—at its zenith. You can follow the sun's path across our planet every day, all the year round……Every day the sun follows a different course between the tropics."

The stainless steel column is 130cm in height. The globe-shaped display screen, circumference 30cm, consists of all-weather acrylic glass.

The photographs may give readers an idea of the structure and working of 'Helios'.

Further particulars, a brochure and a CD, are available from the Editor.



THE ANCIENT CLEPSYDRA OF ATHENS

THEODOSSIOU, E. AND KALYVA, E.-M.

Abstract

A sundial as such has the serious disadvantage of not being able to work on cloudy, rainy days nor at night. This was the main reason why the ancient civilisations also used another physical phenomenon to measure time-intervals: the continuous flow of water. The first mechanical way of measuring time was the water clock. The water clock or clepsydra was crude device for measuring time at night. So its structure was quite simple: a vessel from which water escaped through a small hole, in or near the bottom, at a steady pace and in which the falling of water marked the passage of time. The surface of the water in the calibrated vessel told the time.

Clepsydrae or water clocks were the only mechanical instruments for recording the passage of time in antiquity.

1. INTRODUCTION

It is believed that the inventor of clepsydra was the ancient Egyptian god Thoth, Hermes Trismegistus, who was a time-counter, a divider of time and the father of all sciences, particularly of Astronomy.

"To provide a means of measuring time at night the Egyptians invented the water clock or 'Clepsydra', as the Greeks later call it"[1]

The word 'clepsydra' derives from the Greek words *clephtis* (= stealer, thief) and *hydor* (= water), thus *clephtis* + *hydor* = clepsydra, which means 'the thief of water' or 'water-stealer'. This instrument was able to count the passage of time during the night, when the sundials were of no use.

The Egyptians knew clepsydra, the water clock, from the era of the Kings of Thebes, 18th Dynasty, and the Babylonians record it at least from the 12th century BC.

In India the equivalent of the clepsydra was the 'jala-yantra', dating from 300 BC. Probably the first people who knew the use of the water clock were the Chinese, although the only certain record of it is in the Chinese book: 'Lou-Shui-shuan-Houn-t'ien-i-chi' *(Method of rotating a pinned sphere with water, which drips from a water clock)* written by Tchang Heng, AD 90. So clepsydrae, used in parallel with sundials, were instruments for showing the time in antiquity. Especially, clepsydrae were used for measurement of the hours of the night.

The clepsydra has been known since remote antiquity. The first written report which gives us information about the water clock dates around 1550 BC and was made by the Egyptian astronomer Amenemhet, although *"the oldest clepsydra bears the name of pharaoh Amenhotep III, and therefore dates from around 1400 B.C."*[2]

Amenemhet is the earliest known astronomer and clockmaker in the history of science and possibly the actual inventor of the water clock. He left a brief autobiography, engraved on the walls of his death chamber (tomb) in Luxor, and tell us that the winter night was 14 hours long, whereas the summer night only 12. Statuettes of deities representing the hour count, possibly floating on water, appeared at appropriate hours, while the water level rose or fell.

"There were two types of the clepsydra, one which we may call an 'outflow clock', and the other an 'inflow clock', according as the water flowed out of or into, the graduated vessel serving as the clock In both these forms of clock the principle was essentially the same" (Breasted). According to Hoyle[3] *"The Egyptians used both outflow and inflow models, the latter being vessels into which water dripped at a steady pace, the rise in water-level marking the passing of the hours"*

The Clepsydra was one of the most important of primitive clocks. *"In the simplest terms this device consisted of a water vessel, with a hole in or near the bottom for the escape of the water and a graduated scale of hours engraved on the inside from the top to a point near the bottom"* (Breasted).

Fig.1 The ancient clepsydra of Athens preserved in the Museum of Ancient Roman Agora (Old Market)

Later, its function was based on the continuous flow of water between two vessels (outflow and inflow clocks). So, outflow and inflow clepsydrae were made from two similar and graduated vessels, placed on different levels. From the upper vessel, which carried graduation marks on its interior, water would flow (after reaching a specific level) through an opening hole at its base, to the lower vessel.

"It is not known when the clepsydra first came into use in Greece. In a simple form it was known to Aristophanes (450/444-385 BC) and to Aristotle (384-322BC). Plato (428-347 BC) wished to know the time at night and he devised an elaborate clepsydra"[4]

2. THE WATER CLOCK OF ATHENS

Among the archaeological findings from the Ancient Agora (Forum) of Athens was a unique water clock dated from 400 BC which is displayed at the Museum of the Ancient Roman Agora in Athens (Photo 1). This water clock is kept in a glass case, with the note:

No.27, " Vessels from the law courts, 5th-4th century BC"

Inside the case, on the information plate is written:

"Clepsydra: Used for the timekeeping of the addressing in the law courts. At the beginning of the speech the lid from the separating opening would be removed and the duration of the address was equal to the duration of the water flow: 6 minutes. The water clock carries the inscription ANTIOXIDOS (one of the Athenian tribes). XX=2 XOES (equal to 6.4 liters). It was found in a well, at the south west side of the Ancient Agora place".

The same information plate shows a sketch of the clepsydra, with two pictures of the same water clock, with the one filled of water on a higher level, supplying the one on the lower level, and thus counting time. In the law courts the clepsydra was used to regulate trials (Photo 2).

Fig.2 The 'outflow' and 'inflow' water clocks

"In Athenian law courts, it became the custom to have a clepsydra to ensure that most speeches were limited to half an hour" (Whitrow). Generally, the water clock was used to determine the duration of the trial; the amount of water used depended on the importance of the trial. The person in charge of the water clock was selected by drawing a lot and was called *'in charge of the water' or 'the keeper of the equality of the clepsydra'*. The clepsydra attendant placed the water clock on a tripod, in order to make the water flow visible to everybody in the law court. Occasionally, he was also responsible for opening or closing the communication hole.

The size and the amount of the water clocks in use during the trial varied, depending on the kind of the trial and on the legally specified duration of each address. In the Athenian law court of 'Heliaia'[5] there were a number of water clocks, varying in size and in capacity, from one up to twelve *XOES* (the biggest was that of the size of an amphora). A specific number of similar water clocks was each time in use, depending on the importance of the case. The used time unit was the so-called *'diametrimeni hemera'* (counted day) equal to the duration of the shortest day of the Attic month Poseideon (beginning from the second half of December until the first half of January), which was 9,5 hours long. This time was divided into three parts: the *proto hydor* (first water), the *deutero hydor* (second water) and the *trito hydor* (third water). The first part (*proto hydor*) determined the duration of the address of the accuser (*diokon*), the second part (*deutero hydor*) was for the defence and the closing address of the accused (*feugon*) and the third and last part (*trito hydor*) for the verdict of the judges. Depending on the importance of the case, the prosecutor or the defender had the legal right to speak for *'so many amphorae'*.

