The British Sundial Society

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COVER ILLUSTRATION:

A corner of the Editor's garden last winter.

Overnight Jack Frost hath laid
Cold fingers on the pedestal of Time,
Silent in the dark, hoar frost has made
Evanescent stalactites of rime.

B U L L E T I N

OF THE BRITISH SUNDIAL SOCIETY

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EDITORIAL

Recently someone asked me if I had an extensive dialling library. Bearing in mind that many thousands of dialling books have been published in the last few hundred years, I knew that I did not. However I decided, for the first time, to catalogue the items I did have. For like most people, any catalogue exists in one's head, and as such, perfectly valueless to anyone else. Pressed further, I agreed to supply a list of what dialling books I did have.

The first few books were entered into the word processor before it was realised that it was not going to such a simple task as at first thought, the modest spread of dialling books quite suddenly and mysteriously grew much larger in extent. Then it was realised that there were dialling books in other parts of the house, and the initial quick assessment of about one hundred books was somewhat low. Not only that, but some books were not to be found. Like the good shepherd, whose missing sheep becomes of much greater worth than all the flock, the mislaid ones became of much greater priority (perhaps to escape the monotony of making entries), and this entailed many hours of searching to bring them to light again.

This made me realise that if the dialling books had been removed, although I cannot imagine anyone but a dialling enthusiast taking them, I would have been placed in a very difficult position if asked to give details of what had been lost. From a researcher's point of view, what is the use of such material unless it is listed in such a way as to be easily accessible?

Until the formation of the British Sundial Society and the launch of the Bulletin, there was no real platform for the publication of dialling material. Articles on dialling abound in the older literature, often in places where one would least expect to find them. Some years ago, when attempting to record some of this lost treasure, I compiled a list of dialling references which expanded to over three thousand entries before ennui set in. Like the compiling of sundial details, there seems to be no end in sight for a single individual working on his own, and like the British Sundial Register, such projects require a group of people to handle the vast amount of data available. In other words, many hands make light work.

This is the real value of the BSS, cooperation in the art of gnomonics to achieve that which no single worker, no matter how zealous, can realise.

Charles K. Aked
Honorary Editor

THE 1996 ANDREW SOMERVILLE MEMORIAL LECTURE
SAMUEL FOSTER OF GRESHAM COLLEGE

FREDERICK W. SAWYER III (USA)

EDITOR: Mr. Sawyer is the President of the North American Sundial Society. He delivered the Andrew Somerville Memorial Lecture at The BSS Conference at West Dean College on 5th May, 1996.

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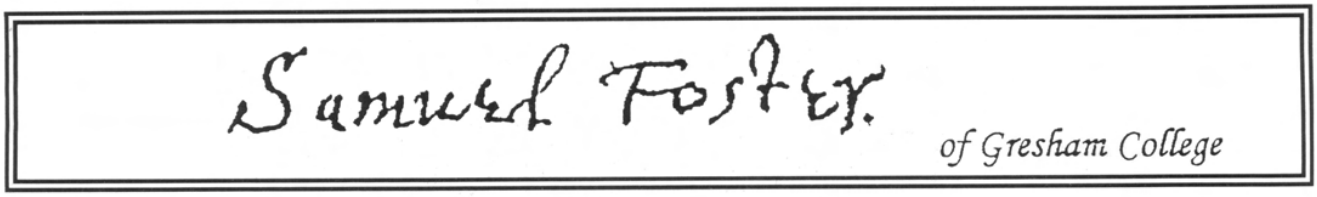


I must tell you that I am both pleased and honoured to be speaking to you in this context. Little more than five years ago I was labouring under the impression that there were probably fewer than a dozen true sundial enthusiasts in the world. I then came across a copy of Andrew Somerville's book on Scottish sundials[1] and was delighted to see a notice at the back of the book for something called the British Sundial Society.

Needless to say, I joined immediately and began writing articles. The obvious success of *this* society led me in 1994 to work with Ross McCluney and Bob Terwilliger to form the North American Sundial Society - which has now grown to 261+ members.

We produce a quarterly journal which intentionally has a flavour somewhat different from, but we hope complementary to, the British Bulletin, with which Charles Aked had done such a marvellous job.

Today I will try to follow the Bulletin's lead and provide something of a historical context for many of my earlier papers; I hope you will recognise some echoes of that earlier work in what I present today.

* * * * *

Samuel Foster was born at the beginning of the 17th century - probably in Coventry, England. In April 1616 he was admitted a *sizar* at Emmanuel College, Cambridge; this presumably means that he was granted a reduction in fees in exchange for performing various chores for the college.

He received his B.A. degree in 1619 and an M.A. four years later. After leaving Cambridge, he worked as an usher, or assistant teacher, at the King Henry VIII grammar school in Coventry.

His great opportunity came in 1636 when he was elected Professor of Astronomy at Gresham College in London. This college represents an interesting story itself.[2] Thomas Gresham was the founder of the Royal Exchange. When he died in 1579 he specified that, following his wife's death, all revenues from his land and buildings should go to the City of London and the Company of Mercers. In exchange, the City and Company were to fund the salaries of seven professors, who were to have free use of his mansion and gardens in Bishopsgate Street.

Lady Gresham died in 1596 and Gresham College lectures officially began in 1598. There was a professor for each of seven topics: law, physic, rhetoric, divinity, music, geometry, and astronomy. Each professor was responsible for delivering a weekly lecture - astronomy was assigned to Wednesday.[3] The lecture was read in Latin in the morning and a translated version was delivered in the afternoon. Attendance was open to the public.

A position as Professor at Gresham College was ideal for Foster. Unfortunately, his puritan religious views were not politically correct in 1636, and he was forced to relinquish his position only nine months after accepting it. He was replaced by Mungo Murray,[4] who had recently been a professor of philosophy at the University of St. Andrew in Scotland. Murray had just been made a presbyter in the Church of England - so he was evidently a more suitable professor of astronomy than Foster.

Samuel Foster returned to Coventry, where he tutored, observed and studied eclipses, and wrote *The Art of Dialling*,[5] the only one of his works (other than his master's thesis[6]) to be published in his lifetime. *The Art of Dialling* appeared in 1638, and its title page still credits Foster with being the Gresham professor of astronomy. Although the book is not very well known, there are at least two aspects of it which should draw our attention.

First, this is the earliest book to use what we today call dialling scales to lay out a sundial. For over two centuries following Foster, the latitude and hour scales he introduces in this book were recognized as providing the simplest means of laying out hour lines. Although Foster's scales were drawn on a quadrant, it became more popular to draw them side-by-side on a straight ruler as we see here,[7] [Figure 2] using a configuration similar to one proposed in 1657 by George Serle[8] and made by Anthony Thompson, who was also earlier an instrument maker for Foster.

Although Serle was probably the first to put the scales on a ruler, he himself clearly attributes them to Foster:

> *The first Scale of Hours and the Scale of Latitudes, I acknowledge to be the Invention of that famous Mathematician Mr. Samuel Foster, laid down in his book of the uses of a Quadrant published Anno 1638...*
>
> *Now having perused the labours of divers Authors that have written on this Subject and finding none (in my judgement) so easie, pleasant, and of so quick dispatch, ... I caused that Scale to be put on Ruler for my own use. - G.S.*

To see how the process works for a horizontal dial, suppose we begin with two perpendicular lines NO and OE, oriented to the north and to the east, respectively. [Figure 3] Two of the scales on the ruler are marked Lat and Hour. Lay the Lat scale along the line OE, with the origin at O,

THE ART OF DIALLING;

BY A NEW, EASIE, AND MOST SPEEDY WAY.

SHEWING,

HOW TO DESCRIBE THE Houre-lines upon all ſorts of Plaines, Howſoever, or in what Latitude ſoever Scituated:

As alſo,

To find the Suns Azimuth, whereby the ſight of any Plaine is examined.

Performed by a Quadrant, fitted with lines neceſſary to the purpoſe.

Invented and Publiſhed by SAMVEL FOSTER, Profeſſor of Aſtronomie in *Greſham* Colledge.

LONDON,
Printed by *John Dawſon* for *Francis Egleſfield*, and are to be ſold at the ſigne of the Marigold in Pauls Church-yard.
1638.

Figure 1

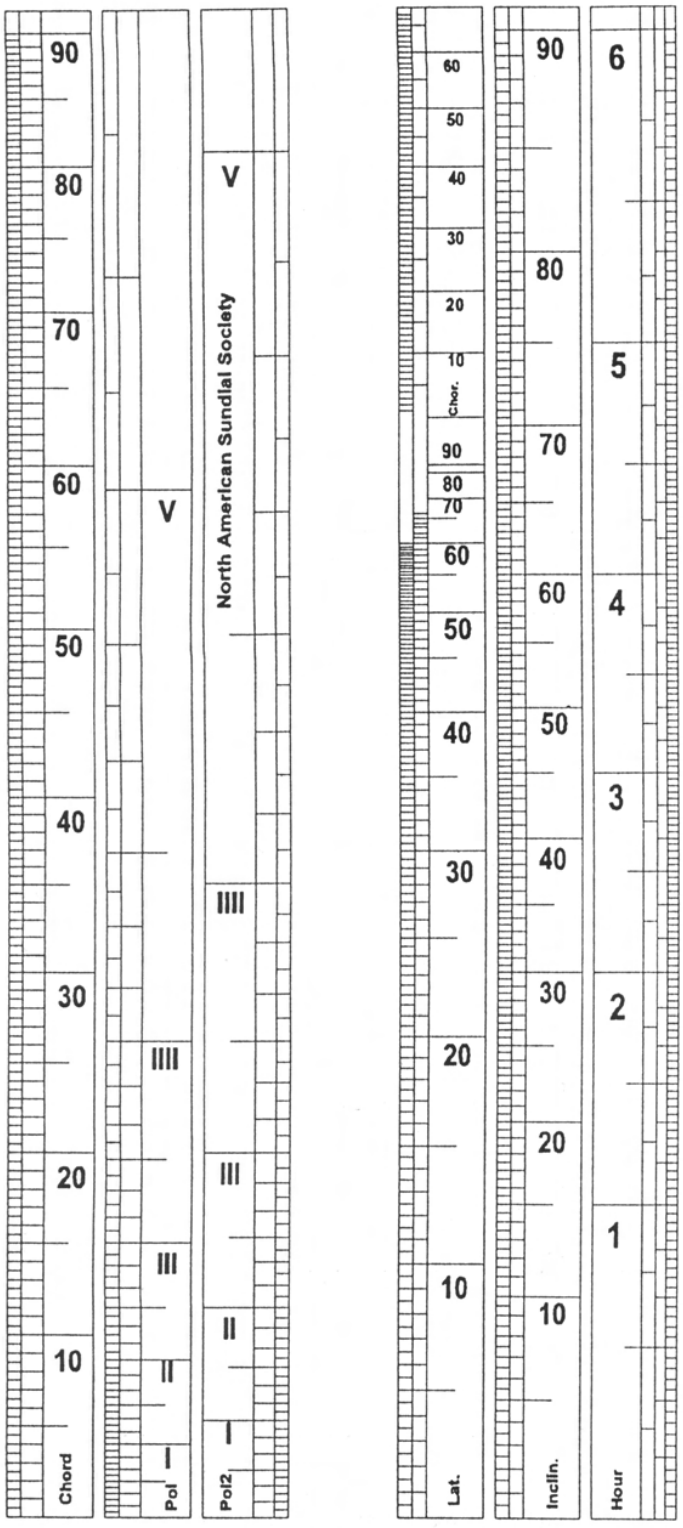


Figure 2

and mark the point L on OE corresponding to the intended latitude of the dial.

Now lay the Hour scale so that its 6 o'clock end point lies on the point L and the 0 o'clock end point M lies on the line NO. Mark the hour points B on the dial face as determined by this Hour scale. Draw the required lines by connecting each of these points to the origin.

This completes the afternoon portion of the dial. Repeat the process on the west side for the morning hours, and extend hour lines through the origin or repeat in the other quadrants to finish the dial.

The secret of the dialling scales is that it is possible to turn the standard sundial mathematics (the problem of constructing an angle Z such that tan Z = tan t sin φ) into the task of drawing a special right triangle which separates the latitude measure into the sides of the triangle and the hour measure into the hypotenuse. When the task no longer combines latitude and hours in one equation, we can design scales to measure out the right lengths - one for the latitude ($OL = \sin\varphi / \sqrt{1+\sin^2\varphi}$) and one for time ($MB = \sin t/(\cos t+\sin t)$). The following proof demonstrates that this procedure indeed does work:

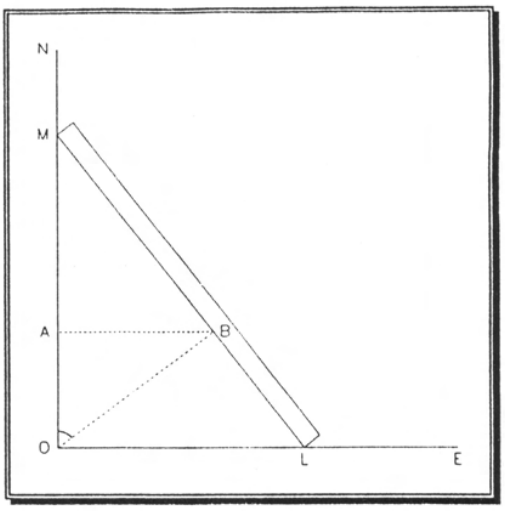


Figure 4

Given perpendicular lines *NO* and *OE*, aligned to the north and east respectively, [Figure 4] lay the *Lat* scale along *OE* and mark the point *L* corresponding to the dial's intended latitude; the length *OL* is $\sin\varphi / \sqrt{1+\sin^2\varphi}$.

Place the *Hour* scale so that its entire length lies between *L* and a point *M* on the north line; the length *LM* is therefore 1, and by the Pythagorean theorem,

the line *MO* is $1/\sqrt{1+\sin^2\varphi}$.

The point on the *Hour* scale *ML* corresponding to time *t* is *B*. By the design of the *Hour* scale, we know the length *MB* is $\sin t/(\cos t + \sin t)$; and the resulting complementary (i.e. 1-*MB*) length *BL* is $\cos t/(\cos t+\sin t)$. The hourline for time *t* is *OB*. To prove that this construction is valid, it suffices to establish that $\tan AOB = \tan t \sin\varphi$, thus satisfying the familiar formula for a horizontal dial.

Triangles *MOL* and *MAB* are similar, so *AB*/*MB* =*OL*/*ML*, and *AO*/*MO* = *BL*/*ML*. Given that *ML* = 1, we obtain the desired results as follows:

$AB = MB \times OL = \sin t \sin\varphi/(\cos t+\sin t)\sqrt{1+\sin^2\varphi}$

$AO = MO \times BL = \cos t/\cos t + \sin t)\sqrt{1+\sin^2\varphi}$

and $\tan AOB = AB / AO = \tan t \sin\varphi$.

Although Foster himself seems to have made no later use of these scales,[9] their general use became widespread. In James Ferguson's 1760 lectures we find the notes that the scales of latitudes and hours "*may be had on scales commonly sold by mathematical instrument makers,*" noting that *"This is the easiest of all mechanical methods, and by much the best"*.[10] And as late as 1852, Henry

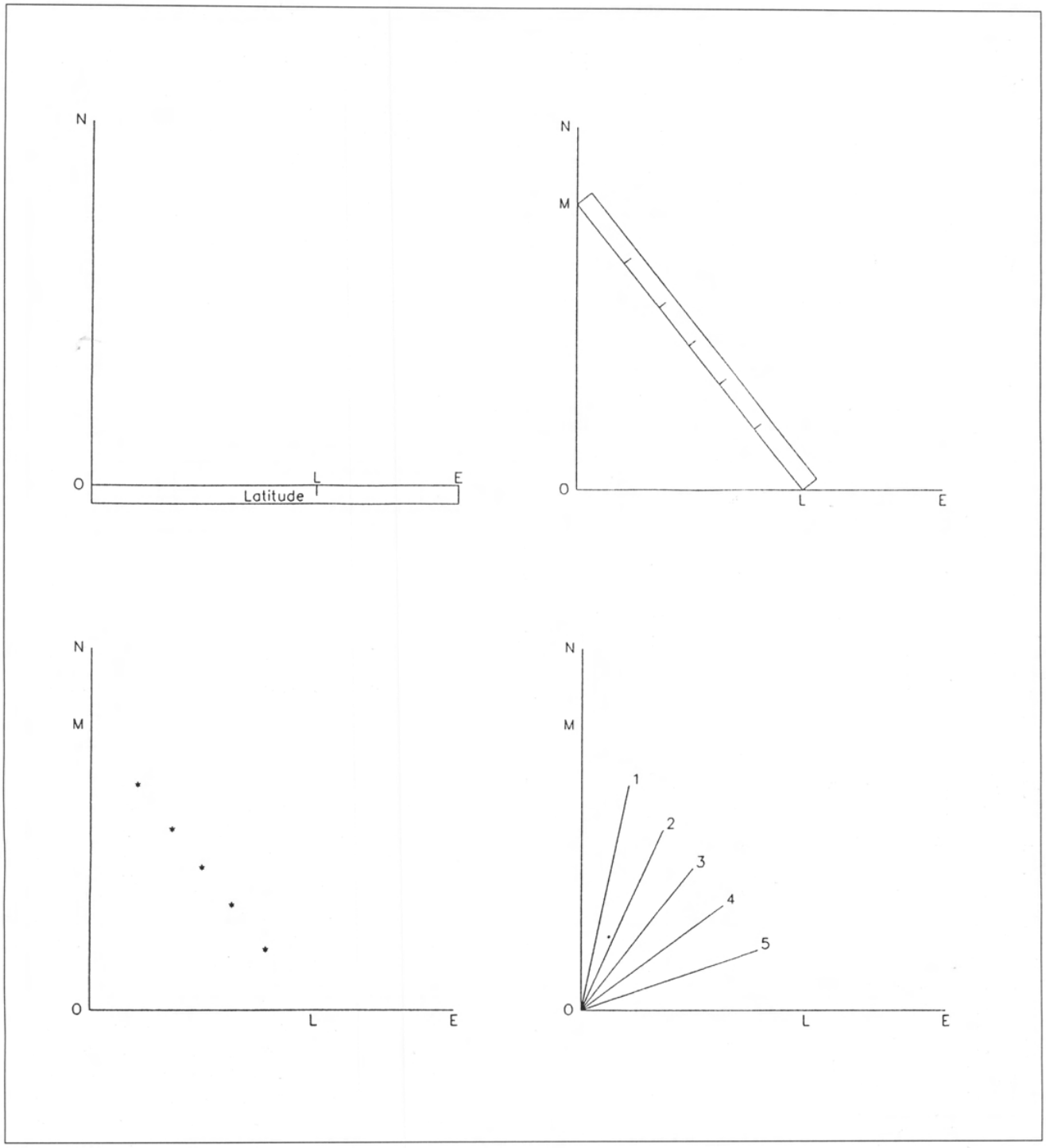


Figure 3

Meikle writes in his comprehensive survey of gnomonics for the *Encyclopædia Britannica (8th edition)* that *"we may lay down the hour lines by means of a dialling scale, the easiest method of any"*.

Samuel Sturmy describes the scales in 1669 and suggests that his longtime friend Philip Staynred, a surveyor in Bristol, is their inventor.[11] But he offers no evidence to support the claim, and Staynred himself seems only to have published a tract on the design of military fortifications. I would not be surprised to learn someday that Staynred attended public lectures at Gresham College.

Foster's claim to having invented the scales would have been stronger if he had given a mathematical development of the scale lines in his book. Although this is lacking, a Latin manuscript, titled *Demonstratio Quadrantis HOROMETRICI*, perhaps prepared for one of his lectures, was found in his papers after his death and was published in 1659 by Foster's friend John Twysden.[12] The Horometrici manuscript contains the missing mathematical treatment.

This accomplishment alone should put Foster among the first rank of 17th century diallists. But it is only the beginning of his innovations.

The second point to note in *The Art of Dialling* is Foster's introduction of what he calls the Prosthaphaeretical arc.

One of the more difficult problems in dialling is drawing hour lines on a plane that both inclines (above the horizon) and declines (away from South). Foster realized that solving this problem is equivalent to solving a general spherical triangle.

Suppose there is a triangle PZH drawn on the earth's

surface, [Figure 5] with P at the north pole and Z at our location; PZE is the local meridian. Let the length ZH, measured in degrees, equal the plane's inclination and angle EZH equal its declination. Then the third vertex H of the triangle is the point on the earth's surface where the plane would be horizontal.

A horizontal plane at H would be parallel to our original inclining/declining plane at Z.

Roughly speaking, drawing hour lines on our inclining declining plane can be reduced to the simpler task of drawing hour lines on a horizontal plane at this new location H.

Once you understand the mathematics, it is a fairly simple task with today's calculators to solve this spherical triangle - not so in the 17th century, which relied heavily on graphical procedures and strangely contorted formulas designed to work when your only calculating device was a table of log sines.

Foster handles the problem by breaking it into two manageable parts [Figure 6], dealing only with right triangles - which are easier to solve than the general case.

First, note that at any other point A on the globe, if a plane is given an inclination and declination that results in a triangle with the same third vertex H, then the original plane at Z is parallel to the new plane at A (since they are both parallel to a horizontal plane at H). The problem of

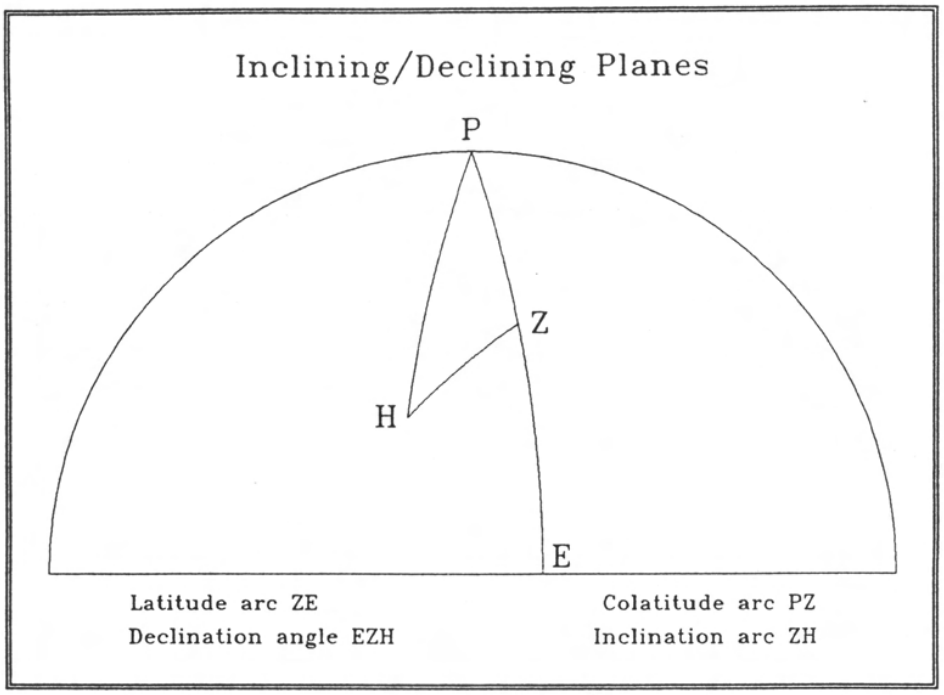


Fig. 5

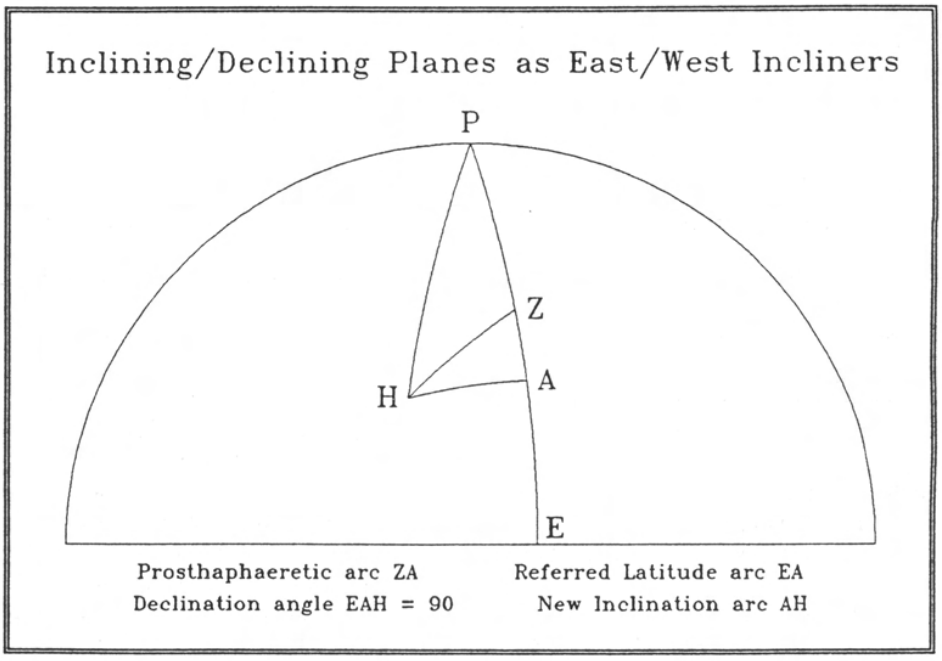


Fig. 6

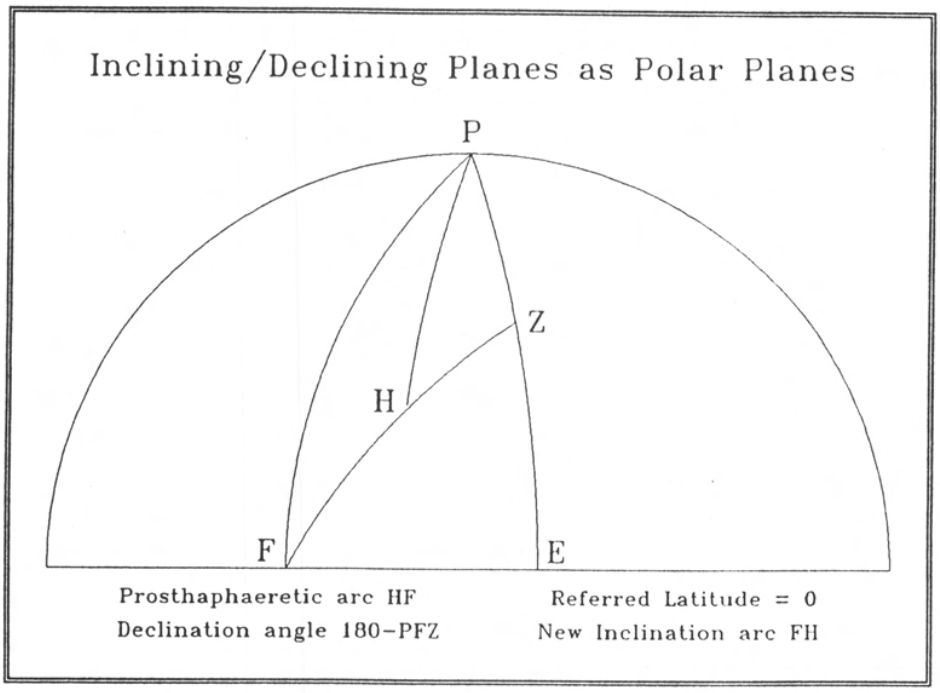


Fig. 7

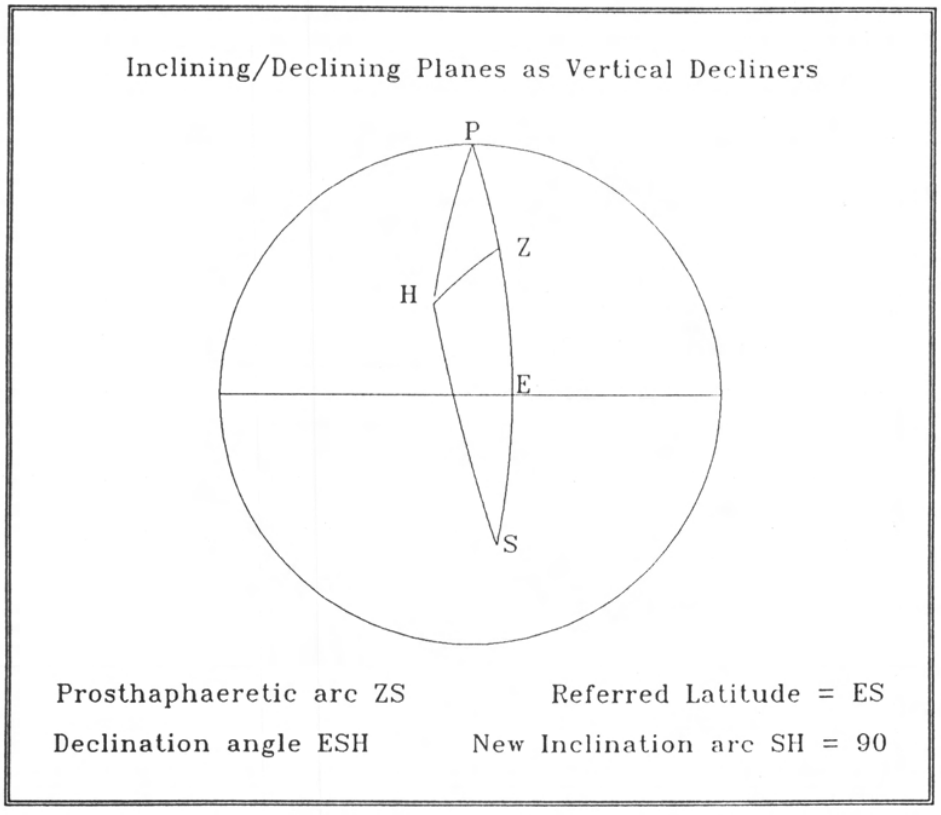


Fig. 8

drawing hour lines on the Z plane is similar to the same problem on the A plane.

Now Foster finds the prosthaphaeretical[13] arc ZA on the meridian to select a special, unique location A such that PAH and ZAH are both easily solvable right triangles with right angles at A.

The point A is at a new reference latitude where the parallel plane has a 90° declination and therefore faces directly either east or west.

Foster then concludes with a general way to draw hour lines on any east-west plane.

This is an interesting approach. It reduces the general case to the special case of a direct east-west plane, and then completely solves the special case. No approximations are used. In spherical trigonometric terms, he is solving the general triangle PZH by constructing two easily solvable right triangles (ZAH and PAH) around it. The general triangle is simply the difference between the two right triangles.

Foster continued to refine and modify this approach

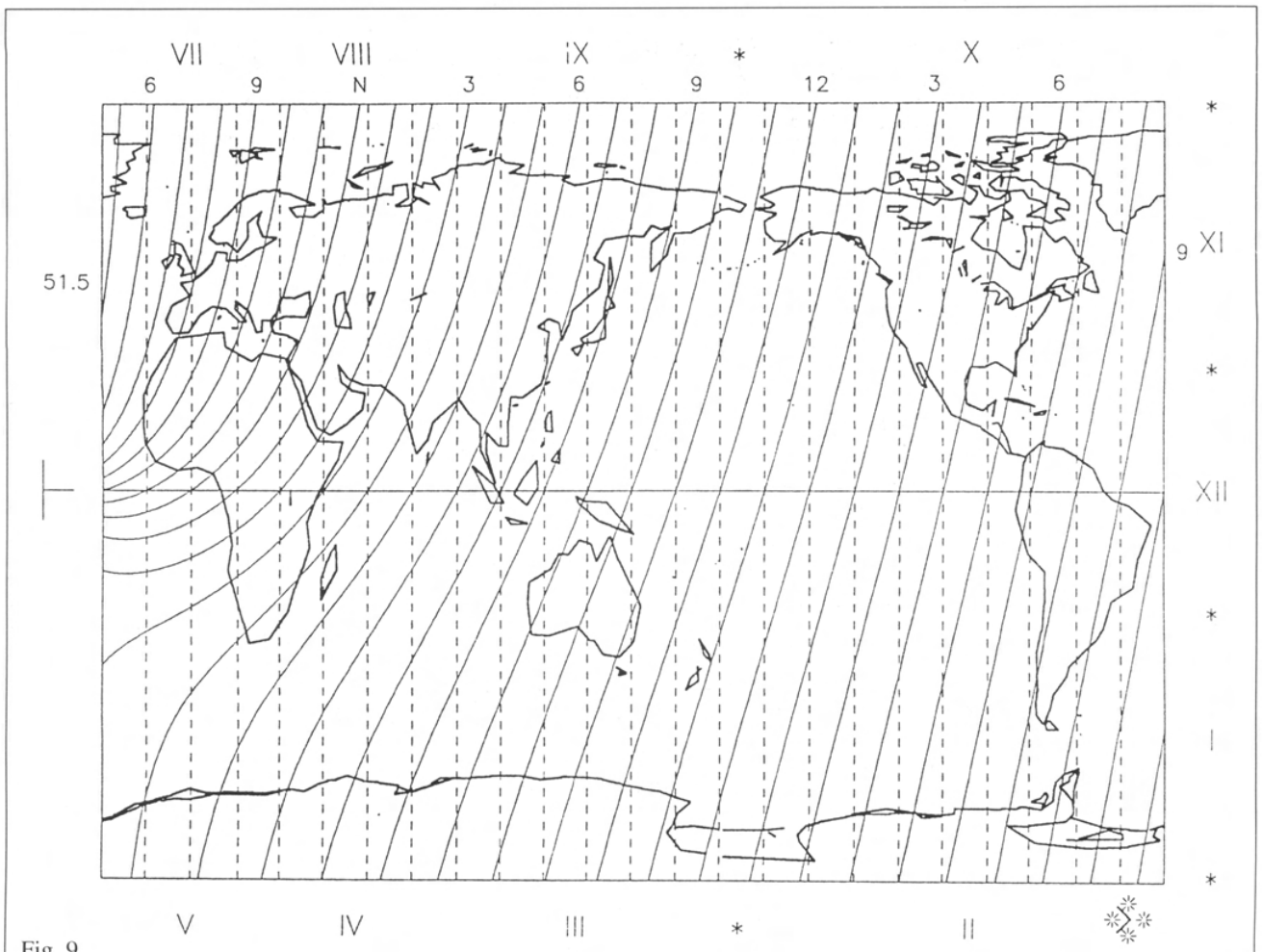


Fig. 9

over a period of years. In 1675, long after Foster's death, William Leybourn published a second edition of *The Art of Dialling*[14] using a manuscript he obtained from John Twysden, who had it from Walter Foster, Samuel's brother. In this second edition both the procedure and the actual layout of the quadrant are considerably simplified.

In 1640 Foster solved this same problem with a different prosthaphaeresis. Thomas Rice, who was one of Foster's students at this time and a Gunner at the Tower of London, later recalled from memory a graphical procedure Foster had taught him. The mathematician John Collins published an account of this procedure in 1659, showing that Foster was this time reducing the general case to a polar plane.[15]

Without reproducing the graphics here, let me describe the procedure in spherical trigonometric terms [Figure 7]. To obtain a solution, it is possible to surround the general triangle with two triangles sharing a common side that is 90° in length. We do this by extending the inclination arc ZH until it reaches the equator at F. The arc PF is 90° in length.

By using the prosthaphaeretical arc HF, Foster determines the inclination and declination that a plane situated at the equator has if it is parallel to our starting plane. He then solves the special case of drawing hour lines on any plane located at the equator.