The orator Aeshenes (389-314 BC) for example, called *'for eleven such amphorae on the counted day shall I be judged"*, meaning that he should have the right to defend himself on that specific day for time equal to the flow of water from eleven successive amphorae. A similar water clock was also used in political assemblies, as one can read from an ancient inscription: *"the ecclesia would go on during the day as long a clay graduated vessel (full of water) having an opening that varied, and which was seven feet above the ground, let water to flow, beginning at sunrise"* (3rd century BC).

In Athens the original clepsydrae of the law courts were kept in the circular building, the *Tholos*, at the south west side of the Ancient Market (Agora) of Athens (Photo 3).

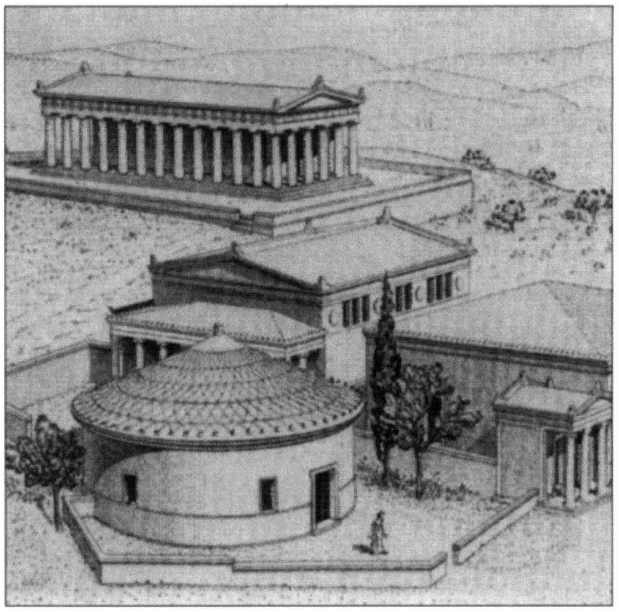


Fig.3 The Ancient Tholos at the SW side of Ancient Agora, the Parliament and Temple of Vulcanus (modern representation)

The duration of a speech in a law court was specific. The amount of the water allotted to a case was measured according to its importance. Usually, both the prosecutor and the defender were given the same amount of time. If, during the trial, witnesses should be called or documents produced, the judge would call to the person in charge of the water clock *'epishes to hydor'* (hold the water), and he would close the opening of the vessel by putting the lid back to place. From the work of the orator Demosthenes (384-322 B.C.) it is known that in the Athenian law courts the water pouring from the water clock, used to measure the duration of the orator's address, was simply called *hydor* (water). The phrase *'en to emo hydati'* (to my water) meant *'during my addressing'*, which naturally was determined from the flow of the clepsydra's water; and the phrase *'ean to hydor ekhori'* (if the water is sufficient) meant *'if the time is sufficient'*.

The Romans learned the use of sundials and water clocks from the Greeks. Scipio Nasica set up a public clepsydra in Rome in 158 BC From Julius Caesar[6] we learn that clepsydrae were used in military camps to set the night watches. The architect Vitruvius (30 BC) described a number of water clocks of different types.

"The introduction of water clocks into Roman law courts following the practice in Greece led some unscrupulous lawyers bribing the clepsydra attendant to regulate the water supply in their favor" (Whitrow)

Like the Greeks, the Romans used the water clocks in the law courts, where *"the phrase 'aquam dare' meant to allot*

time to an advocate, whereas the phrase 'aquam perdere' meant to waste time" (Wilson)

The defenders had the right to address the judges for six minutes, as long as the water flowed. Nevertheless, on many occasions this time was not enough. Therefore the defenders frequently bribed the usher to fill the vessel of the clepsydra with waste waters or litter, which blocked the opening of the water clock. In this way, the defenders were able to gain more time to convince the law court of the innocence of their client.

The normal use of the clepsydra had two main difficulties. First of all, the constant rate of flow of the water should be assured, despite the variation of the water level inside the vessel. For that reason, the vessel was usually wider on the top. Nevertheless, the ancient people were unable to limit this error. The second problem was the division of the 'political day' into 24 hours, unequal between them, with 12 hours for the day and 12 for the night from sunrise to sunset. The hours of the day and the hours of the night obviously could not be equal (seasonal hours) except at the equinoxes, and their difference depended on the time of year. Therefore, the scales of the hours should also have varied.

"These seasonal hours varied in duration according to the time of year. The inconvenience of this practice, although not so great in countries like Egypt as in more northerly places, introduced an unnecessary complication into the development of the water clock and was quite impractical in scientific astronomy" (Whitrow)

Antiquity's astronomers and clockmakers tried to overcome this difficulty in the following way: the hour scale was placed inside the vessel, which had a cylindrical shape. Items floating on the water could indicate the level of the water, referring to the scale, in respect to the hours. This was a major step from water clocks to hydraulic mechanical clocks.

3. THE FOUNTAIN 'CLEPSYDRA OF ATHENS'

We should notice that 'Clepsydra of Athens' was also the name given to the fountain at the foot of the Athens Acropolis rock, at its north west side. This fountain supplied the famous hydraulic chronometer (large clepsydra) in the *Tower of the Winds* (50 BC), of Andronicos Kyrrhestes, also known as Aerides (Winds). This excellent building, located on the Ancient Roman Forum of Athens, is still among the famous sights of Athens.[7]

Many authors report that the archaic name of the spring was *Empedo*, probably deriving from the ancient Greek verb *'empedo'* meaning 'to bind' (possibly to bind the water), or from the adverb *'empedon'* which means 'continuously, without stop' (possibly referring to the water flow). Later on, the fountain was called 'Clepsydra', because of the fact that sometimes it overflowed and sometimes it ceased, due to the underground flow of the waters towards Phaleron. The Alexandrian lexicographer Hesihios (5th century AD) calls the spring *"the one who steals, for its water flows towards subterranean places"*. The historian Istros from Kyrrenaia (3rd century BC) in his work *'On Egyptian Colonies'* says that like the Nile of Egypt, so the waters of the spring of Athens rose and the spring itself overflowed when the annual winds blew; and the waters fell and the spring was empty when the winds ceased.

Pausanias[8] (2nd century AD) in his Attica says:

"On descending, not to the lower city, but to just beneath the Gateway (Propylaia), you see a fountain and near it a sanctuary of Apollo in a cave"

Indeed, the spring is at the north west side of the Athens Acropolis rock, behind the monument of Agrippa, deep into the rock, down a narrow staircase of 69 steps. These stairs lead nowadays to a small Christian *Church of the Apostles*, in which there is a marble well, 10 meters deep. At the bottom of this well one can see, even now, the waters of the ancient spring. These waters indeed are lowered during the summer months, but the fountain is never dry.