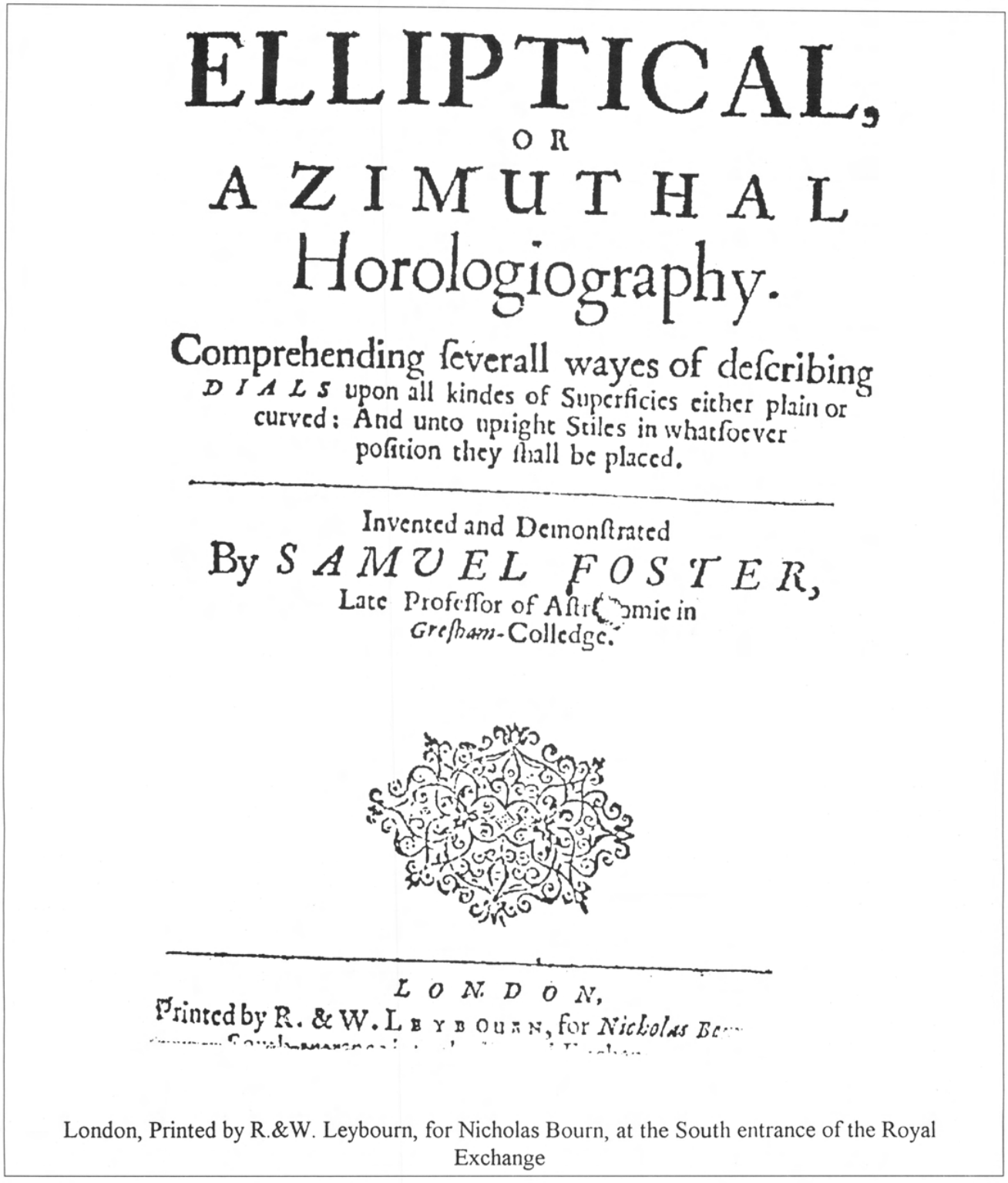
Finally, in a work with the partial title *Posthuma Fosteri,*[16] published by John Twysden in 1652, we find yet a third approach which John Collins acknowledges to be the best and easiest to calculate, and which William Leybourn adopts as a standard in much of his later work.

For this last procedure, Foster reduces all planes to vertical decliners [Figure 8]. Solving for the prosthaphaeretical arc tells you the latitude on your meridian where the given plane would be vertical (i.e. inclination arc HS = 90°). Once this location and the corresponding new declination are known, the general problem is reduced to drawing hour lines on a vertical dial. Using spherical trigonometry, once again note that Foster is solving the general triangle by solving two simpler quadrantal (i.e. having one side equal to 90°) triangles ZSH and PSH.

With these three procedures he has shown that the problem of rectifying a plane, given latitude, inclination and declination, can be reduced to a simpler problem in which one of these three quantities is fixed. In the first solution, he held the declination constant at 90°; in the second the latitude was a constant 0°; and finally in the last solution Foster held the inclination constant at 90°.

* * * * *

These are the significant aspects of the one book of his own that Foster saw through the press. He never published the significant additional work and innovations later found in his manuscripts. This lapse may be due not only to ill health but also to a renewed focus after 1641 on his teaching career.[17] In that year Bishop Laud, a notorious persecutor of puritans, was arrested, and being a puritan was no longer so politically incorrect. Also in that year, Mungo Murray fell in love and married. He therefore had to resign from his position at Gresham College, since the



ELLIPTICAL,
OR
AZIMUTHAL
Horologiography.

Comprehending ſeverall wayes of deſcribing DIALS upon all kindes of Superficies either plain or curved: And unto upright Stiles in whatſoever poſition they ſhall be placed.

Invented and Demonſtrated
By SAMUEL FOSTER,
Late Profeſſor of Aſtronomie in
Greſham-Colledge.

LONDON,
Printed by R. & W. LEYBOURN, for Nicholas Bo...

London, Printed by R.&W. Leybourn, for Nicholas Bourn, at the South entrance of the Royal Exchange

Figure 10

charter required that all professors remain unmarried.[18]

Samuel Foster returned to Gresham College and lectured there for the rest of his career. A (1739) drawing of the buildings of the college[19] identifies the astronomy professor's chambers on the northwest corner of the college, with a private entrance on what is now Old Broad Street. The apartments had south windows facing onto the main courtyard - perfect placement for a diallist such as Foster.

Biographer John Aubrey tells us that sunlight entering his window illuminated a dial of Foster's own design:

. . . in his lodgeing, on the wall, in his chamber is of his own hand draweing, the best diall I doe verily beleeve in the whole world. Inter & c. it shews you what a clock 'tis at Jerusalem, Gran-Cairo, &c. It is drawen very artificially. . . [20]

Foster's method for accomplishing this feat is not contained in any of his published work. But from the description, we can surmise that the design may have been similar to the geographic sundial design presented here ([Figure 9] in *horizontal* form for the latitude of London, so that it may more likely be useful to BSS members who

would like to experiment). This dial is based on a design published in 1673 by Jacques Ozanam in Paris.[21]

The Roman numerals around the perimeter of the dial function as a normal horizontal sundial with gnomon rising above the equator of the map. The map is turned 90° so that the equator actually lies on a north-south line. To read the time at another location on the earth, note where the gnomon's shadow intersects this location's longitude line. This intersection falls among the curved hour lines and indicates the time.

On Wednesdays, following the afternoon lecture, Foster's version of this dial no doubt formed a backdrop for what became a regular meeting of Foster's friends and acquaintances. Even Royalists were welcome in his chambers.[22] We know that the renowned mathematician John Wallis joined this group in 1645. They met for

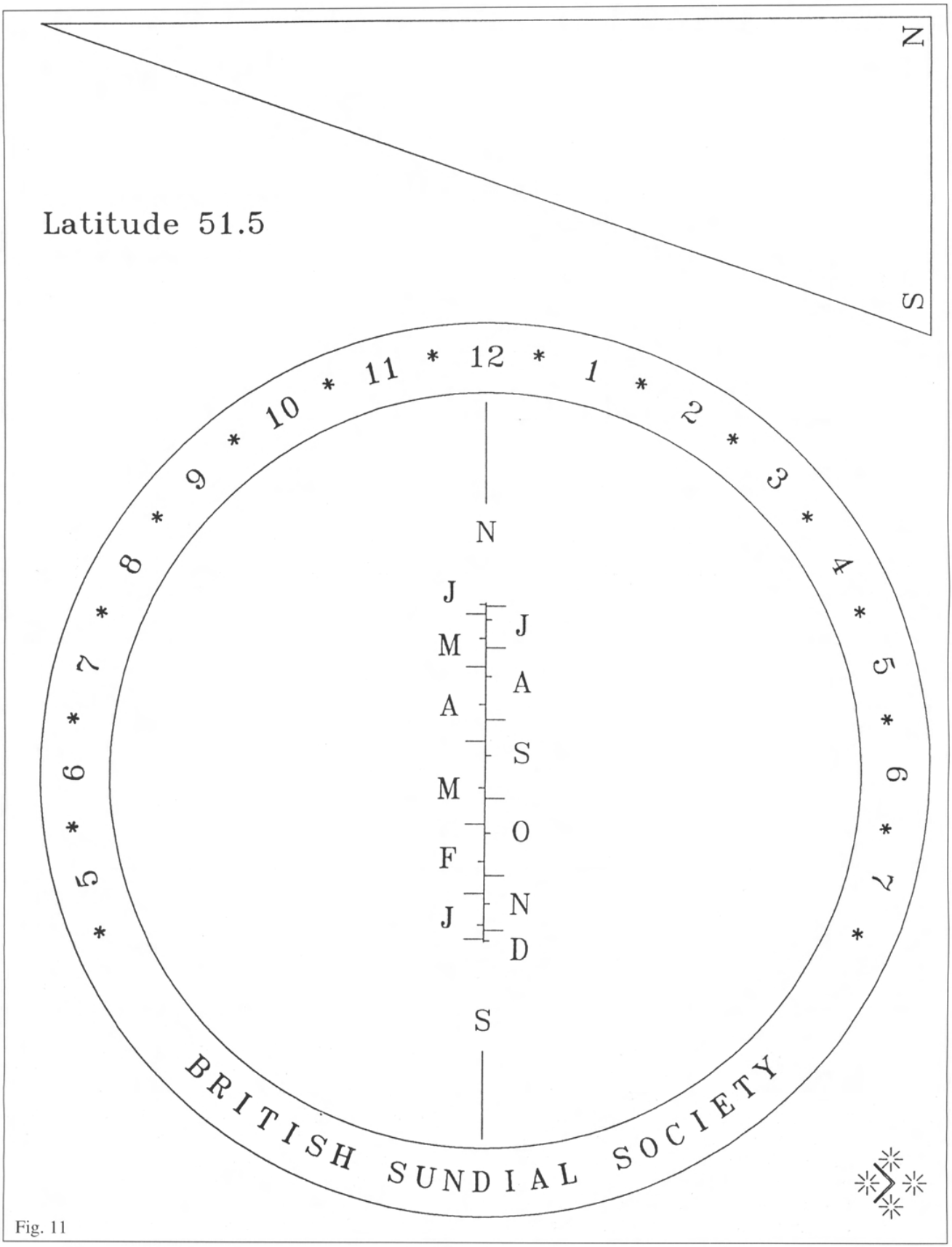


Fig. 11

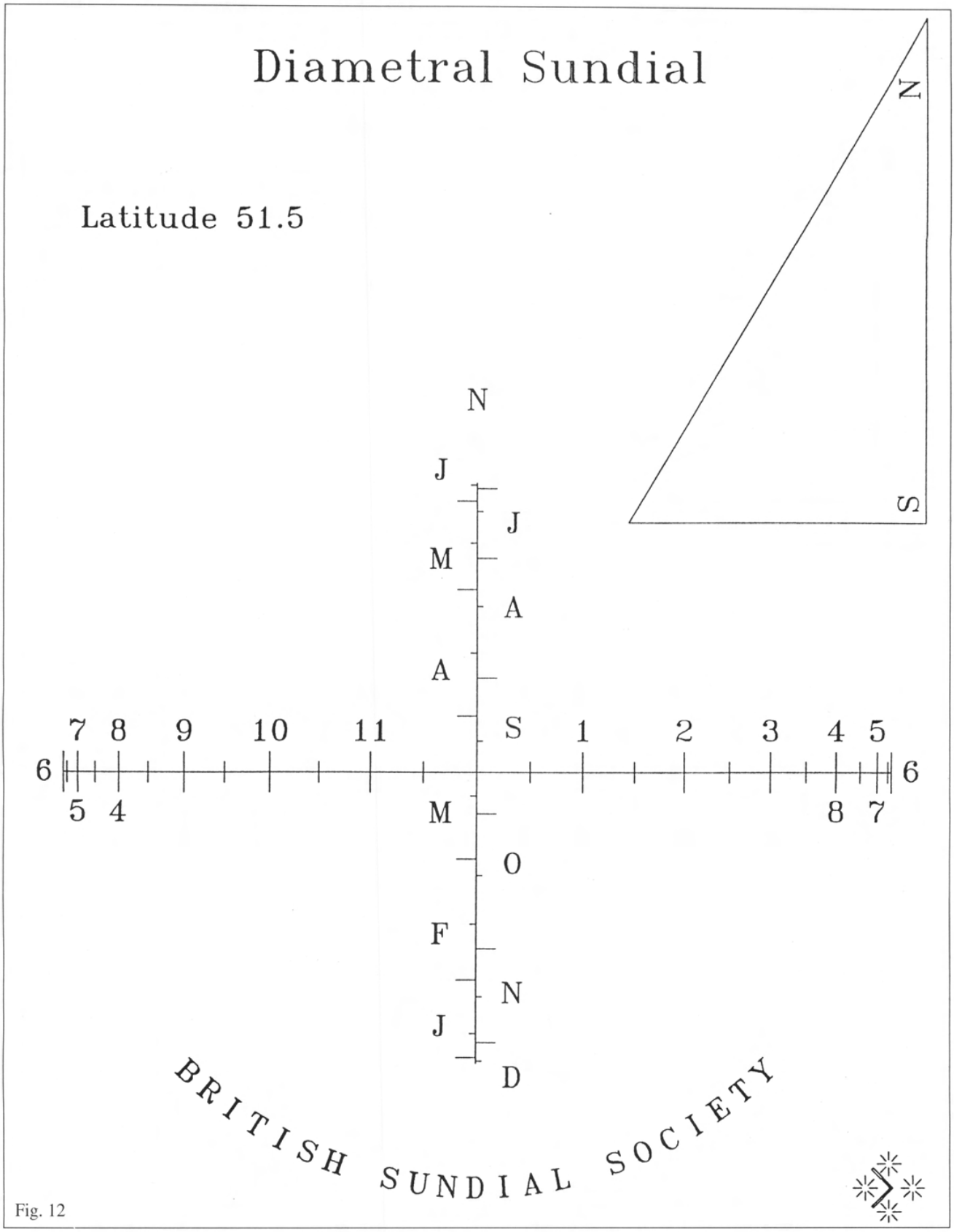


Fig. 12

discussion of "physick, anatomy, geometry, astronomy, navigation, staticks, mechanicks and natural experiments".[23] Even after Foster's death in 1652, they continued to meet in the astronomer's chambers and formed the nucleus of what has become the Royal Society.[24] Although Gresham College no longer exists as an independent institution,[25] historians do view it as the Royal Society's birthing ground; in fact, early Fellows of the Society were known as *Greshamites*.[26] Unfortunately, Foster died before the Society came into being in 1660.

He prepared his will on May 7, 1652, a few days before his death.[27] His will is interesting. It tells us that his nephew John Bayes was a London watchmaker - a sign of the transition from an old technology to a new one. We also learn that Samuel's sister Elizabeth was married to a wicked Christopher Poyner. Foster notes that

ye wicknesse of her husband is such, that what ever shee hath, hee will spend, therefore I giver her nothinge at all.

In fact, he leaves her share to two minister friends in the hope that they will use the money for her good.

The most valuable part of his estate - his library at Gresham, including all his manuscripts - is left to his brother Walter.

Samuel was buried on May 11th in the Gresham College plot at St. Peter the Poor's in Broad Street, London.[28] That church was demolished in 1792 and its replacement in 1907. Although some inscriptions and monuments were saved and transferred to neighbouring churches, there is apparently no existing monument today to Samuel Foster.

Now, certainly it would be easy to expect that with Foster's death his story basically comes to a close. However, in fact, it just grows more interesting. In the years following his death, there was a virtual scramble to publish many of his papers. At least 7 publications with his name appeared before the end of the century.

Without doubt, the most important and one of the rarest of these books was *Elliptical or Azimuthal Horologiography*,[29] [Figure 10] taken from Foster's manuscripts and edited by his friend John Twysden and his lawyer Edmund Wingate in 1654. As the long title indicates, the work provides *severall wayes of describing DIALS upon all kindes of Superficies either plain or curved: And unto upright Stiles in whatsoever position they shall be placed.*

This book takes a very broad approach to dialling and presents general solutions for several different surfaces and for stiles not restricted to being parallel to or part of the celestial axis. Basically, he breaks out of the restrictions of the gnomonic projection and explores what new types of dials can be generated.

. . . thou wilt see, that the representing the true Houre by the shadow made by the Axis of the World is but one of those infinte wayes which may be invented . . .

Besides its final, very general treatment, the book has 3 specific subsections.

Elliptical Horologiograpy develops the mathematics of what we today call an analemmatic sundial. This type of dial was first published by M. de Vaulezard[30] in Paris in 1640. However, Foster's treatment is far more comprehensive and is certainly the first English treatment of the dial. The editors acknowledge the prior publications of Vaulezard's idea but rightfully claim a more general approach for Foster.

The next section of this book is *Circular Horologiography*. Since Foster deals with arbitrary planes and movable stiles that do not have to be parallel to the celestial axis, he finds the very interesting special case where the ellipse of hour points rearrange themselves into a circle and are uniformly distributed - 15° to each hour. [Figure 11 is a horizontal version for London.] So, for example, if we have a non-declining plane with inclination i, the stile should be at an angle $45°+(\varphi - i)/2$ above the plane and move in a slot similar to the analemmatic dial, but defined by the formula

$$\tan\delta \cos (45°-(\varphi - i)/2.$$

The basic idea of this dial should be familiar to all of your who have seen the Greenwich Observatory Tercentenary Dial designed by Gordon Taylor. It's the same idea - developed by Foster decades before the observatory was founded.

In its horizontal form, this dial is sometimes attributed to J. H. Lambert,[13] who published it as a new discovery in 1775, and it was developed again in 1972 by Albert Ericson,[32] and finally, in a general form more akin to Foster's analysis by Gordon Taylor[33] in 1975. But the original discovery appears to be in this rare, virtually unknown work by Samuel Foster.[34]

The third section of the book introduces Rectilineal or Diametral sundials, a variety I have seen nowhere else. Foster uses the line common to the meridian and equatorial planes as the stile and shows that its shadow moves back and forth in the course of a day along a finite segment of a straight east-west line. If the stile's base is properly placed (in a slot similar to the analemmatic dial's but with a displacement of $\tan\delta/\cos\varphi$), the stile's shadow will move westward until 6 a.m., stop and reverse direction, then move eastward until 6 p.m. when it stops and changes direction again - heading back to the west [Figure 12].

Foster also shows that by moving the stile out of the meridian, but always keeping it in the equatorial plane and making the necessary adjustment in the placement of its base, we can design the dial to make the shadow reverse directions at any selected time of the day.[35]

This innovation sounds very much like the Biblical dial of Ahaz, with the shadow that was miraculously made to move backwards. Various diallists have sought ways to reproduce this miracle in a novel sundial, but Foster's invention seems not to have had any other independent discovery.

* * * * *

These are the innovations in one of the books published after Foster's death. There are more - and yet the interest these works hold is not limited solely to Foster's dialling. There is an additional mysterious melodrama played out in the prefaces to some of the publications.

For decades after Foster's death, we find accusations of plagiarism and deceit in the posthumous publication of his papers. Consider the commentary by Foster's lawyer and editor Edmund Wingate, writing in July (less than three months after Foster died), in the preface to *Posthuma Fosteri*. Wingate aplogizes for publishing the book perhaps before it is ready, and certainly for publishing it before *its fellows* - the rest of Foster's material. But he feels that he has strong motivation for rushing publication:

We should not thus hastily have thrust this into the World without its fellows, had we not been assuredly informed that some people, greedy rather of unjust gain to themselves, then with honesty to sit still, had prepared one for the Presse, from a spurious and imperfect Copie, both to the abuse of thee, and discredit of the industrious Author: who had he thought such things as these worthy him or the Presse, could have daily cram'd thee with them, to his own losse of time, and thy satiety . . .

We thought fit father to advertise thee, that there are abroad in particular hands, imperfect Copies of some other Treatise of the same Author . . . We fear least sinister ends of some mean Artists, or ignorant Mechanicks . . . may engage them to father these things as their own, or at least under the Authors name put out lame and imperfect Copies of otherwise good things:

This clearly the pronouncement of a lawyer concerned to protect his client's estate. He asks the reader to forebear

from reading unauthorized Foster texts, promising to present additional books within the next few months.

. . . we give thee this timely notice, assuring thee, that these, together with divers other pieces never yet seen, except by very few, and if we deceive not our selves, of much greater weight, are making ready for the Presse by the Authors approbation, and from his own Copie in our command, with his other papers, of which thou shalt be made partaker within few moneths.

In the mean time, we desire thee not to lose thy time in reading, or money in buying any the forementioned Treatises put out by any other, either under their own, or our Authors name, except such as shall be attested by me, who am one of those intrusted for that purpose, and who shall be ever studious of thy good.

Whoever these mean Artists and ignorant Mechanicks may have been, they did perform a real service in pushing Wingate to publication, since most of the other treatises he promised within a few months seem not to have come off the press.

Two years later, in 1654 he and John Twysden acknowledge their tardiness in the preface to *Elliptical or Azimuthal Horologiography:*

Amongst other Treatises of this deceased Author, of which, in their due time, we intend to make thee partaker, we have, in the first place, made choice of this, as well in some measure to keep our word with thee, as also to stay thy expectation till other things can be made ready.

I have tried to identify who these mean Artists and ignorant Mechanicks might have been - but so far to no avail. Of course, it could have happened that they never actually printed the texts they are accused of stealing. But this probability is low, since John Twysden complained of plagiarists five years later (1659) when he edited Foster's *Miscellanies*:[36]

I might name some others, shall I call them Mathematicians, or Plagiaries. Who having got into their hands some things of our Authors, which (out of that diffusive goodness, and candor of disposition, that was in him) he communicated to others, have under a disguised face, vented as their own. Yet shall this return also to the honour of our Author, that what he esteemed as trifles, they reckon as a treasure; from which they endeavour, to snatch unto themselves, the vain, and empty name, of glory.

The clear indication here is that some unauthorized publication of Foster's manuscripts occurred in the period between 1652 and 1659. But I have not yet been able to identify either the publication or the culprit.

Virtually no one has been considered above suspicion. I admit even to having suspicions about William Leybourn, who was such a prolific writer and editor of topics ranging from surveying to mathematics to dialling. Leybourn was involved in producing a number of authorized Foster publications, was a friend of John Twysden's, and even joined somewhat belatedly in the cry against the plagiarizing culprit. In his 1673 fifth edition of *The Works of Edmund Gunter*, he includes as appendices two articles from Foster on the use of sectors and quadrants which Foster had designed. Leybourn takes great pains to avoid any accusation of plagiarism being directed at himself. He then notes:

Having thus declared my self, and endeavored to take off such aspersions as might possibly have been thrown upon me; Give me leave (for the Dead cannot plead for themselves) to take notice of some Plagiaries and Purloiners of other mens Labours and Ingenuities, who out of Lucre to themselves, and Emulation to others of better parts, have lately thrown into the World (to the grand abuse thereof) several trivial Tractates, extracted (or rather transcribed) both from [Mr. Gunter] and also from the Works and Manuscripts of . . . Mr. Foster, . . . Publishing them to the World in their own names, without taking the least notice of the learned Authors, whence they originally filtcht those ornaments wherewith they pride themselves in their several Pamphlets, not so much as mentioning their names with any due respect. I need not tell thee who they be . . .[37]

This is unfortunate. I wish he had felt the need to confide more in his readers and not assume that they were all as up to date on late seventeenth century London as he was.

So I am still left without a culprit - but not without any nagging suspicions. I am still not convinced that Leybourn's hands are entirely clean in this matter.

Consider for example his publication in 1682 of *Dialling: Plain, Concave, Convex, Projective, Reflective, Refractive*.[38] This book with its 2nd edition in 1700 is generally thought to be the best and most comprehensive book on dialling to appear in English before the 18th century. Much of Leybourn's reputation as a diallist is tied to this publication, and yet if we dip once again into the confessional of the preface, we find:

And now give me leave to prevent the Calumnies of some (already) Detracters, and to take off the aspersion of a Plagiary, to acquaint thee from whence all that is herein contained had its issue. Therefore . . .

Leybourn goes on to acknowledge 5 of his 11 chapters to be Samuel Foster's work:

Of Eleven Chapters In The First Edition:

3. Instrument and arithmetical dialling - referring all dials to latitudes where they become vertical decliners: *partly Mr. Samuel Foster's*

7. A succinct way to describe hour lines and furniture: *came to my hands in a Latine Manuscript of Mr. Samuel Foster's.*

9. Projective dialling, including techniques for projecting hour lines on any plane: *wholly Mr. Samuel Foster's.*

10. Projective dialling, including the insertion of furniture on any plane: *also . . . wholly his, and was . . . transcribed from a Manuscript of his, which he (for the excellency of many things contained herein) Entituled GOLD.*

11. Refractive dialling, treated instrumentally and protectively: *is Mr. Foster's also . . .*

And of the three chapters added in the second edition, similarities in style lead me to suspect that one (on reflective dialling) is originally Foster's.

It would not be out of line to suggest that fully 40% of this *most comprehensive* dialling text originated in Samuel Foster's manuscripts.

The detective game could continue. There are still

several loose ends. For example: An innocent William Leybourn should be expected to explain his treatment of *The Art of Measuring*.[39] This text has nothing to do with dialling, but the first (1669) and third (1681) editions are generally attributed to Leybourn,[40] and only its second edition reveals to the reader that it was *at least primarily* the work of Samuel Foster, who composed it in 1644.

* * * * *

However, rather than extending the search for a culprit, let me return to Foster himself for a closing assessment.

Consider two printed evaluations of Foster's work:

Samuel Foster can hardly be said to have directly advanced the mathematical arts, except in so far as he stimulated an interest in the intricacies and elegancies of the 'Art of Shadows'.

- E.G.R. Taylor[41] *(1970)*

[we] yield him his honour, to have made [the Art of Dialling], in all the Cases of it, and all Circumstances thereunto belonging, more easie and expedite . . . than any that have gone before him either of our own or other Nations.

- John Twysden, Edmund Wingate[42] *(1654)*

Perhaps both assessments are valid. The first has the objectivity that comes with being 3 centuries removed from the subject, but it also suffers from not being familiar with Foster as a teacher, an innovator, or the source of much dialling material that originally came out of his manuscripts.

The language and phrasing of the second are not as familiar to us as the first, and it may border on the excessive. Yet, I hope I can now suggest to you that the spirit of the *second* is a better reflection of Foster's actual accomplishment and the esteem in which he was held following his death.

REFERENCES

1. Somerville, Andrew R., *The Ancient Sundials of Scotland,* Rogers Turner Books, London, 1990.
2. Ward, John, *The Lives of the Professors of Gresham College, To which is prefixed the Life of the Founder Sir Thomas Gresham.* A facsimile of the London Edition of 1740, The Sources of Science No. 71 Johnson Reprint Co., New York NY, 1967.
3. Johnson, Francis R., "Gresham College: Precursor of the Royal Society", *Journal of the History of Ideas,* 1940, 1:413-438. See p.421 for the assignment of astronomy to Wednesday. However, it appears that the original 1598 assignment of dates for lectures placed astronomy on Friday. The morning lecture in Latin when from 8-9; the afternoon lecture in English went from 2-3. See Adamson, Ian R. *The Foundation and Early History of Gresham College, London, 1596-1704,* Doctoral Dissertation, St. John's College, Cambridge University.
4. Ward, John, *Ibid.*
5. THE ART OF DIALLING; BY A NEW, EASIE AND MOST SPEEDY WAY. SHEWING, HOW TO DESCRIBE THE Houre-lines upon all sorts of Plaines, Howsoever, or in what Latitude so-ever Situated; As also, To find the Suns Azimuth, whereby the sight of any Plaine is examined. Performed by a Quadrant, fitted with lines necessary to the purpose.

   Invented and Published by SAMVEL FOSTER, Professor of Astronomie in Gresham College.

   LONDON, Printed by John Dawson for Francis Eglesfield, and are to be sold at the signe of the Marigold in Pauls Church-yard. 1638.
6. This was probably *The Description and Use of a Quadrant,* published later as a supplement to the Works *of Edmund Gunter.*
7. The ruler graphic presented here was created for the North American Sundial Society by Ronald Anthony, following the 1657 design by George Serle. Only the Latitude and Hour scales relate specifically to Samuel Foster.
8. Dialling Universal: Performed by an easie and most speedy way. SHEWING How to describe the hour lines on all sorts of Planes whatsoever, and in any Latitude. Performed by certain Scales set on a small Portable Ruler. By G.S. *Practicioner in the Mathematicks.*

   LONDON Printed by *R.* and *W. Leybourn* for *Thomas Pierrepont* at the Signe of the Sun in *Pauls* Church-yard. 1657.

   Annotated and Edited by Frederick W. Sawyer III With a Portable Ruler by Ronald L. Anthony.

   North American Sundial Society Press, Glastonbury Ct USA 1995.
9. See for example Posthuma Fosteri: THE DESCRIPTION OF A RULER, Upon which is inscribed divers SCALES. Although this ruler is used to draw hour lines on dials, it does not have either the latitude or hour scale.
10. James Ferguson (Lectures on Select Subjects - X), 1760.
11. See Captain Samuel Sturmy's *The Mariners Magazine,* 1669. Sturmy claims that the dialing scales were first developed by Philip Stayred some 37 years earlier (*i.e.* in 1632):

    . . . Mr. Philip Staynred, which first composed the Scale and Gnomon Line [i.e. the Hour and Latitude Scales], and Inclination of Meridians, and the greater and lesser Pole on the Dialling Scale, for 37 years since, as I have seen by him calculated, and the Projection Geometrical in his Study.

    It does not appear that Staynred ever published anything relating to the dialing scales. Perhaps this comment by Sturmy is the only evidence for a claim of priority.
12. Demonstratio Quadrantis HOROMETRICI. in *Miscellanea: sive lucubrationes mathematicae. Miscellanies: or Mathematical lucubrations of Mr. Samuel Foster, Sometime publik Professor of Astronomie in Gresham Colledge in London. Published, and many of them translated into English, by the care and industry of John Twysden,* ed. John Twysden, 19pts, fol., Printed by R. & W. Leybourn, London, 1659.
13. In astronomy, *prosthaphaeresis* is the process of adding to or subtracing a small amount from an observed value - in this case, our latitude - to convert to a more convenient value to use in calculations.
14. THE ART OF DIALLING, By a New, Easie and most Speedy Way. SHEWING, How to describe the Hour Lines upon all sorts of Plains; Howsoever, or in what Latitude soever, situated. ALSO; To find the Hour of the Day, and the AZIMUTH of the Sun, whereby the Sight of any Plain is Examined.

    Performed by a Quadrant filled with Lines necessary to that purpose.

    Invented and Published in Anno 1638, by SAMUEL FOSTER, then Professor of Astronomie in Gresham Colledge.

    The Second Edition, With several Additions and Variations of the Authors, deduced from his own Manuscript.

    With a SUPPLEMENT, Performing all the Instrumental Work of the Quadrant, by Calculation. By help of the Canons of Sines and Tangents, which of all ways is the most Exact.

    By WILLIAM LEYBOURN Philomath. LONDON, Printed by J. R. for Francis Eglesfield at the Marygold in St. Pauls Churchyard. 1675.
15. Geometricall Dyalling: OR, DYALLING Peformed by a Line of CHORDS onely, Or by the PLAIN SCALE. . . . Being of full Explication and Demonstration of divers difficulties in the Works of Learned Mr. Samuel Foster deceased, later ..... Professor of Astronomy in Gresham College. . . . Written by

John Collins of London Accomptant, Philomath. 1659.

16. Posthuma Fosteri: THE DESCRIPTION OF A RULER, Upon which is inscribed divers SCALES: AND The Vses thereof: Invented and written by Mr. SAMUEL FOSTER, Late Professor of ASTRONOMIE in GRESHAM COLLEDGE.

    By which the most usuall Propositions in Astronomie, Navigation, and Dialling, are facily performed. Also, a further use of the said Scales in Deliniating of far declining Dials; and of those that Decline and Recline, three severall wayes.

    With the deliniating of all Horizontall Dials, between 30 and 60 gr. of Latitude, without drawing any lines but the Houres themselves.

    LONDON Printed by ROBERT and WILLIAM LEYBOURN, for NICHOLAS BOURN, at the South entrance into the Royall Exchange. 1652.

17. Foster evidently did suffer from ill health. In the 1654 posthumous publication *Elliptical or Azimuthal Horologiography*, his editors John Twysden and Edmund Wingate note *"Lastly, we advertize thee (Reader) that our Authour, in regard of his great and long infirmities, could not fit either this, or any other of his Treaties for the Presse, as he desired and intended . . ."*.
18. See Ward, *Ibid.* and Johnson, *Ibid.*, p.426.
19. In custody of the Guild Hall Library, London, England. The college observatory was on the roof at the south east corner of the courtyard - diametrically opposite from the astronomer's chambers and above the geometry professor's rooms. The Gresham mansion was situated between Bishopsgate and Old Broad Streets, roughly where the Nat West Tower stands today.
20. *Very artifically* here means with great skill or craftsmanship. Aubrey, John, *Lives of Eminent Men*, bound with John Walker's *Letters Written by Eminent Persons*, 2 vols., London, 1813. Vol. 2, Pt. 2.
21. Ozanam, Jacques, *Traité de gnomonique pour la construction des cadrans sur toutes sortes de plans*, Lyon and Paris, 1673. Problem 19, Chapter 2. The present author is not aware of any earlier publication of this geographic sundial design, but would be pleased to learn of any with which readers are familiar.
22. Taylor, E.G.R., *The Mathematical Practitioners of Tudor & Stuart England*, Cambridge Unversity Press, Cambridge, 1970, p.79.
23. From John Wallis' 1678 pamphlet *A Defence of the Royal Society*, as cited in Johnson, *Ibid.*
24. Johnson, Francis R., "Gresham College: Precursor of the Royal Society", *Journal of the History of Ideas*, 1940, 1:413-438.
25. The college has been absorbed by the City University.
26. Johnson, *Ibid.*
27. Prerogative Court of Canterbury. Public Record Office, London, Prob II 222. Prob 10/746. The will was proved May 18, 1652.
28. Burial Register of St. Peter Le Poer, City of London. The register actually gives the date as August 11, but it is positioned between two May entries and the probate date of his will establishes that May is the correct month.
29. Elliptical, Or Azimuthal Horologiography. Comprehending severall wayes of describing DIALS upon all kindes of Superficies either plain or curved: And unto upright Stiles in whatsoever position they shall be placed.

    Invented and Demonsrated By Samuel Foster, Late Professor of Astronomie in Gresham-Colledge.

    London, Printed by R. & W. Leybourn, for Nicholas Bourn, at the South entrance of the Royal Exchange. [1654]
30. M. de Vaulezard, *Traicte ou usage du quadrant analematique*, Paris 1640. *And Traitte de l'origine, demonstration, construction et usage du quadrant analemmatique*, Paris 1644.
31. Lambert, J. H., "Eine neue Art Sonnenuhren", *Berliner Astronomisches Jahrbuch fur 1777*, ed. J. E. Bode, 1775, pp. 200-202.
32. Ericson, Albert, "A hybrid sundial", *Sky and Telescope*, Nov 1972, 44(11): 299, 305.
33. Taylor, Gordon E., "Equiangular Sundials", *Journal of the British Astronomical Association*, 86(1):7-17, 1975. See also Sawyer, F.W., "Letter to the Editor", *Sky & Telescope*, Dec 1975, 50(6):355, 382.
34. See Sawyer, F.W., "A Self-Orienting Equiangular Sundial", *Bulletin of the British Sundial Society*, Oct 1991, 91(3):24-25.
35. See Sawyer, F.W., "Foster's Diametral Sundial", *Bulletin of the British Sundial Society*, Feb 1992, 92(1):16-17.
36. *Miscellanea: sive lucubrationes mathematicae. Miscellanies: or Mathematical lubrucations of Mr. Samuel Foster, Sometime publik Professor of Astronomie in Gresham Colledge in London. Published, and many of them translated into English, by the care and industry of John Twysden*, ed. John Twysden, 19pts, fol., Printed by R. & W. Leybourn, London, 1659.
37. Leybourn, William (ed.) *The Works of Edmund Gunter: Containing the Description and Use of the Sector, Cross-staff, Bow, Quadrant, And other Instruments . . . To which is added, The Description and Use of another Sector and Quadrant, both of them invented by Mr. Sam. Foster, Late Professor of Astronomy in Gresham Colledge, London, furnished with more Lines, and differing from those of Mr. Gunters both in form and manner of Working.* The Fifth Edition, Diligently Corrected, and divers necessary Things and Matters . . . added, by William Leybourn, Philomath. London, Printed by A. C. for Francis Eglesfield at the Marigold in St. Pauls Churchyard, MDCLXXIII.
38. Leybourn, William, *Dialling, Plain, Concave, Convex, Projective, Reflective, Refractive, Shewing, How to make all such Dials, and to adorn them with all useful Furniture Relating to the Course of the Sun; Performed Arithmetically, Geometrically, Instrumentally and Mechanically*, fol., London. Printed by J. Matthews for Awnsham and John Churchill at the Black Swan in Pater-Noster-Row. 1682. Second Edition in 1700.
39. The Art of Measuring, Containing the Description and Explanation of the Carpenters New Rule. Furnished with variety of Scales, fitted for the more speedy Mensuration of Superficies and Solids. Written by Sam. Foster, sometime Professor of Astronomy in Gresham College. Also Certain Geometrical Problems, a Table of Logarithms to 10000, and some Uses of the same exemplified in Arithmetick and Geometry; but more particularly applied to the Mensuration of Superficies and Solids, as Board, Glass, Pavement, Wainscot, Plaistering. Tyling, Timber, Stone, Brick-work and Gauging of Cask. The Second Edition with Additions, by W. Leybourn. To which is added, A Supplement, being the Description of the Line of Numbers, with its Use in divers Practical Examples of Mensuration: Of Singular Use for Work-men, Artificers, and other Ingenious Persons delighting therein. By John Wiblin, Carpenter. London, Printed for John Williamson, at the Bible in Canon-Street, 1677. 8vo. This is listed as second edition; the first was published with no attribution to Foster in 1669. A third edition, with no attribution to Foster, appeared in 1681.
40. The Wing Short-Title Catalogue lists the 1st and 3rd editions under Leybourn, as entries L1903 and L1903A. The second edition is listed under Foster as F1629B. Wing, Donald G. *Short-Title Catalogue of Books Printed in England, Scotland, Ireland, Wales and British America, and of English Books Printed in Other Countries, 1641-1700*, 2nd edn., rev. & enl., 3 vols., Modern Language Association of America, New York, 1982.
41. Taylor, *Ibid.*, p78.
42. From the Preface to *Elliptical or Azimuthal Horologiography.*

PORTABLE DIALS - CARE AND RESTORATION

JOHN MOORE

A collection of portable dials will usually include specimens of all ages and conditions. Some of the specimens will be less than perfect, being damaged, having missing parts or just plain dirty. It is sometimes a difficult decision to make, as to the amount of attention to give them. Over cleaning a dial or incorrect repairs may severely damage it, thereby reducing its value. The aim of this article, is to suggest remedies and solutions to the problems that may be encountered, but actual restoration, particularly of valuable dials, should always be left to the expert.