4. CONCLUSION

The clepsydra led to a new perspective about Time. With the filling or emptying of its vessels, it gave a specific and clear indication about the flow of time. In contrast, sundials were indicators of specific hours that certain things should be done. From this point of view, the invention of the water clock is the beginning of the history of measuring time, using mechanical means. The clepsydra was widely used and thus spread the idea that time is a flowing reality that could be measured independently of celestial motion.

The clepsydra was a simple-to-use instrument easily replaced if broken, and which counted time under any climatological circumstances, day and night. Its only disadvantage was that it was difficult to set up its function accurately.

However, the clepsydra like the sundial used the old system of hours, which vary according to the time of year. Both these instruments reflect the ancient belief that 12 hours, of

variable duration, pass from sunrise to sunset, in any time of year.

Professor Enrico Menti in his book '*The Moon is watching us*' delightfully compares the moon with a huge bright clepsydra. He writes:

"...the lunar disk slowly and progressively lessens, until it completely disappears, and then, with precisely the same accuracy slowly and steady it fills up again, revealing to us its whole bright disk, the whole moon, in a continuous, never-ending procedure.

The variation of its face, always steady, in this rhythmic repetition, gives the pulse of time in the pace of history. She gives Earth the regular signal of time, which passes and returns".

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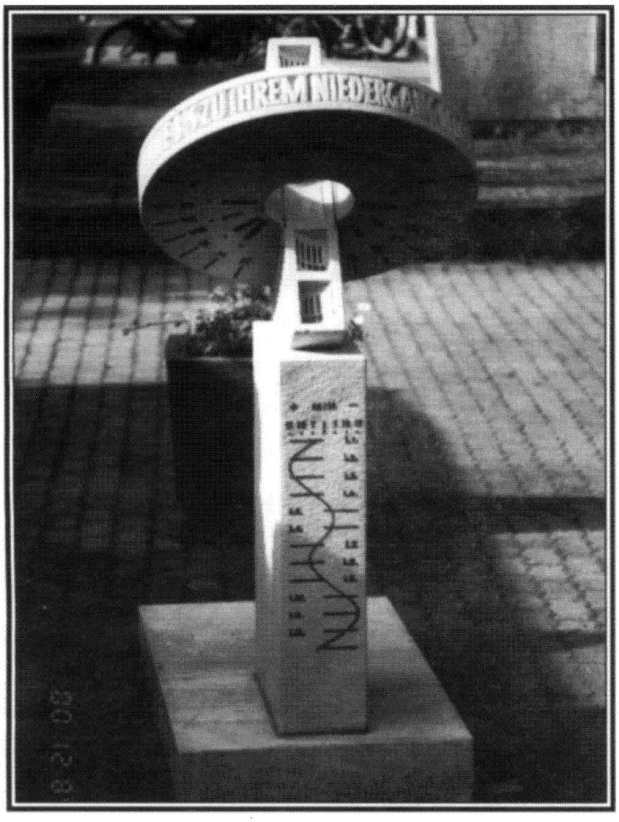

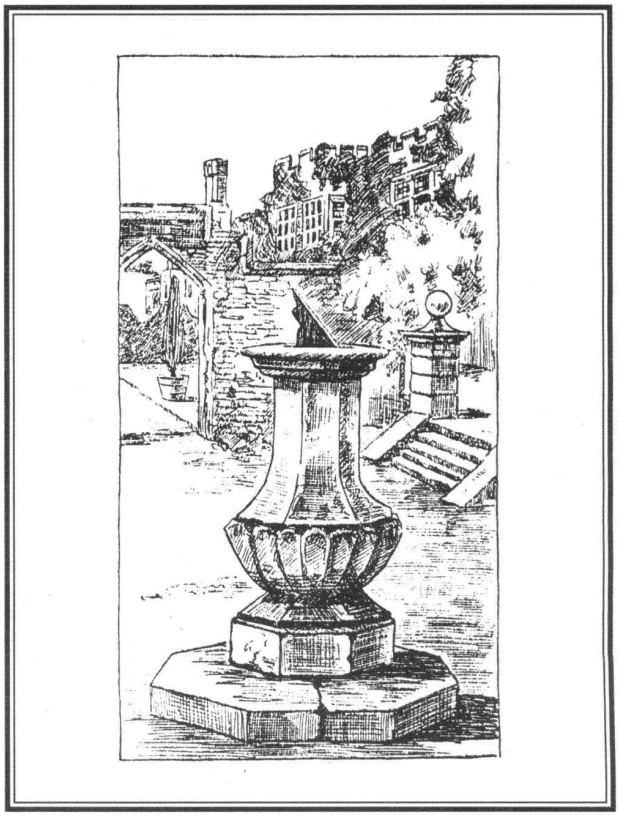

SUNDIAL SEES THE LIGHT OF DAY

CATE PAWLUK

In August 2001, while Mark Harris from Lanner was hedging at Glebe Barns, next to the church at Crowan, Cornwall, he unearthed a piece of slate. The piece was about nine inches in diameter, and on it there were clearly visible twenty- four marked divisions, with lettering around the circumference. Unfortunately, most of the top portion of the dial was missing. We brought the slate home, and left it on the shelves in the garage for several weeks, until the next time we were going to Truro. We thought that we would take it to the Royal Cornwall Museum, on the off chance that they could throw some light on our find.

A few days later we received a phone call. Apparently the Crowan dial was creating huge interest, and considerable excitement amongst historians in Cornwall. The thinking was, that it was probably a sixteenth century sundial. The lettering around the edging was in fact lower case Roman numerals in a rather fine flowing style known as secretary hand. Unusually, the numerals run anti-clockwise from four to fifteen. A twenty-four hour sundial!

As nothing quite like this had been seen in Cornwall before, we were advised to contact the British Museum. When we were in London in March 2002, we had an appointment to meet with an expert on scientific instruments. It seemed slightly bizarre to be carrying a sundial made nearly five hundred years ago on a London tube!

We were taken into the bowels of the British Museum, where the scientific principles of different types of sundials were explained by a very helpful curator, but she too hadn't seen anything similar. She suggested that we make contact with the British Sundial Society who are very active, and hold a register of all known sundials in the U.K.

So back we came to Cornwall, and made contact with the Society, who suggested we contact Len Burge in Truro, who was in the process of publishing a book on Cornish sundials. At last we were finally getting somewhere. Mr. Burge is of the opinion that it is what is known in the trade as an equatorial dial, as all the divisions are an equal fifteen degrees. It seems that it would have been one of a pair of dials, one for summer months, and the one we have for winter. The dial would have been tilted at an angle downwards to catch the winter sun, and hence the numerals are running anti-clockwise. There is also a cross marking the division at noon.

The dial may have been positioned in the churchyard, or it might have been for use at the vicarage at Glebe House. Parish priests in the sixteenth century were often men of science from Oxford or Cambridge Universities, who had an interest in the most modern means of time keeping. The next bit of research is to see if any of the incumbents at Crowan had such a background.

It just goes to show, that a piece of muddy slate which could so easily have been discarded as a useless bit of stone for hedging has turned out to be a very exciting historical find. It could well be the oldest sundial still in existence in Cornwall, and one can only wonder who would have used it to keep time in a small agricultural hamlet where the church and times of worship and the changing seasons would have been so important.

The Crowan dial was exhibited as part of the Treasures of the See exhibition at Truro Cathedral. No, we are not digging up the whole area looking for the other part of the dial!

Cate Pawluk
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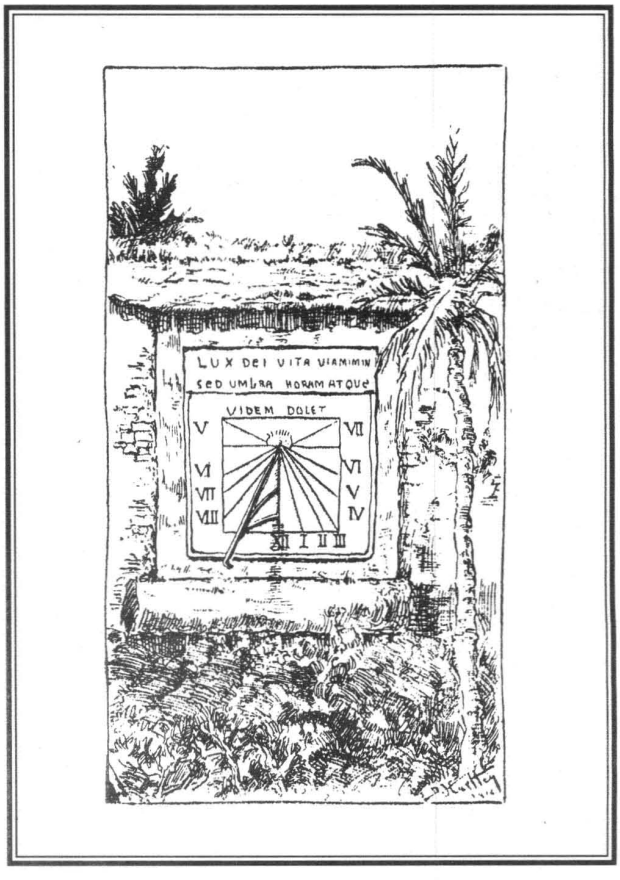

THE CROWAN DIAL: FIRST IMPRESSIONS

LEN BURGE

[The dial came to light after Cornish Church Sundials had gone to press, but a provisional assessment has been made of it in the light of that county-wide survey. The thanks of the author are due to Mr. & Mrs. Pawluk for bringing the discovery to his notice.

L.R.B.]

WHAT TYPE OF DIAL IS IT?

The Crowan dial is an exciting discovery The hour-marks around the dial are equally spaced, making the dial a rare specimen of an Equatorial design. The usual church dials are 'vertical' or 'horizontal' either hanging upright on their walls or standing level on their churchyard plinths. These others cannot like Crowan's have equal divisions for their hours.

Crowan, as you know, is not on the Equator. The name 'equatorial' refers to the attitude in which such a slate is set up, the slate being tilted to make it lie parallel to the earth's equator. The same tilting will make the rod which throws the shadow lie parallel with the earth's axis. The rod, the 'gnomon', will then make an angle with the ground equal to Crowan's latitude, 50 degrees, whilst the slate, at right angles to the rod, will be sloping at an angle of 40° to the horizontal. The high end of the tilted slate will be towards due south.

The summer sun will tell the time on the upper surface of the dial plate until September, after which the sun will be casting a shadow on the underside for six months, returning to the top in late March. Now the hours marked on the top of the disc are the same as the ones marked on the lower side, in one sense, referring to the same times of day. But they are opposite in direction to the viewer; to someone reading the upper scale the hours will be running clockwise, whilst to a reader of the lower scale they will run anticlockwise.

So Crowan's dial, seeing that it is not double-sided, has to be either for summer or winter use; one of the two. Which? Clearly, for Winter use, running as it does anticlockwise. Perhaps it was one of a pair of dials, providing between them a round-the-year service? The message for Crowan has to be

(a) Well Done, and

(b) Keep Digging.

Even at the height of summer there will be a few hours either side of midnight which will not need labelling; the sun will have set before it reaches them. The night-time end of the Crowan slate has unfortunately been lost, so we do not know exactly how far the maker took his early and late numbering, but at the morning end the hours certainly go