CLEANING

Many dials when acquired are in a filthy state, some having being untouched for centuries. There is no excuse for a dirty object, and some form of cleaning should be attempted.

In the case of brass, and some silver dials, previous owners have probably 'cleaned' them using metal polish. This is one of the greatest sins possible. The abrasive nature of most types of cleaning polish will remove the surface layer of the metal, obliterating the delicate patination of age, damaging delicate silvering or gilding, and destroying the crispness of any engraving. In addition, residues of such 'cleaners' are left in the engraving and holes as a white deposit. This is unsightly and may be damaging (Figure 1). There is little that we can do about a dial that has been cleaned in this way. Obviously, if it is too badly smoothed by repeated polishing, it is best avoided in the first place. Let someone else buy it. In practice, most dials that are found have these white deposits on them. These are best removed, as it is possible for corrosion to start where it remains, particularly if the dial is subjected to a high level of humidity, not uncommon in the British climate.

FIGURE 1: Residue of metal polish found on dismantling a brass dial by Butterfield

To remove all traces of metal polish, it is best to dismantle the dial carefully, taking care not to do any damage in the process, particularly to its screws. These may have been unmoved for centuries and may be unwilling to move. Too much force on one of these may shear its head off. Always use a screwdriver with a blade that fits the screw slot properly. Many early screws had 'V' shaped slots, and a modern screwdriver could damage them. If necessary, grind up the tip of an old screwdriver for this purpose. Much damage is done to screws by screwdrivers, particularly when the blade is too small for the screw. Remember too, to keep the screws so that they will be fitted back into the same holes that they came out of. Old threads can vary, and screws are seldom interchangeable. Also make a careful note of the position of each part so that you do not end up with some bits that won't fit (Figure 2).

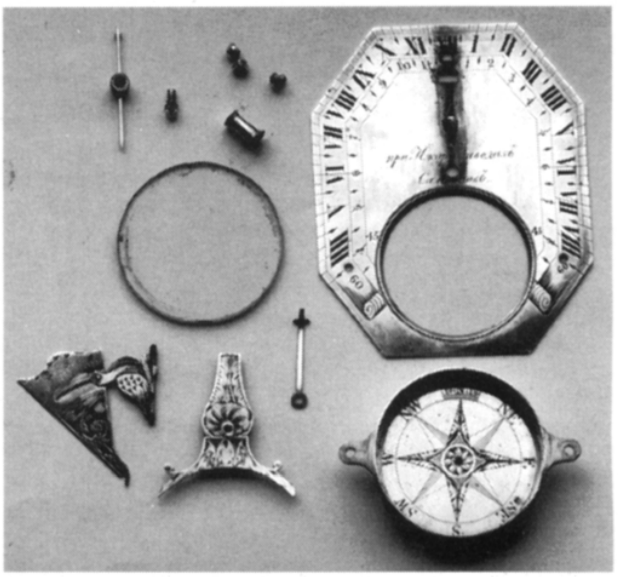


FIGURE 2: Silver 'Butterfield' type dial by Izhor of St. Petersburg dismantled in preparation for cleaning.

The cleaning process will depend on the material. In the case of a brass dial, warm soapy water is often the best solution. The soap used can be a mild detergent such as Teepol or washing up liquid, but avoid those with fragrances such as 'lemon flavour' just in case they contain harmful acids. Avoid cleaning the compass needle unless it is particularly soiled because the water could encourage rusting. The glass cover for the compass will certainly benefit from a wash. It will always have a dirty ring around its edge where in-situ cleaning was impossible. If the compass is covered by a mica window, just wipe its surface carefully with a damp cloth. Be careful not to crack or de-laminate the mica that may now be very fragile. The individual parts may be soaked for a few minutes, then may be rubbed gently with a piece of soft cloth. Be particularly careful of any filler in the engraving. Many waxes used as fillers may melt if the water is too hot. An ultrasonic cleaning bath is sometimes useful, but it should be used with special care. The metal parts of the dial should not contact the metal parts of the tank or its basket as this may cause abrasion damage. A good protection is a layer of thin card or paper on the bottom of the tank. The agitation of an ultrasonic bath may also dislodge the filler from the

engraving, or remove loose paint work, so it must be used with care. Once cleaned to a satisfactory state, the parts should be rinsed in clear water. From this time on, they should only be handled with gloved hands to prevent the oils and acids from the fingers being deposited on the now unprotected cleaned surface. A final rinse in distilled water is recommended. To dry the parts, use a warm air supply from a hairdryer to make certain that all moisture is removed from every crevice and particularly from screw threads. Take care when drying the screws, as the blast of air may send them in all directions. Put them into a vertical sided dish to prevent this.

The parts, once cleaned, will be particularly vulnerable to any form of corrosion, any protective layers of grease, etc., having been removed. One simple way of protecting the parts is to apply a thin coat of wax. One that is used by most museums and professional restorers is known as Renaissance Wax.[1] It was introduced commercially in 1968, and has been approved of by the British Museum. It is inert, with a neutral pH, and may be used on most materials including metals, wood, leather and even ivory. Apply the wax with a small piece of soft cloth or cotton wool. Avoid paper and wood based tissues. Most paper products contain high levels of acid. Once thinly coated with the wax, use a clean soft cloth to polish the part gently.

An alternative to wax that may be considered is varnish. The choice is rather difficult as it should be removable if future cleaning is required. Most varnishes may be removed by acetone, but think what this will do to the wax filler in the engraving! Acrylic lacquers sprayed onto the items seem to be the best solution. However, if in doubt, don't do it.

Now is the time to re-assemble the dial. Do not hold any of the parts in the uncovered fingers. Cotton gloves are cheap and may be washed when soiled. Fit the screws carefully without over-tightening them. Return the dial to its protective case, or place it in a suitable showcase. If the cleaning has been carried out successfully, and it has been properly coated with wax or varnish, it will stay in this condition without further degradation for several years. Most museums do not expect to have to clean their artefacts more than once in perhaps 15 years, but most of their treasures are housed in climate controlled cabinets.

If the dial is showing signs of corrosion, particularly from a careless fingerprint left by a previous owner (Figure 3), it may be cleaned with a light abrasive cleaner, but this is only recommended in cases of severe damage and where the dial has previously been cleaned in this way. To remove corrosion damage left by the fingers fully, metal has to be removed from the object's surface. A dial in pristine condition apart from a corroded finger print is best left alone. There is little that can be done to rectify this type of damage and attempts should be made to remove the offending acid in the hopes of halting the decay rather than completely removing it. Cleaning in warm soapy water is probably the best way to proceed, followed by a coat of wax. To wash out all acids completely from the pores of the metal, it may be necessary to wash the parts several times in distilled water, leaving them to soak for a day or more each time. An elevated temperature will assist the process.

Another form of damage often found on all types of antique comes from the use of self adhesive labels. These are still used by many salesrooms and dealers for identifying their stock. They should be banned from use

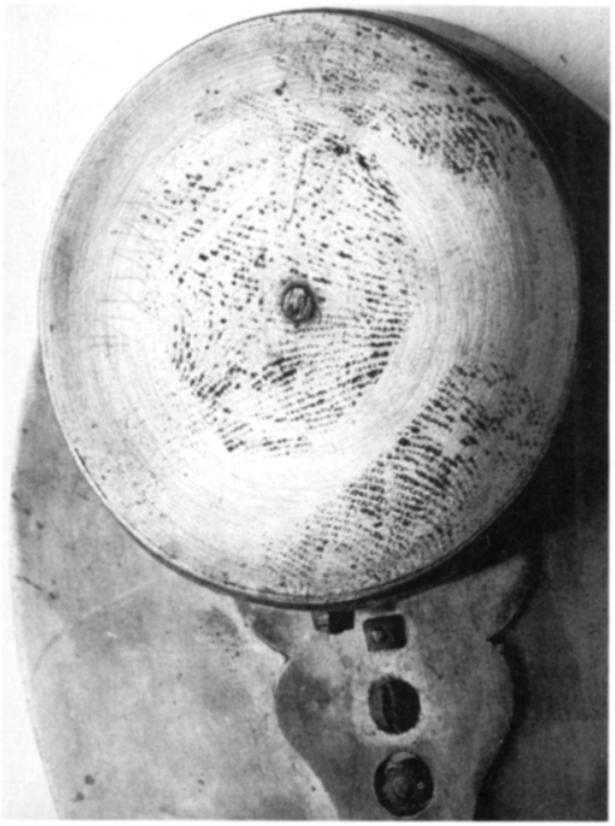


FIGURE 3: Severe fingerprint damage to the compass bowl of a dial by Thomas Heath

anywhere near antique items. They always leave a sticky residue, remove surface coatings and their position will show if the rest of the surface has faded in light. The chemicals used in the adhesive may also be damaging. The same applies to other 'harmless' substances such as Blue Tack. This has been seen to mark paper with an oily mark after a few months.

Silver may be treated similarly to brass. However, silver may also have a blackened surface due to the presence of sulphur in the atmosphere. There is at least one museum in this country that has a fine collection of blackened silver dials, so the problem is not unique to private collections. In most cases, this black layer will clean off with a soft cloth. If this is not possible, sparingly apply some proprietary silver polish, (again an abrasive item, so take care), or use Silver Dip to remove the contamination. Leave the fluid to stand for a few minutes without rubbing the metal surface, then rinse it off. Most of the black corrosion should now have been removed from the surface. If areas are still persistent, try a light rubbing with the cleaning fluid. If areas have severe pitting, cleaning of the cavities may be possible using metal polish and a sharp cocktail stick. Always rinse well in clean water following any chemical treatment. Clean the parts as already described for brass dials, and apply the wax coating.

Silver is particularly prone to blackening. It may be noticed, that certain pieces blacken quicker than others. This is either due to the grade of silver, its surface finish or its coating. The blackening comes mostly from sulphur. We all know not to eat a boiled egg with a silver spoon. Sulphur is present in the atmosphere from vehicle exhausts, fires and general industrial pollution. It is also present in the house in large quantities, coming from two main sources. The first is unavoidable, and is from the human

body, and our domestic animals. It comes from bodily waste and is even exuded by the skin. The second is also difficult to avoid, coming from the timber used in house construction, newspapers and even books, and, what is more important, the house furniture. The worst source of pollutants may be the display cabinet! Wood will slowly breathe, giving out toxic gases, in particular sulphur, but generally, by the time that it is around a century old, its 'bad breath' is reckoned to have dissipated and it is considered to be fairly safe to use. Modern 'woods' that are made from layers, such as plywood or chippings that are bonded together, may be even greater sources of dangerous gases. Humans and wood have to be lived with, but a good wax coating may protect the dial for a period of time. If the dials are to be stored, wrap them only in acid free paper, then put them into polyethylene bags. Polyethylene bags are available from specialist plastics' suppliers, and are well worth searching out. Standard plastic bags may be used for short times, but this material usually contains chlorine, and this is another major source of chemical damage.

Ivory dials need different treatment. Often they are quite dirty or even stained from years of handling and display. Most ivory dials did not have cases, so they are less likely to have been protected during their long lives.

Do not try to take these apart. Clean them carefully with a damp cloth, with a little soft soap if necessary. Remember, that the soap needs to be removed carefully afterwards. Do not expect the stains to be removed as these will probably be of a permanent nature, but most ivory dials certainly look whiter following a careful cleaning. Another method that is generally successful in cleaning ivory or bone is to use isopropyl alcohol or even surgical spirit. Like all cleaning agents it must be used with extreme care, and not too liberally. Apply it with a soft cloth rubbing it gently into the dirty areas. Be particularly careful of the wax filling in the lines and numerals. This may be dissolved by the alcohol. At the first sign of damage, stop and dry the dial by warm air (not too hot).

Ivory needs special care and attention. In particular it needs a relatively high humidity level, around 60%RH. Metals need much lower level, 40%RH and below. It therefore makes it difficult to store or display both types of dial together. Two separate display cabinets are often the only sensible solution. For the case holding the ivory dials, a small dish of water should keep the humidity at the correct levels. A humidity meter is a good investment for such items. When ivory becomes too dry, it is prone to cracking, and many early dials from both Dieppe and Nuremberg are found severely cracked along their grain, or even split into two pieces (Figure 4).

CONSERVATION & RESTORATION

These two words are often confused. Conservation means the keeping of an object in its present state, without it deteriorating further. In other words, it stabilises its present condition for the future. This is our primary priority for our valuable dials. Restoration is the process of re-creating the parts of an object so that it is in the same condition as it was when it was new, or replacing missing parts. Obviously, this should not be attempted except under strict control. The most important point in both conservation and restoration is that whatever it is that is done to the object, it must be such that it is possible to return to object to its present state at any time in the future. In other words, it must not be damaged or modified by the processes. Many museums have damaged the objects in their charge, particularly in the 19th Century by over zealous acts of restoration. We are probably still doing the same today, inadvertently, but to a much lesser extent. The most important task that we have today is to stabilise an object to prevent further deterioration. At some time in the future, when restoration skills and methods improve, it may be possible for the dial to be restored to its former glory.

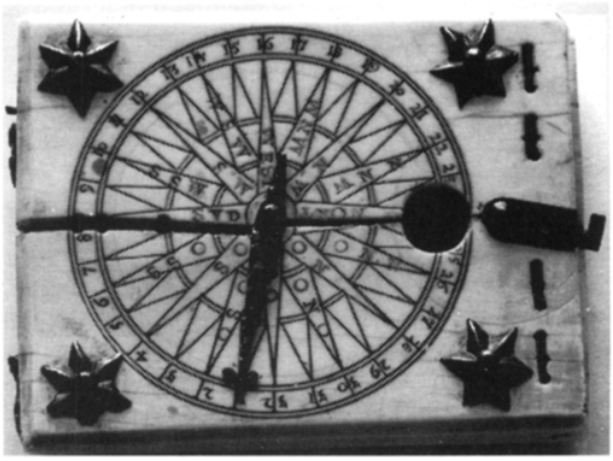


FIGURE 4: Split Ivory Diptych Dial by Paul Reinman

REPAIRS AND REPLACEMENTS

These two terms are really forms of restoration, but they will be considered separately.

If a dial is broken, should we repair it? This is often the most difficult decision. The best rule, as always, is that if in doubt, leave it alone, or at least obtain professional advice. Perhaps a few examples would be the best way to illustrate possibilities.

If an ivory dial has been split due to misuse or to low humidity, should we attempt to join the two pieces together? If we decide to affect a repair, we should then consider how this may best be achieved. The obvious solution is to use glue, but which one? It must be a glue that does not disfigure the dial. It must not stain or irrevocably damage the dial. It must always be a glue that can be removed in the future so that 'better' repair may be attempted. Most common glues are clearly not suitable. An epoxy resin is probably the best choice, if necessary with some white filler in it where it is required to fill a wide gap between the two parts. 'Super Glue', cyanoacrylate, may be considered as an option, but is probably less stable than a good epoxy. The parts to be joined should be lightly clamped together during the curing process, and all flashes of glue must be removed. If the parts of the object are held too tightly together, especially where each has warped, when the epoxy sets, new strains will be placed on the object and leave open the possibility of further cracking of otherwise whole parts. Epoxy may subsequently be removed, if necessary, by careful chipping and peeling. The use of resin softening chemicals such as acetone, or the much stronger dichloromethane should be a last resort, as these may leach the original oils from the ivory making it excessively brittle. They will also remove all traces of wax filling and any oil paint. The decision to repair is quite often a difficult one.

A metal dial may have a piece broken from it. Maybe an original casting has cracked. The solution here is quite

difficult. In many cases, epoxy will serve as a short to medium term solution. Its use is also reversible, especially on metals. If the pieces to be joined are part of an arm, the subsequent small joint will not be strong enough to hold them together for long. Solder may be considered to affect the join but with caution. Ordinary 60-40 lead-tin solder will join the two pieces of brass, and often steel parts. Soldering should only be undertaken with considerable forethought, as solder forms an alloy with the metals joined, and is extremely difficult, if not impossible to remove in the future. There is the case of an early medieval astrolabe where the rete became cracked in several places, and the owner decided to strengthen it with a thin sheet of brass soldered to its back surface (Figure 5). In time, due to corrosion, and because the soldering was not too well done, the thin sheet of brass lifted, and eventually fell off. The problem now is what to do. The back of the rete is covered in a thick layer of solder, and how can that be removed? This was a case of damaging restoration, and was probably done 100 or more years ago. Any process likely to remove the solder, is likely to damage the already weakened rete. If the decision is made to remove the solder, the only sensible way forward is to carefully scrape away all traces of it from the rete. This process will inevitably remove some of the original brass. There is then still the problem of bridging the cracks in the rete. With careful handling, it may be left in its present condition for someone in the future to find an acceptable solution. The object is in a relatively stable condition and is unlikely to deteriorate further if kept at low humidity. It can wait for future restoration when solder removal and new jointing materials become available. If a temporary repair is necessary to prevent the rete falling apart, a thin layer of rigid acrylic sheet could be applied to the rear face with a soft epoxy resin.

FIGURE 5: Rear of Rete from a medieval astrolabe showing solder used for repair

Another more permanent way of joining two pieces of brass or steel is by using silver solder. The joint produced will be almost as strong as the original, so this is the ideal method. The disadvantage is that the process of silver soldering needs a high temperature, normally to red heat, and this may degrade and will certainly anneal the areas so joined. Any surface finish or patination will already have been lost at much lower temperatures.

Silver has its own special problems. Low melting point silver has been used for centuries by jewellers and silversmiths, and many objects are found that have been almost invisibly joined. This process also needs considerable heat, often doing damage to the original parts. If the silver parts are gilt, as many of the better portable dials, then most forms of soldering should not even be considered.

A popular form of 'restoration', often used by clockmakers is to re-silver items. They nearly always re-silver clock dials. To do this, the original silvering is removed, then the dial is polished, before the new silver is applied. They also use certain chemicals for cleaning the brass parts, such as the famous Horolene, but we would never consider such products when used on precious instruments. A silvered sundial often has areas with silvering worn away, particularly when it has been cleaned with an abrasive metal polish. These dials are best left alone. Re-silvering may always be considered by a subsequent owner. Trying to patch the silvering normally leaves the part mottled and often looking worse then the original silver loss. We should again leave it alone. Re-silvering will not significantly add to the value of the dial, but in many cases may reduce its value to a prospective purchaser. If nothing else, he may become suspicious about what else may have been done to it.

Replacement parts of dials may be required so that they will still function as their maker intended. Where parts are missing, replacements should be made that are as close as possible to the originals. However, these parts must never be made such that a subsequent owner will be unable to tell them from the originals. When a new part is made, it is usually possible to mark it on an under surface with one's initials and the date. This is a way in which we can 'sign' part of the dial.

A quadrant dial by Walter Hayes was found without its gnomon,[2] which normally slides into a dovetail slot. It was decided to make a replacement so that the sundial was complete. A similar dial by Culpeper is known in the Whipple Museum in Cambridge,[3] so the new gnomon was made in the same form. Modern brass was used. This is whiter than the yellow cast brass of around 1700, so it obviously does not look 100% original (Figure 6). Just in case, this gnomon was stamped on the underside with maker's initials and the date.

Many dials that are found have had replacement glass covers over their compasses. In some cases, the compass needle will have been lost and a replacement fitted. It is often simple to detect a new piece of glass, as the original would probably contain small bubbles and surface imperfections. Compass needles can be more difficult to spot, but they should be compared with others of the same period. If a glass or the needle are missing on a dial, consider a replacement. Obviously, we would like the dial to function correctly. Try to mark the needle if possible to show that it is a replacement, but the glass will normally speak for itself.

HANDLING AND STORAGE

Much has been said about the damage done to dials, and other valuable antiques, by handling them with naked hands. Human skin contains acids that will fairly quickly etch away brass and other metals. This is such an important point, that the author makes no apology for repeating the warning. Never handle these objects. Wear the best cotton gloves, nylon will do but this could leave abrasive marks on softer silver, or use a clean cloth. If the gloves become soiled, wash them well and rinse them in clean water to remove any residual detergent. When removing the gloves,

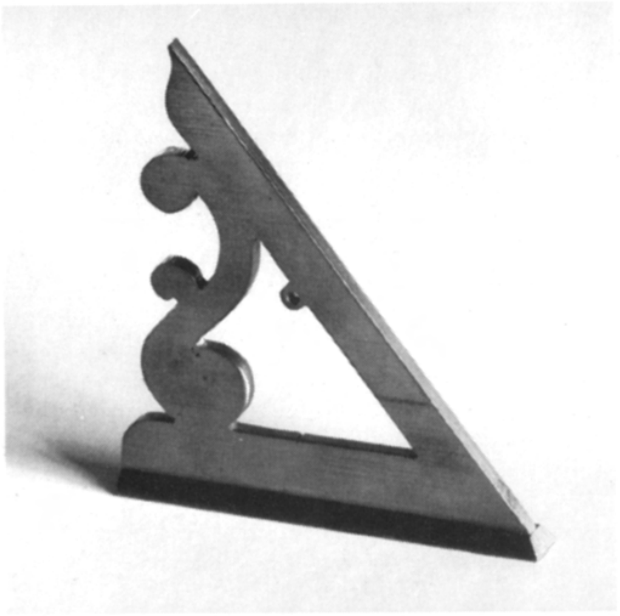


FIGURE 6: Replacement gnomon for a quadrant/sundial by Walter Hayes

remember that the second one to be removed will probably be pulled off with the other hand that is now naked. This contamination, although of a small risk, will still be there next time the gloves are used. Also avoid the possibility of the gloves being worn next time inside out.

Store the dials in their original cases, unless displayed. Whenever paper is used, make certain that it is acid free, but generally, this should be avoided for long term storage. If the dial is for display, choose a cabinet that is preferably at least 100 years old. If it is new, allow a gap in the door for ventilation.

Be careful about lighting. Ivory, wooden and paper clad dials may be affected by excess light and its associated heat. Fluorescent lighting is normally fairly safe, if unattractive, but look out for ultra violet radiation which may damage some items. Low voltage halogen lighting has become very popular due to its colour temperature and convenience. However, for delicate items, choose the lamps with an integral infrared shield to prevent damage and fading. In all cases, avoid sunlight if possible. A sundial without sunlight seems perverse! However, long term exposure to the sun's radiation will severely damage most organic materials.

For storage, use acid free materials and consider the use of polyethylene bags. These are available from specialist plastics' dealers. They may also be heat sealed to make them airtight.

CONCLUSIONS

A collection of dials is a very valuable asset. As with all antiques, we are not the owners of them, but merely their custodians. Therefore we must look after them to the best of our ability so that they will last for the benefit of future generations.

To enjoy these dials to the full, they should be clean and preferably in good order. All visible dust and contamination should be removed. This is especially important, if by leaving it, further deterioration would take place. We must not damage these wonderful objects through our ignorance.

Missing parts should be replaced where possible so that these dials remain functional.

A fine, well cared for collection is a treasure to be enjoyed by all.

REFERENCES

1. Renaissance Wax Polish. Available from:- *Picreator Enterprises Ltd., 44 Park View Gardens, Hendon, London, NW4 2PN.*
2. Moore, J. Portable Dial Accessories. BSS Bulletin 96.3.
3. Culpeper Quadrant in the Whipple Museum. Catalogue 6. Sundials and Related Instruments. Cat. No. 285 (Gnomon not illustrated).

LIST OF PORTABLE DIAL ARTICLES AND THEIR PUBLICATION DATES IN THE BULLETIN OF THE BRITISH SUNDIAL SOCIETY

1. Portable Dials. An Introduction 92.2 June 1992
2. Portable Dials. The Butterfield Style 92.3 October 1992
3. The Ivory Diptych Dial. Part 1 93.3 October 1993
4. The Ivory Diptych Dial. Part 2 94.1 February 1994
5. Ring Dials 94.2 June 1994
6. The Augsburg Dials 94.3 October 1994
7. The London Dial Makers 95.1 February 1995
8. Portable Dials. Art and Decoration 95.2 June 1995
9. Portable Dials - Altitude and Celestial 95.3 October 1995
10. Portable Dials. Accessories 96.2 June 1996
11. Porable Dials. Miscellany 96.3 October 1996
12. Portable Dials. Conservation and Restoration 97.1 January 1997
13. Portable Dials. Starting a Collection 97.2 April 1997
14. Museum Collections 97.3 July 1997

UMKHONTO WE LANGA SUNDIALS

R.P.M. HOLLIDAY (SOUTH AFRICA)

By way of background, in April 1996 I was invited to give a lecture to a small luncheon gathering of some engineer friends about another unique and quite interesting sundial (actually a heliochronometer), that I had designed and made for one of the "little rooms" in my wife's "secret" garden. Most people, it seems, think of the traditional horizontal sundials as being purely decorative, and totally unreliable in telling the time: indeed, such had been my own experience as a boy and I'd never really bothered with them again, so I spent no time in deciding not to have one in our garden. Instead I decided to design something from first principles, and what emerged was what I now know to be called an "equatorial type" of dial. In my design the sun shines through a style-hole representing the centre of a (transparent) Earth onto the inner surface of a cylinder notionally wrapped around the Earth's Equator and parallel to its axis of rotation. The image of the sun on this cylinder moves at constant speed of course, and gives the time ("o'dial" so to speak), as well as the sun's declination and thereby the approximate date. After some difficulty in finding data about the Sun's meanderings (which I really only knew about because Earth is a wanderer like all the other planets), I was introduced to the charming Mayall book on Sundials which provided a table of the Equation of Time. This in turn led me to design and incorporate into my dial an analogue computer which calculates the correction simply by setting the date against two discs which then automatically offset another hole from the first, and (coupled with a further fixed offset to correct for our longitude differing from our time zone origin) enable one to read the time "o'clock" directly, generally to within about 20 seconds accuracy.

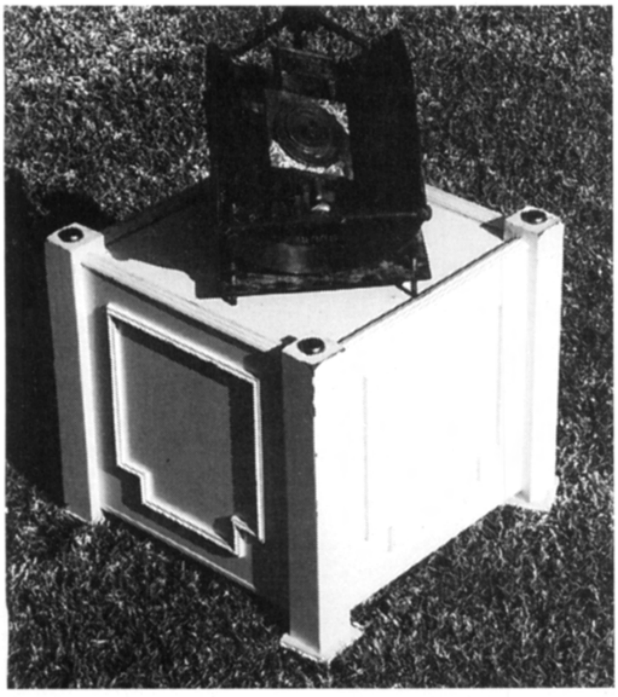


FIGURE 1: Heliochronometer

In giving my lecture I revisited my reasons for deciding against the traditional horizontal sundial for my wife's garden, and realised that even if I had had data for the Equation of Time, I would still have rejected it. Setting one's watch would still involve the varying shadow angles between the hours, i.e. widest over the dawn or sunset hour, and narrowest over the noon hour. How can one possibly interpolate the time with any degree of accuracy when the scale length is varying, even between the graduations?

And then it struck me that one may be able to calculate a line on a horizontal dial along which the shadow of the style would move with constant speed, the pre-requisite for linear interpolation, and so overcome my objection. At the end of the talk I posed the question to my audience thus: "If a striped shongalola (. . . this is the Zulu name for a millipede . . .) were to sun himself on a sundial in such a way that the sun touched a new stripe every minute, what pose would he adopt? I gave them an intuitive sketch of my idea, anticipating that the shape would resemble the sole of a shoe, with the shongalola draping his midriff around the noon hour (i.e. the toe of the shoe) widen at mid-morning and afternoon, then narrow down near his nose and tail (i.e. the insteps at 6 am/pm). My friend Mr. James Ridley, a Wits University Maths professor took the bait, and a day or two later very kindly dropped me a note giving me a general solution in the form of a polar equation (see Addendum).

I put it onto my computer and plotted some members of the family of curves that arise. Instead of a round nose like a shoe, the plot had a sharp nose like a spear, so I changed the name from "Shongalola" to "umKhonto we Langa". . . Zulu for "The Spear of the Sun".

I was quite excited by this, and couldn't wait to make two sundials, the first for my sister-in-law's new house, and the second for a friend to whom I owed a big thank-you. Both dials are unique, as each was designed for the exact Latitude and Longitude of their homes, and further "personalised" by my gouging out small "cradles" on their faces, and filing a notch on each style to expose the cradle to sunshine on the days and hours (o'clock) of their respective births. Further, to touch the imagination of the children and grandchildren in their lives, I drilled a hole in the style permitting the Sun to illuminate (hone) the very tip of the spear at 12 o'clock on Christmas Day (the sun is less than 3 degrees from vertical at noon as we live close to Capricorn and Xmas is only 5 days after our Summer Solstice: also at our Longitude a very small offset from the centreline of the style corrects for the time difference between Sun's noon and 12 o'clock).

On both dials, the hour lines radiate from the origin of the gnomon to a series of points comprising an ellipse. These points are all the exact same distance from the style, as measured perpendicularly to its nearest edge, and are the projection on the horizontal plane of the hour hand of a

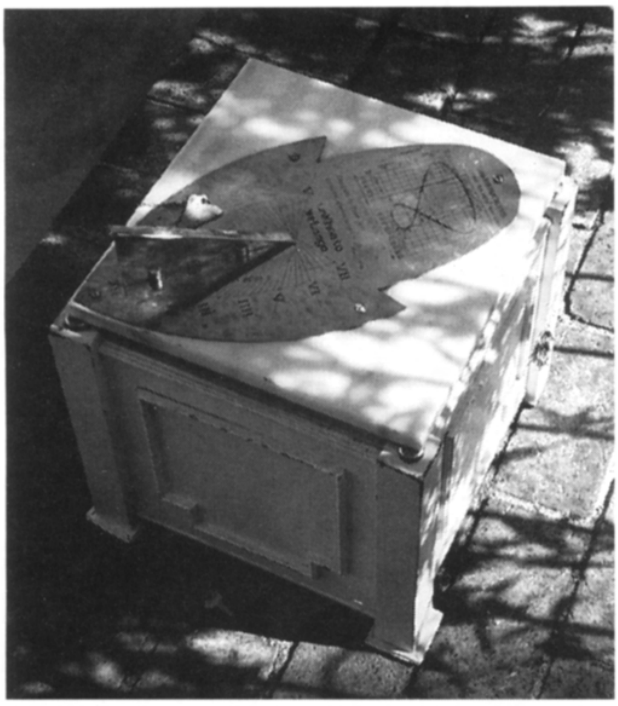


FIGURE 2: UMKHONTO Sundial mounted on white marble slab

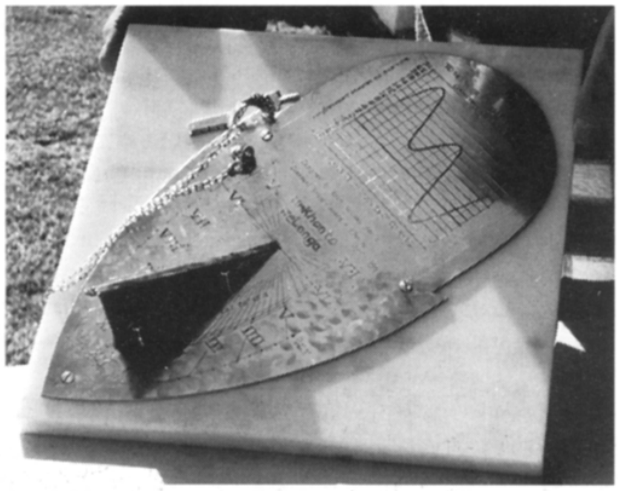


FIGURE 3: UmKhonto Sundial with Interpolator Scale, attached to main dial by gilt chain

clock whose axis is the style. This ellipse is contrasted against the Spear. The jagged edge of the spear arises from the style's width, i.e. to the switch-over from the shadow of the western edge to that of the eastern edge as the Sun passes the 6am/pm meridian lines. The time scale along the edge of the spear is sparsely graduated, only every 15 minutes, but a separate "interpolator" scale chained loosely to the dial has a more closely graduated scale which can be set alongside any hour where the dial's shadow lies to obviate guesswork. Such a supplementary scale would not be feasible on any other horizontal dial, it arises solely as a result of the linear time-scale concept.

A deliberate point of difference between the two dials is in the treatment of the correction from time o'dial to time o'clock. Both dials have graphs which correct for The Equation of Time, in itself adjusted to our Longitude, and 4 minutes per degree that we are West of the B time zone. On the first dial the correction is conventionally graphed against the month as X-axis, but the interpolator has a second function - it can be used on the graph too, to locate the exact date in any month and then to read off the relevant correction in minutes-cum-fractions as graduated up the Y axis. On the second dial I provided a version of the Analemma, with a horizontal time graticule widened to make it easier to read from: Declination is on the Y-axis but with the top of the analemma being maximum South, not North, declination, i.e. as we see it from South of the Equator. The limits are shown as Cancer and Capricorn lines: and the solstices as marks on the analemma itself, additional to those demarcating the months and weeks. Of particular interest may be an ellipse inscribed within the graph . . . this is the "first harmonic" of the Equation of Time, as generated by the eccentricity of the Earth's orbit around the Sun: the offset of the analemma line from this ellipse is clearly revealed and is the "second harmonic" of the Equation, generated by the obliquity of Earth's rotational axis to its orbital plane. I know that on this dial I have sacrificed the interpolative accuracy of the the Spear by incorporating the very non-linear Analemmatic correction curve, but the Analemma with all its assymetries is bait for the curious, and has the special beauty of things natural.

The dials are made of gilding metal, 90% Copper 10% Zinc, so much prettier than brass or lead, even when tarnished: over a time it also develops a greeny-blue patina. Judiciously "faked" rotary brush marks make the Spears appear to be aflame, and I mounted them on African marble squares (330mm side) which provide a clean contrast to the metal.

* * * * *

APPENDIX
CALCULATIONS FOR UMKHONTO WE LANGE (THE SPEAR OF THE SUN)

Mr. Ridley's solution is that the radius "R" (from the origin) of any point along the curve is derived from the radius "r" of its immediate predecessor by solving the expression below, given that angle "A" is the angle of the new point and "a" that of its predecessor, both from a line of reference (e.g. 6am or midday).