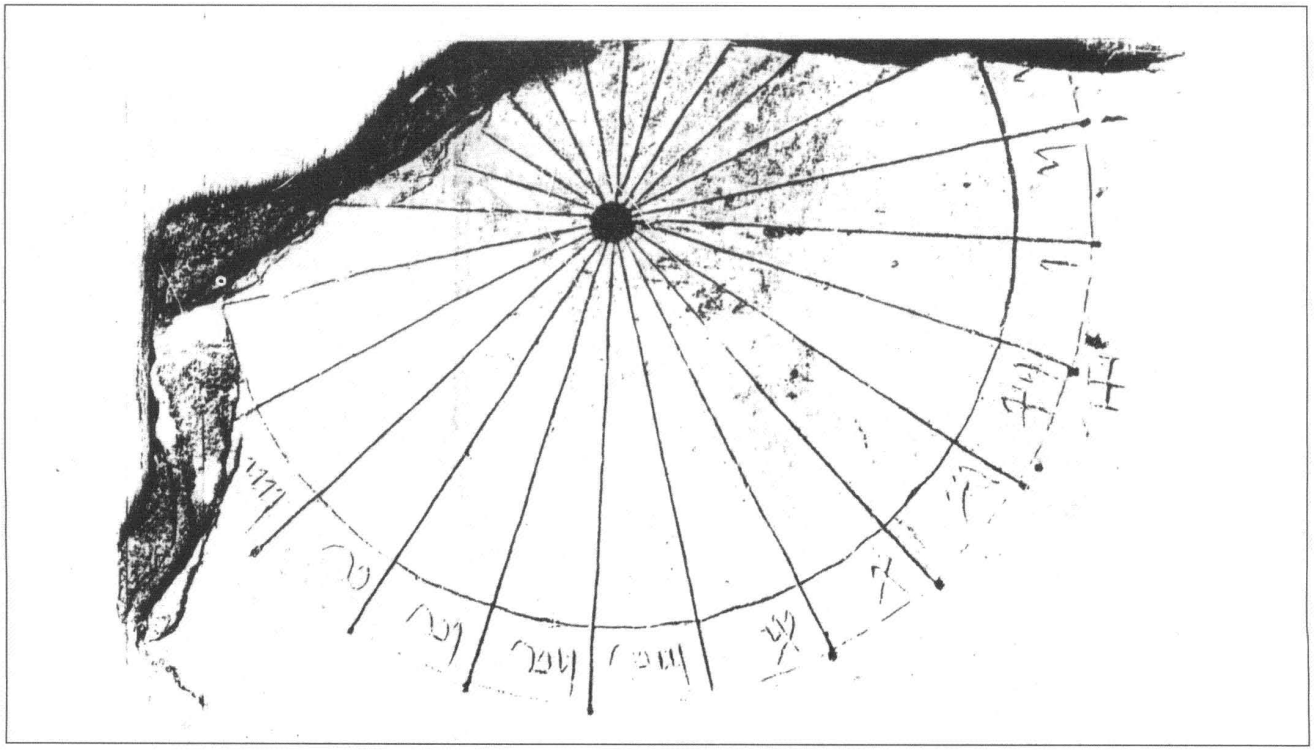

Fig. 1 Crowan dial, showing dots for guidance, on outer circumference

back as far as four. This leaves us with a problem: if this dial only works in the 'winter' half-year it can not have actually needed a '4 a.m.', nor indeed anything before six a.m. - nor after six at night. The contradiction needs thinking-about. However, some other types of church dial are known to be over-hopeful, too; see Cornish Church Sundials for a look at the limitations of vertical dials.

THE LAYOUT OF THE DIAL

The dial is set out on a piece of common slate. The better side has been used though the surface is not particularly good for carving. The general thickness is around half an inch.

Dials are often made to a round size - one foot, twenty inches, half a yard, etc - but the two circles on the slate do not seem to have been made to any such formal measure, their radii being about three and seven-sixteenths inches, and four and three thirty-seconds inches, respectively. The overall dimensions of this dial, and those indeed of most dials, are of little importance compared with the necessary pattern of hour-lines radiating from the middle. Given this central pattern, the size of the dial can be whatever the maker fancies (or can afford, or even can manage to lift).

The pattern of hour-lines and how these might have been obtained is better understood by close examination of a detail of a print of the slate itself (see Fig.1).

The maker seems to have made himself a ring of dots as a guide to drawing the hour-lines. They lie on a circle measuring 173.5 millimetres across, and 24 'steps' around such a circle would come out in theory at 27.4 mm each. The gaps between his dots are all within a millimetre of this; perhaps he used a pair of dividers to 'walk' around. This repetition would tend to accumulate an error, so I have put in (as he may have done) some large divisions at 60 degrees to keep the shorter divisions from wandering. These large divisions - worth four hours each - could be set out at the start by stepping around the circle with a pair of dividers set to the circle's radius, which will always fit a neat six times.

THE NUMERALS AND THE NOON CROSS

The setting-out diagram also shows the composition of the numerals. Vertical church dials, the common sort, often use Roman numerals done in capitals. Here we have the lower-case version, as was often used in writing of a few centuries back in, for example, churchwardens' accounts (this could be the oldest extant Cornish dial). The sample numbers below are Six, done as five-and-one (vi), and Nine, one-before-ten (iX). The upstrokes to the numerals and the joins between the parts are, as usual, a hindrance to reading them.

By now we should perhaps be looking at the slight possibility that this is not a sundial at all. The thought comes a bit late, but it is a little disturbing to see a dial apparently made only for winter use yet carrying Summer hours such as 4 a.m.

If it were not a sundial, what else could such a thing have been used for? Well, astronomy has for ages been

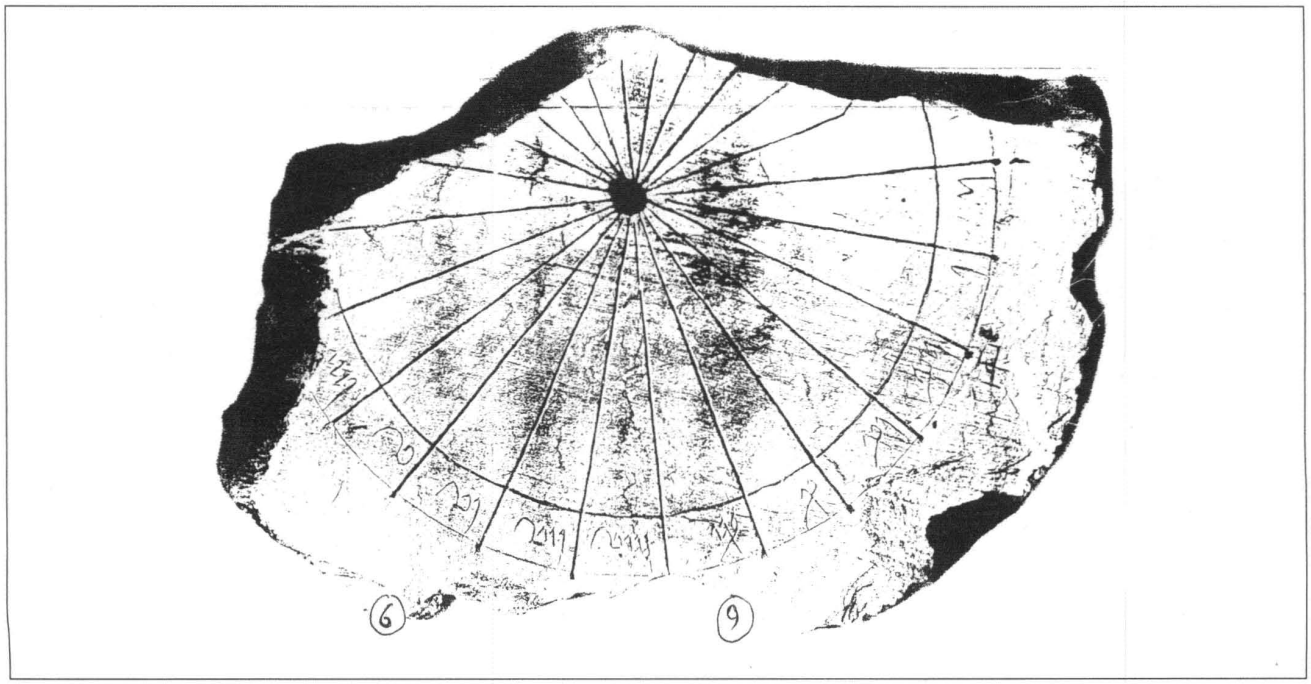

Fig. 2 Dial showing Roman numerals VI and IX in 'secretary hand'