The expression is:

$$r = \pm\sqrt{C^2 - (r^2 \times [A-a])^2}$$

NOTES:

1. Each angle "a" or "A" is expressed in radians, and (if the reference line is 6am) it can be calculated from tan(a or A) = tan(hour angle)/sin (LATITUDE).

   If you choose to plot the curve at say 1/4 hour intervals, remember each hour = 15 degrees, i.e. every 1/4 hour =

3.75 degrees. Find A first in degrees, then to convert to radians multiply by Pi and divide by 180.

2. "C" is a constant which, like the initial value of "r" must be chosen. Both have a bearing on the scale (and shape?).

   The uninitiated will find that the calculation will fail unexpectedly at times. This is because the term under the square root sign can become negative, i.e. if "C" is smaller than the maximum value of "r x (A-a)". Note that r and A increase, but (A-a) decreases the nearer you approach 12 o'clock, which is when the calculation is most likely to break down. All values are also dependent on what time interval you choose between the points you wish to plot.

   Mr. Ridley suggests "repeat the calculation taking the plus sign each time, with *different* values of C until you get one such that the term under the square root sign *becomes zero* at the halfway stage, then take the minus sign for the rest of the calculations to get a symmetrical curve".

3. On my computer I simply found a minimum value of C that worked for a 5 minute time interval when calculating the curve for the hours between six am and twelve only; then used symmetry for the remaining dawn, dusk and afternoon hours. The radii were thereafter simply scaled up to suit the overall size of dial I wanted. (This could possibly be an aesthetically sub-optimal solution, but satisfies the requirement.)

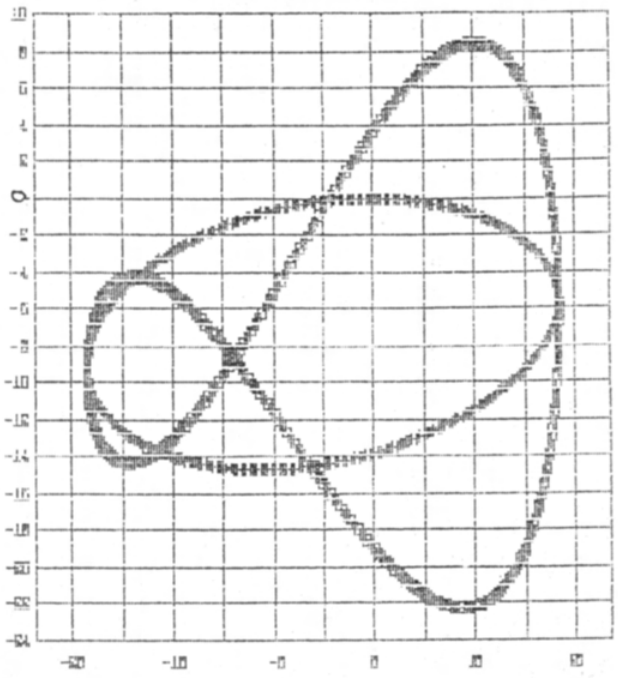


FIGURE 4: The Analemma seen from the South

This graph is NOT annotated with month, week, solstice etc. markings, it is on the actual dial.

This is the widened analemma with the first harmonic ellipse in it. It is rotated (and the titles) 90° on the dial itself. The zero time correction is displaced because of local longitude time correction.

Continued from page 24

THE 1996 SOMERSET MASS DIAL SURVEY

fascinating insight into a subject closely related to the study of mass dials.

On Sunday, again fair and sunny, but with the promise of a shower or two, the group concentrated on the dials in the local Yeovil area. Again, much success with almost all the dials on the plan being recorded, together with several sundials. Also there was much interest including some places which needed persistence. St Andrews, Aller, is in the middle of the Somerset Levels and access proved awkward. Gerald Stancey and John Ingram attempted to cross the Levels by train tracks and canal service roads but were frustrated and had to drive round some 15 miles. Even when they got there they found the South porch had been blocked off, negating access to the original nave doorway. However, the church was open and the team found the porch had been converted into the cleaners' room, with access from the nave. Gerald was clever enough to find the light switch and the team were rewarded by the sight of a beautiful Norman arch with mass dials almost as fresh as the day they were made, probably c1200.

The final tally has yet to be added up. The team record sheets and photographs were to be sent to the group co-ordinator, Edward Martin, when photographs had been developed, for compilation, analysis and a final report. Suffice to say that some 97 churches were visited during the weekend, recording 172 dials, and these numbers will improve as some late reports come to hand.

FIGURE 2: Stratton-on-the-Fosse

THE 1996 SOMERSET MASS DIAL SURVEY

JOHN INGRAM

During the last weekend of June 1996 members of the Mass Dial Group re-traced Dom Ethelbert Horne's journeys in Somerset to seek out and record the dials he had reported and described so carefully in his book *Primitive Sun Dials or Scratch Dials*, published by Barnicott and Pearce, The Wessex Press, Taunton in two editions during the early part of the century. The Dom visited all the almost 500 churches in Somerset, and found that 142 of them still had their mass dials, although often repositioned, much eroded or rendered inutile by subsequent re-building. He described 224 dials altogether and his method of analysing their qualities was to use photographs, a relatively new technique, to group and compare the dials, with the aim of devising a classification which in time might lead to theories as to their construction and use.

Horne grouped all the churches where dials were to be found geographically into areas which he called North and South Somerset; these he divided in turn into districts by the nearest principal towns. It was therefore a straight forward task to devise routes for group teams to follow, using his reports, for motor car travel and modern Ordnance maps; it is not recorded how the Dom travelled, though it is known that he corresponded not only with his ecclesiastic colleagues, but also with local people including a postman. Most of the churches to be visited were in very rural locations, requiring a detailed knowledge of deepest Somerset and accordingly a large map was constructed by joining no less than 8 1:50000 Ordnance maps together, so that the locations and relative positions of the churches could be identified easily. A realistic appraisal of what might be achieved by the group, within a sensible time scale, could now be undertaken.

It was decided therefore to centre the weekend at the Hollies Hotel, Martock, near Yeovil, in central South Somerset, as this was in the middle of the main mass dial area, the hotel offered first class facilities, and travel was satisfactory. Having assembled on the Friday evening, and after a refreshing dinner and being joined by local members, the group set itself up into teams for the following day, each one choosing either one or part of one of the Dom's districts containing from 6 to 8 churches, covering between 8 and 12 dials. Alan Cook and Edward Martin took Bridgewater and Frome respectively, the most far flung, and David and Lilli Young took a double, Langport, with a total of 12 churches and 19 dials. The more remote districts in North Somerset, until recently called Avon, including Axbridge, Keynsham and Bath, proved to be too far away. All the dials were to be recorded using the Mass Dial Record form and were to be photocopied.

On the Saturday, the weather was set fair and sunny, and after an excellent breakfast the teams set out. It proved to be a day of much interest, and a deal of success. About 90% of the dials programmed were found and recorded. Some were missed because of time, some were no longer there, but by far the majority were found as recorded by the Dom and generally in much the same condition. However, one or two inaccuracies in the Dom's reporting were also found! These included such things as portions of nearby 'copy' gnomon holes, heights and positions. Surprisingly, several 'new' dials were also found; no doubt this would have been because in the Dom's time creepers on churches was much more prevalent than it is today. Peter and Jane Walker, and David and Mrs. Brown recorded most of the dials not visited on the Sunday morning.

On Saturday evening the group were treated to a talk by local historians Brian and Maria Gitto, members of the Somerset Archaeological and Natural History Society who described the local churches, and in particular some of their monuments explaining their significance, together with

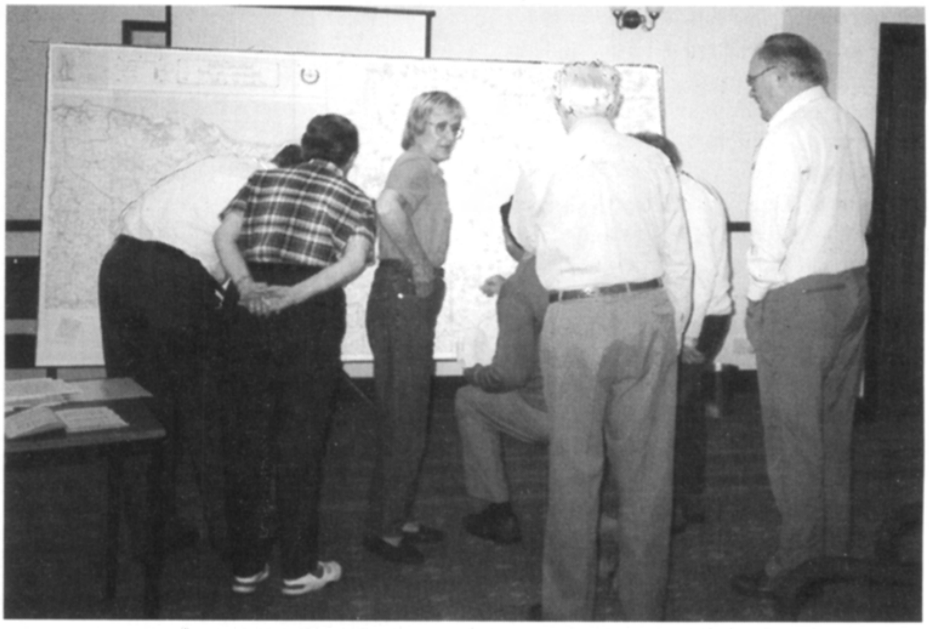


FIGURE 1: Route Planning: Left to Right: David Watts, Betty Watts, Diane Morgan, Alan Cook (kneeling), Haydn Morgan, Margaret Stanier (part hidden), Gerald Stancey

Continued on page 23

FINDING THE MERIDIAN LINE BY MERIDIAN TRANSIT

RENE J. VINCK

The meridian line, or true north-south is commonly assessed by the following principle:

The shadow, on a flat level surface of any vertical object or of a plumb line will lie in the local meridian or true north-south line at the moment of local apparent noon, which is true solar noon.

At that instant the sun is in the local meridian and bears due south in the northern hemisphere.

The altitude of the sun at meridian passage is given by the formula:

$$h = 90° - L + d$$

where L is the latitude of the observer.

The declination "d" of the sun is to be treated as a negative quantity when latitude and declination are of contrary signs.

The accuracy of the method depends on the right moment of observation, which should be true noon.

If for any reason the moment of marking the shadow differs slightly from true noon due to a small error on your watch for instance, the ex-meridian error can be computed as follows.

If "A" represents the position of the sun near meridian passage, the azimuth is given by the sine rule:

Sin Z / sin PA = sin P / sin ZA

sin Z = sin P. cos d / cos h

Error = 180°-Z and:

sin error = sin P. cos d / cos h

since we consider only small angles we may write:

sin Error = Error in sin P = P (in radians) or
Error = P . cos d / cos h (in degrees)

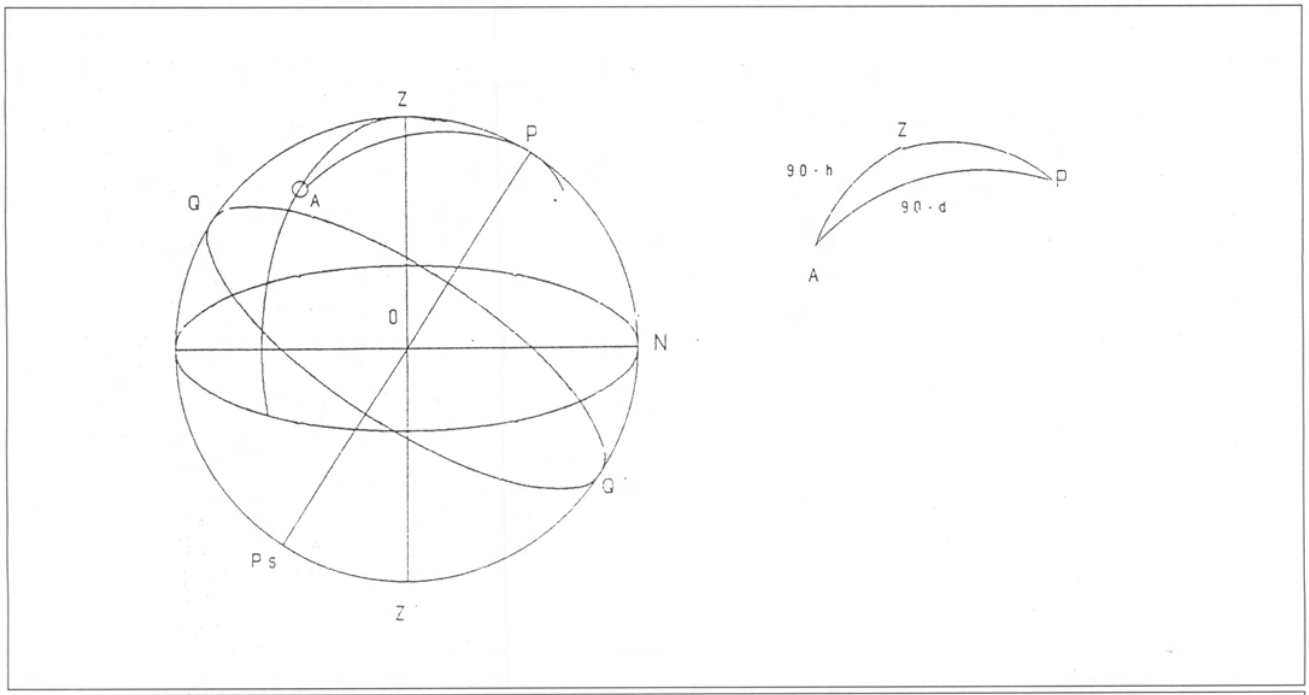
In the case of the sun, the cosine of whose declination is always nearly 1, we may write:

$$\text{Error} = P / \cos h$$

Since an hour angle of 1° corresponds to 4 minutes or 240 seconds of time the final formula is:

Error ° = time in seconds from true noon / (240.cos h)

The next table is computed in function of the average altitude of the sun and the time difference from true noon, for latitude 51° north.



EX-MERIDIAN ERROR in degrees (L = 51° N)							
TIME FROM MERIDIAN PASSAGE in seconds							
	h	10"	20"	30"	40"	50"	60"
January	16°	0.043	0.087	0.13	0.173	0.217	0.26
February	27°	0.047	0.094	0.14	0.187	0.234	0.281
March	31°	0.049	0.097	0.146	0.194	0.243	0.292
April	43°	0.057	0.114	0.171	0.228	0.285	0.342
May	54°	0.071	0.142	0.213	0.284	0.354	0.425
June	61°	0.086	0.172	0.258	0.344	0.43	0.516
July	62°	0.089	0.178	0.266	0.355	0.444	0.533
August	57°	0.077	0.153	0.23	0.306	0.383	0.459
September	47°	0.061	0.122	0.183	0.244	0.305	0.367
October	36°	0.052	0.103	0.155	0.206	0.258	0.309
November	25°	0.046	0.092	0.138	0.184	0.23	0.276
December	17°	0.044	0.087	0.131	0.174	0.218	0.261

DESTRUCTION BY VINES

CHARLES K. AKED

In BSS Bulletin 93.3, pages 32-38, under the title of "Destruction by Decay", the writer drew attention to the accelerating rate of deterioration of sundials under the impact of our modern environment.

In the above title "vines" is an acronym for:

1. Vandalism
2. Indifference
3. Neglect
4. Etiolation
5. Stolen

VANDALISM

Although this is a matter for immediate concern, ranging from bending of the gnomon to ripping it clean off, theft of the dial plate itself, and sometimes the pedestal as well, it is a relatively modern phenomenon or we would not have had any sundials left at all. But see the last section.

The great majority of British people are well-behaved and law-abiding, and whilst the number of incidents concerning sundials are relatively few, it is because sundials are in such prominence as public furniture that when a sundial is involved, it is quickly drawn to our attention. We do not have to fear deliberate criminals alone in guarding against loss of dials, they may well be on a public building and presented by someone in the past as a gift, but if some incompetent, as at the Greenwich Maritime Museum, makes a decision that they are in the way - they will be removed and destroyed before anyone is able to make a protest. Similarly, church authorities, in deciding to clear a burial ground of memorials, have no compunction in removing a sundial which is part of a memorial to someone. Those who might have protested have already journeyed elsewhere where there is everlasting light and presumably no need for sundials. On this aspect the writer has no facts upon which to draw.

Sometimes the vandalism goes unnoticed, as for example in Figure 1 showing the sundial at Deal Castle. When enquiries were made about the missing gnomon, evidently wrenched off for some time, the people in charge did not know about the damage, whether it had been like that for a long time, or even that anything was amiss with the sundial. As the pedestal is relatively new, the sundial must have been in good order when that was erected. For other examples of vandalism, see picture gallery under that heading. The most common act of vandalism is wrenching the gnomon off the dial plate. It is not confined to hooligans, the ancient armillary sphere at Merton College was twisted into uselessness by undergraduates after a night's celebrations in 1991. It has since been restored.

For three other examples see Vandalism in the picture gallery.

INDIFFERENCE

Indifference is a great an exterminator of sundials as anything else. The gradual change in the sundial caused by cause 4 (Etiolate - to become or cause to make pale or weak), is such a slow process that it is like the observed shadow of a sundial, impossible to detect except by going away and coming back again after a suitable time. This is why most of us look at the stone skeletons of sundials and accept these as normal, whereas from the beginning of the adoption of the polar gnomon in the Middle Ages, we know that these were decorated in multicoloured dress like Joseph's coat, and were painted at regular intervals to maintain them in good order. When it comes to maintaining the fabric of a church building, sundials have a very low priority as far as restoration funds are concerned. By the time someone comes round to deciding that something ought to be done, the dial has deteriorated into a state when restoration of the original work is not possible, the work will have to be started from scratch. Once paint has begun to peel extensively from a base, nothing less than complete removal is going to make it possible to form a firm and lasting foundation for the dial delineation. Modern paints are only better by lasting longer, and whilst gilding with gold leaf can stay in good condition for a quarter of a century or more, the best of paints can last a decade or so only before becoming leached into instability.

Figures 5-7 illustrate the insidious nature of paint damage. That in Figure 5 shows the sundial at Old Isleworth Parish church before its recent restoration. At a glance the dial looks in excellent condition, look more closely and the damage to the paint at the left and base in only too visible, that is why in the arch above, Old Father Time is saying "Watch and Pray", but he looks as though he is fishing instead of wielding his scythe. The sundial has since been repainted (1994). Figure 6 shows a painted sundial where the top part of the frame has succumbed to rot, and the bottom rail is about to fall off. The wood has also started to rot at the lower gnomon foot mounting. This dial shows the folly of using a panel made of strips of wood joined together, sooner, rather than later, the joints will open and allow water to penetrate. A panel of Marine Ply is far better, it can present a single surface without a break.