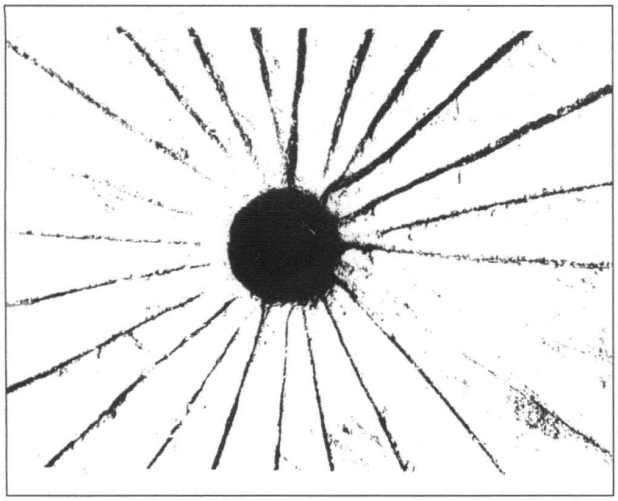

Fig. 3 The converging hour-lines near centre

describing star positions in twenty-fourths of a circle: 'hours of right ascension' astronomers call it, moving round the celestial equator clockwise. So our divided slate could have served for observing the positions of heavenly bodies, a second dimension being 'declination' measured up or down the sky from the celestial equator. For such use the slate would again have had to be used upside-down, perhaps with a pointer rotating round the centre rod. Parsons and others of the educated minority are known have had an interest in astronomy.

However, what makes it most likely to be a sundial after all is the presence of a cross, marked against the line of Noon. Here it is, as engraved on the end of the line for 12.

I should be glad to receive an account of the reason for - or the significance of- the practice of setting a cross in place of the numeral at noon. It is familiar on several of Cornwall's church dials, variously between six and ten, from firm cases to strong suspicions.

Before leaving the design of the Crowan dial, there is another feature worth a comment. The hour lines are running towards a centre, at the hole for the gnomon. Well before they are due to meet, the convergence is beginning to look ragged. The enlargement picks out this feature in an unkind light, but to make lines with only fifteen degrees of angle between them come together entirely neatly is impossible; try it with a pencil. (For converging radial lines, see L.Burge "Cornish Church Sundials" p.40)

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A 'TABLE TOP' ANALEMMATIC SUNDIAL

JOHN CARMICHAEL

(We have much pleasure in publishing this short contribution from a BSS member in Tucson, Arizona, USA. it describes a luxury item made of a rare stone, gold and gemstones. -Ed)

I think your readers will be interested in seeing my new sundial. It is rare in both size and material; and also in function, furniture; and Roger Bailey says it is the first analemmatic that has his now famous "seasonal date markers". These points show the time and direction of sunrise and sunset for any date...

After scouring the Analemmatic Sundial links in the BSS, NASS and Frans Maes websites, I was unable to find a single example of a 'table-top' type analemmatic sundial. Every single analemmatic that I can find on the internet is large 'people' size. I think smaller pedestal versions are great. Because they sit horizontally on pedestals they are a nice option to traditional horizontal dials. I think they have a commercial future. And actually they are slightly easier to make than horizontals because the gnomons are simpler.

I've redesigned the gnomon, and it is being gold-plated now.

I've used Fer de Vries' Delta Cad Analemmatic Macro for the date lines and hour points and Roger Bailey's Analemmatic spreadsheet for the east and west seasonal

Fig. 1 A view of the sundial, mid-October.

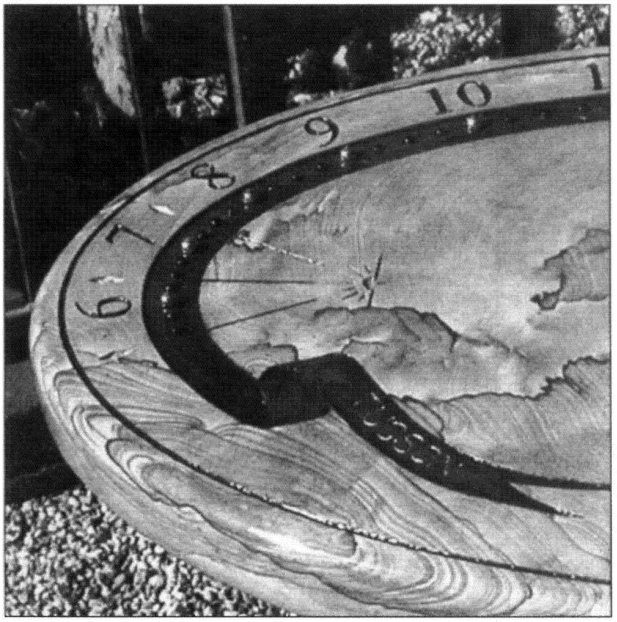


Fig. 1a Close-up of east part of sundial, to show sunrise marker.

marker locations and gnomon height calculations, and Delta Cad for general design work. The 2" thick stone is a very rare hard-to-get Picture Rock Sandstone... .The inlayed fittings are either 24 carrot [sic] gold plated brass and tiger eye stone spheres. The oval face measures 32 inches by 20 inches and weighs about 80 pounds. The gnomon is 14 inches tall. I have never seen a "table top" metal or stone analemmatic so I thought people might be interested.

The dial can also function as solar azimuth indicator if you place the gnomon over the center of the inlayed 16 point gold star at the bottom.

John L Carmichael Jr.
Tucson, Arizona, USA

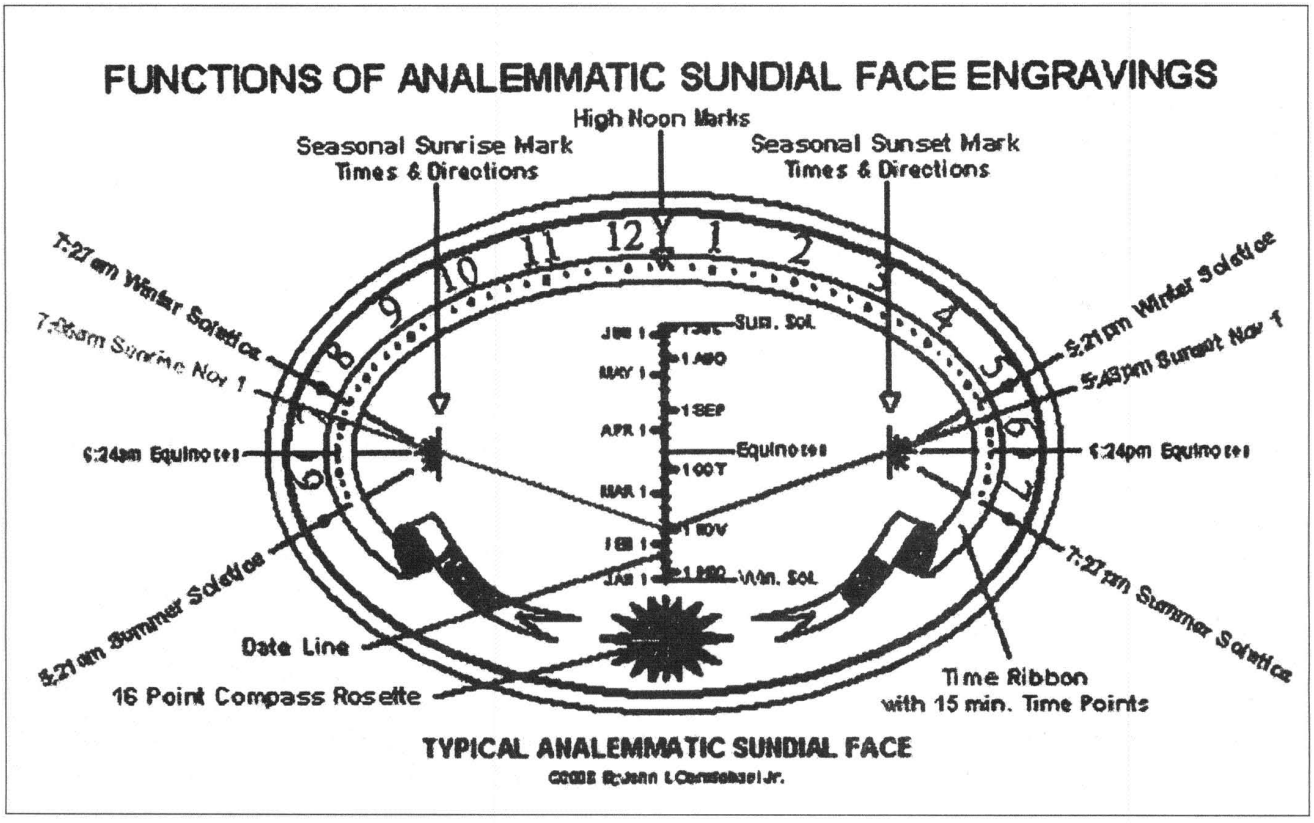
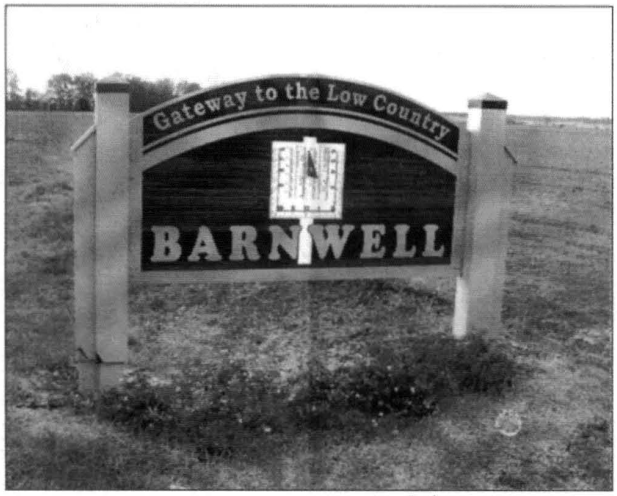


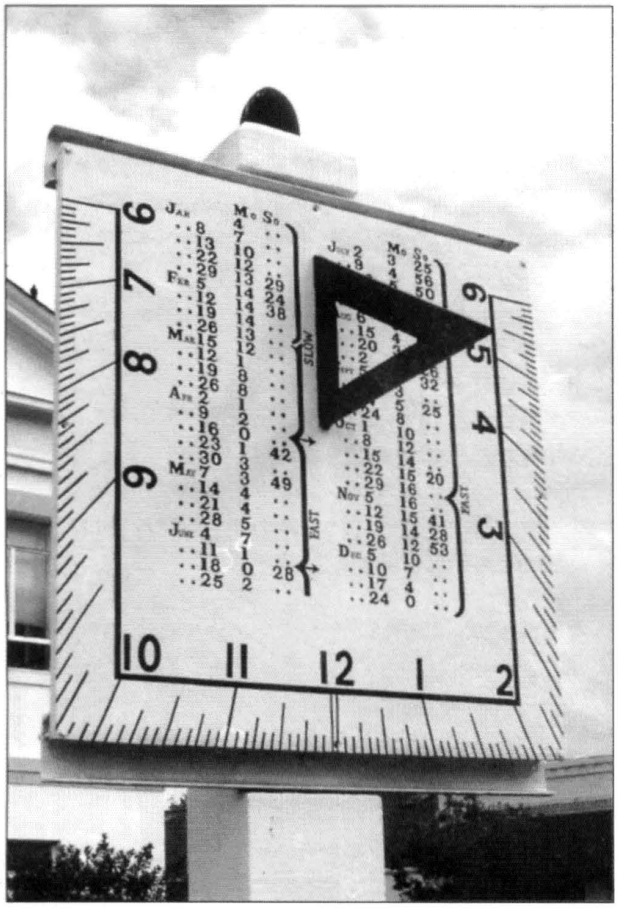
Fig. 2 Functions of analemmatic sundial face engravings

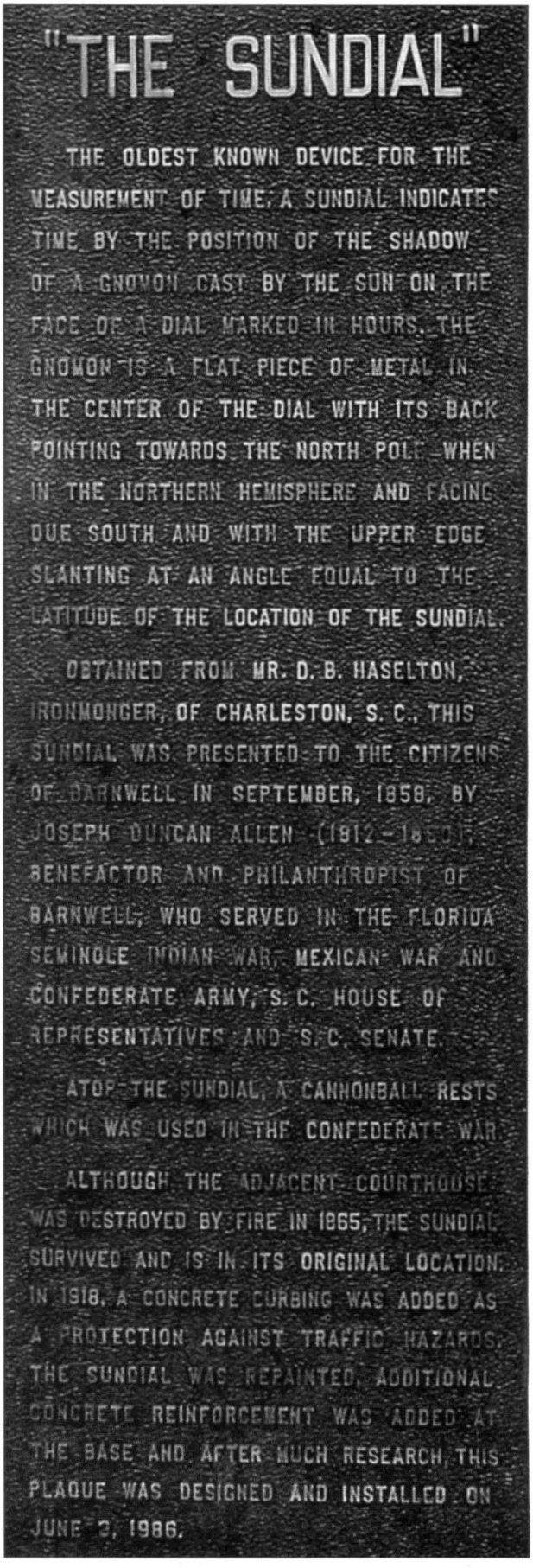
A SUNDIAL IN SOUTH CAROLINA, USA

The Cowhams have recently returned from travels in South Carolina, where they came across an interesting sundial in the small town of Barnwell.

Mike Cowham writes: "This town boasts a sundial that is claimed to be the oldest of its type in America. It is certainly an imposing dial with figures for the EoT painted on it. At present it stands on a pillar near the town centre. Also of interest are the town signs that have a model of this sundial on them."







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2. Format: The preferred format for text is typescript, single-spaced or double-spaced, A4 paper; or on disc, 'microsoft word' or 'ASCII', with one printout. Authors are asked not to submit any material by e-mail or e-mail attachments.

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4. Notes are best avoided: it should be possible in a short article to incorporate into the text all the background information which the reader needs, to understand the article. If notes are used, they may be referred to, in the text, as (Note 1), (Note 2) in brackets; then listed at the end of the article, after the 'Acknowledgements' and before the 'References'

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   A.A. Mills: 'Seasonal Hour Sundials' *Antiquarian Horol.* **19,** 142-170 (1990)
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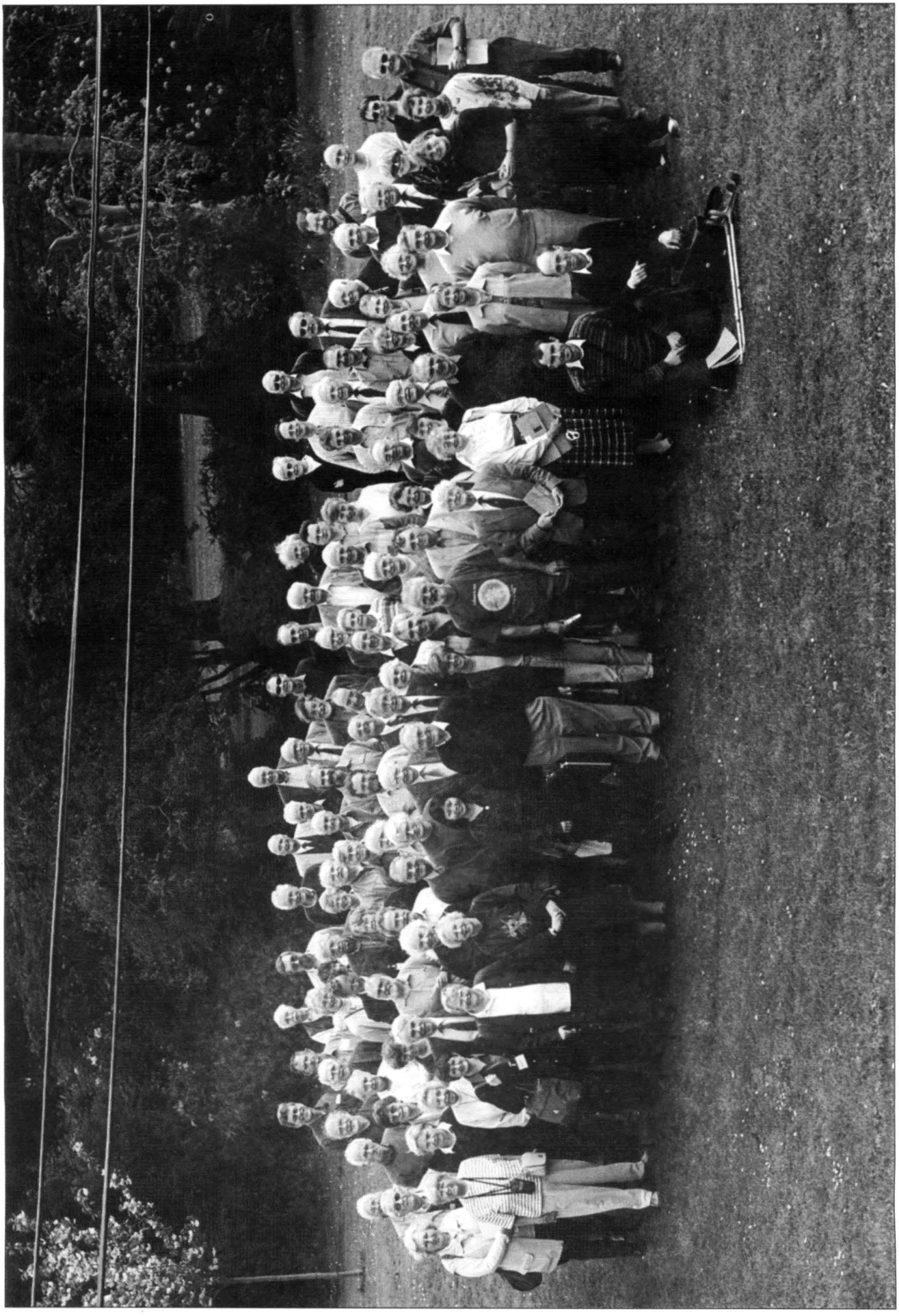

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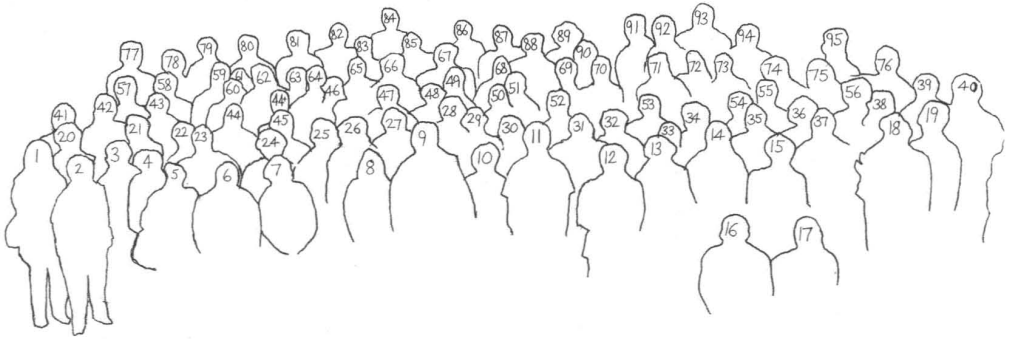

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