Wooden panels forming the base of a sundial always crack in time, once water penetrates, the scene is set for wet or dry rot to propagate.

Figure 7 illustrates a country dial untouched for the last fifty-years to the writer's knowledge, and as a result, is beyond redemption, even though mounted on a church wall out of normal reach.

Neglect is obviously a natural result of indifference but many sundials are neglected even though the owners are not indifferent to their condition. It may be merely ignorance of how to care for their charges, for example a Pilkington-Gibbs solar chronometer cannot be left outside permanently without regular treatment to resist corrosion, because the surface of the exposed metal becomes so granular as to efface the graduations of the scales. Patination is a prized state for many owners, but a constant deposition of bird droppings on a brass horizontal dial leads to a gradual degradation of the dial surface, accelerated by rain. These deposits need to be cleared, preferably on a daily basis. Of course a light patination on a brass sundial improves the indications considerably. Do not polish!!

Similarly with pedestals, once cracks or damage allow the ingress of water, the first frost of winter will be the wedge to drive deeper into the body of the support. Ordinary car fillers are ideal to repair such minor faults, using the elastic variety to allow for the constant

VANDALISED

FIGURE 1: Gnomonless sundial at Deal Castle, Kent

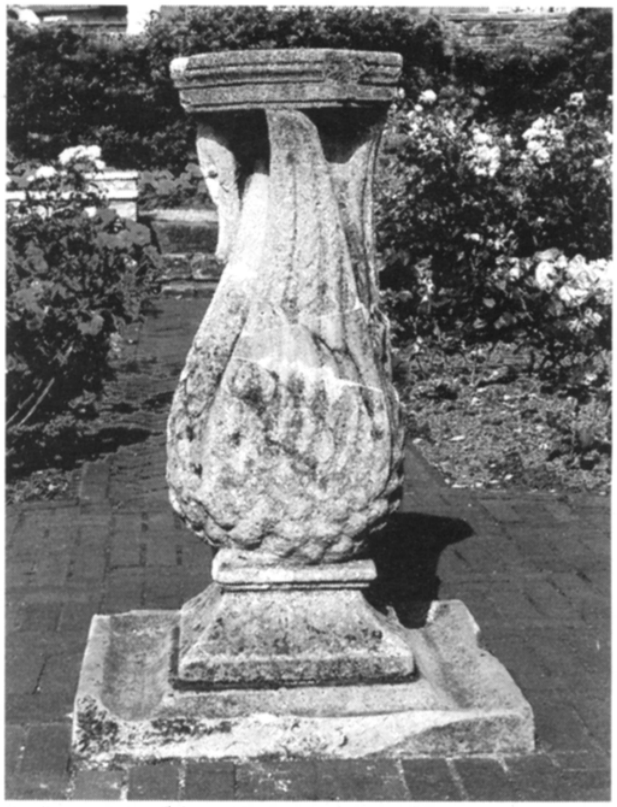


FIGURE 2: Gnomonless dial at Stratford-upon-Avon

FIGURE 3: Gnomonless dial at Lewes, St. Anne's church

FIGURE 4: Damaged terracotta pediment of sundial, Glasgow

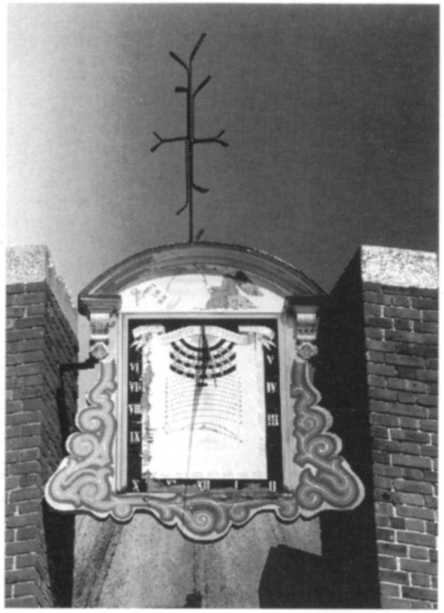


FIGURE 5: The Sundial on the Old Parish Church, Isleworth

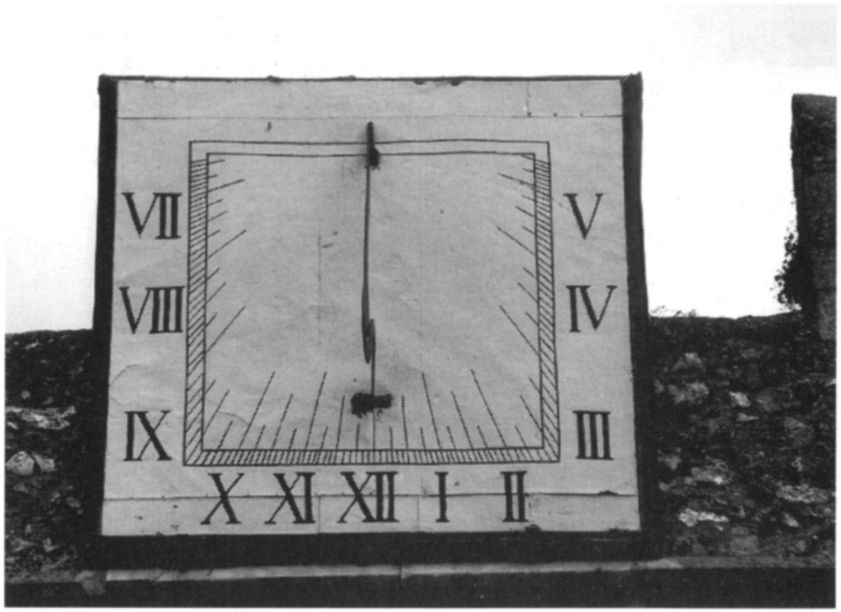


FIGURE 6: The wooden panel sundial on a village church

FIGURE 7: The remains of the painted sundial at Lilleshall church, Shropshire

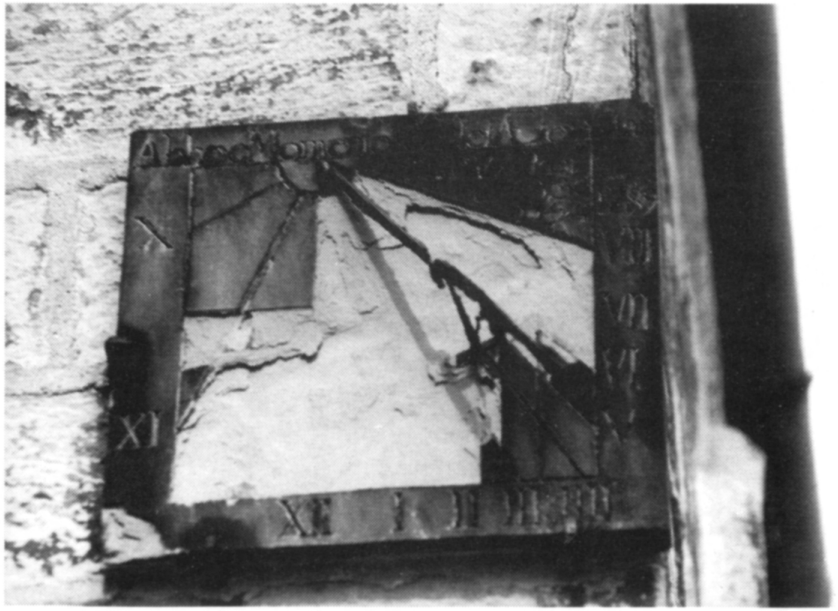


FIGURE 8: The cankered remains of the sundial on St. Peter's church, Tankersley

dimensional changes. A small piece of the original stone, ground into dust, rubbed into the surface of the filler will camouflage the intrusion. A couple of coatings of water repellent silicone treatment works wonders in keeping moisture out of the pedestal and yet allows "breathing" of the stone which is so essential to keeping it in good condition. One of the best treatments, if it is not out of place, is limewash. This protects stone indefinitely and is the reason why so many old dials are still with us today, at one time they were regularly limewashed. Although this treatment might hide the details in time, it could always be removed without damage to the dial surface when the lime coating became too thick. The lime coating becomes sacrificial in the presence of acidic rain, preventing damage to the stone.

Figure 8 shows the final results of indifference, a fine dial destroyed.

NEGLECT

This requires no effort at all on the part of the owners whatsoever and is the greatest destruction agency of all. Throughout the country examples of neglected sundials are to be found - see Figures 9-12. Figure 12 shows an unusual case where ivy has been allowed to grow over what was quite a nice dial and obliterate it almost completely, this was the example which suggested the title to this article. The lamp above? Fitted by the owner to obtain the time from the sundial at night in the absence of the sun! He found it rather less than successful, although the substantial gnomon gives a good shadow. The smaller size of the leaves over the dial shows that the ivy is cleared off the dial occasionally.

It is salutary to remember that although England probably has the greatest number of mass dials of any country, not one of them is protected from the weather apart from those which have fortuitously been taken inside the church or covered by a later porch. The Anglo-Saxon dial at Kirkdale, as with that at Bishopstone, have been preserved in excellent condition by the protection of the porch. Kirkdale is the supreme example of preservation, first by lime wash, and then by a layer of lime plaster until it was re-discovered by the Reverend W. Dade in 1771, see *Archaeologia*. Volume 5, pages 118-205, published 1779. This has no protection against vandalism, when really it should have a toughened glass panel covering this national treasure. It gives great credit to the church authorities that this little church, so far removed from other habitation, is left open for visitors to enjoy in this age of mindless destruction.

On the opposite side of the country, at Bewcastle is the supreme result of neglect. Here the oldest native sundial has been allowed to vanish, almost with trace. It has left its mark in the plaster casts in Durham Cathedral, the Plaster Court in the Victoria and Albert museum, and the Science Museum, in London. How careless we have been with our dialling treasures of the past, irreplaceable and lost for ever.

One of the few meridian lines in the country, at Durham Cathedral, is completely neglected, see Figure 9 for the remains of the line installed by William Lloyd Wharton and Mr. Carr, headmaster of Durham School, in 1820 in the cloister of the cathedral. Lower down on the wall, and on the floor, only vestiges of the line remain. Just below the word "MERIDIES" and the date of 1820, is a very faded row of numerals, progressing 5 10 15 on the right hand side of the line, and from these, faint vertical lines on the wall drop to the floor, presumably to take account of the Equation of Time. No scale was required on the left as the Winter sun only strikes the wall. The summer sun is always on the pavement below.

As for the sundial outside the Dean's kitchen in Durham Cathedral, it was much decayed as long ago as 1888. Its motto read SOLES PEREUNT ET IMPUTANTUR, "Suns Depart and are Reckoned" (but not by this sundial). It must be conceded that the exposed site of Durham Cathedral and the bitter winters are not kind to stonework.

ETIOLATION

In his lifetime, the writer has seen a number of sundials sink into oblivion through the fading of the painted features, but even deeply incised lines on stone surfaces are not invulnerable to the action of time and weather, see Figure 16, for an extreme example. Sundials, by their very nature, demanding as they do a clear uncluttered exposure to the sun, also face the full blasts of inclement weather. Paint is alternately heated by the sun, cooled by rain, snow, frost and wind, until its surface becomes crazed; whilst sunlight at its strongest is doing its best to bleach every iota of colour out the paint. Inevitably, if a dial is not constantly freshened, it will fade into insignificance, as in Figures 13-16, in less than the lifetime of an interested observer. The sundial at Lilleshall church shown in Figure 7 is interesting because of the "Railway Time" tablet which is under the sundial. The tablet is of bronze and has survived unscathed, whereas the sundial has expired through a complete lack of maintenance.

STOLEN

This is a relatively new phenomenon, for it is certainly the case that no dial of any value can be left outside these days. Some dials have been removed in the past merely for the metal, a tragedy because this value is but a very small fraction of its worth as an unblemished artifact. The writer has recommended on a number of occasions that it would be better to remove a dial and replace it with a garden centre sundial for ornament only. The fact that a sundial has been unmolested for a couple of centuries is no safeguard, for example the Thomas Ore sundial at Tong Church was there for 200 years before someone decided to take it, and part of its stone supporting pillar, on an old preaching cross, see Figure 17. As Thomas Ore was a local clockmaker, this is a lamentable loss of a local treasure. Let us hope the thief suffers with his conscience and returns the dial to its rightful place to save his soul.

Of course the theft of sundials has always occurred from time to time, as witnessed by the following newspaper advertisements of long ago:

> Whereas a small dial made by . . . Rider of London, was lately offered to sale for a very small value, and the same being suspected to be stolen was stopt; these are to give notice, that any person may by inquiry at the King's Head at East lane-stairs on Rotherith-Wall in the county of Surrey, be informed where the said dyal may be seen.
>
> *Daily Courant*, 27 February, 1712.

NEGLECTED

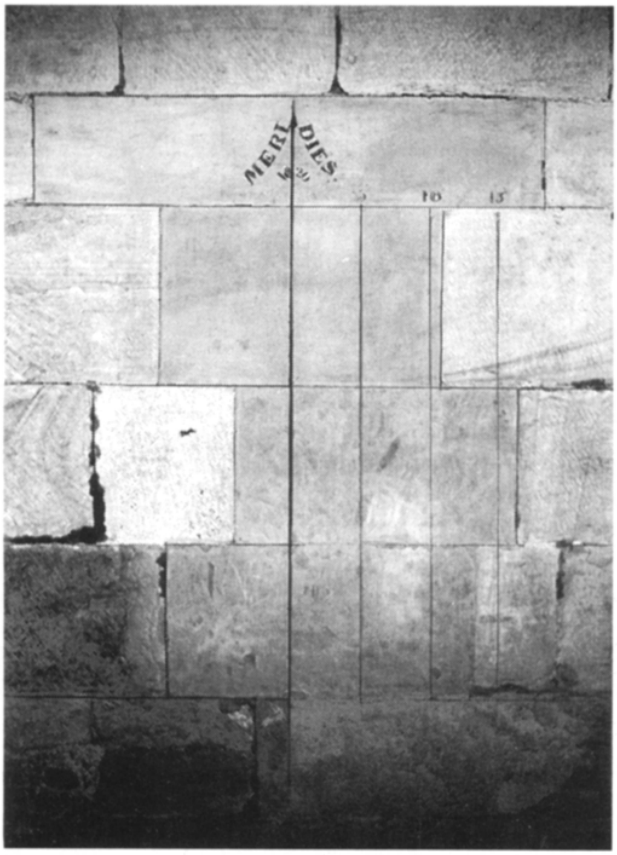


FIGURE 9: The Meridian Line at Durham Cathedral, taken by Marinus Hagen, 1976

FIGURE 10: Horizontal sundial, St. Peter's church, Tankersley, Sheffield. Gnomon ripped off, plate damaged, sundial under shade of overhanging tree!

FIGURE 11: Folorn pedestal at St. Luke's Church, Lowton. The sundial was stolen many decades ago and never replaced.

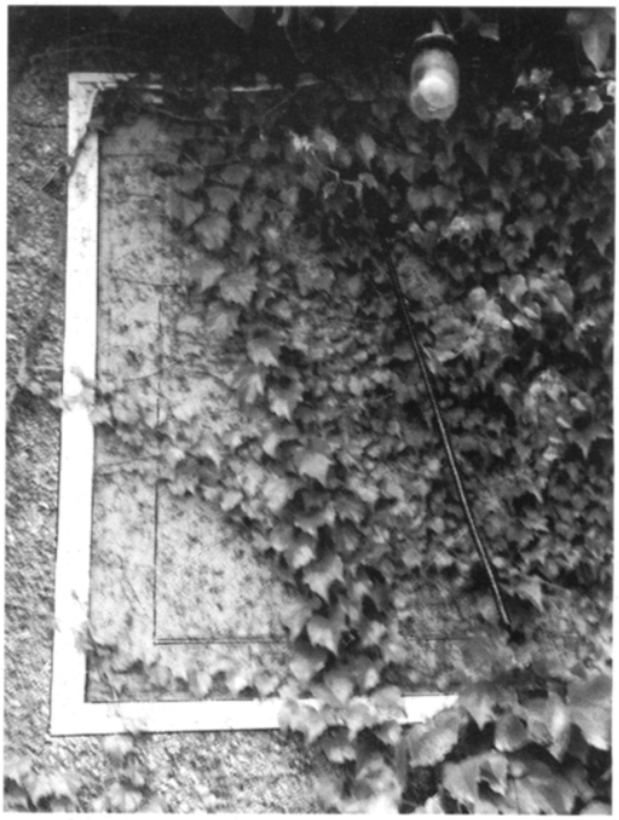


FIGURE 12: Sundial on Sundial Cottage, Wentworth, Yorkshire

ETIOLATED

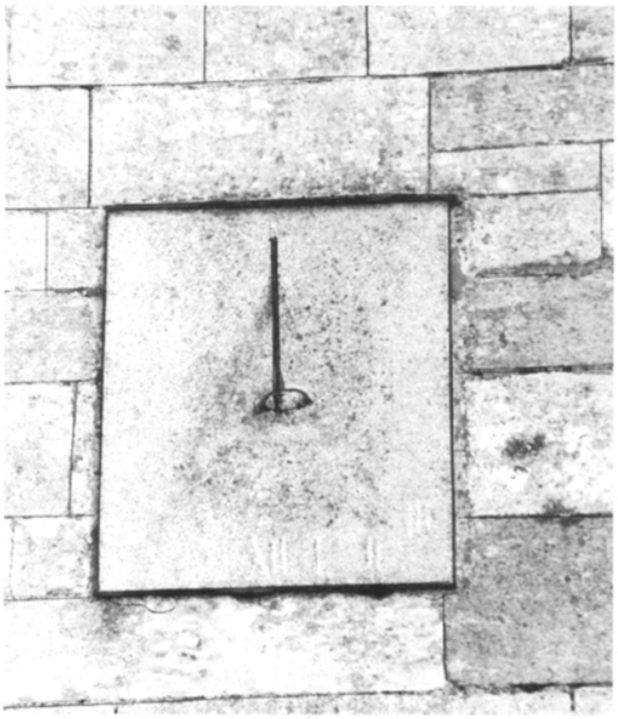


FIGURE 13: Time has almost effaced the vertical sundial on Sir Isaac Newton's church - Colsterworth Parish Church, Lincolnshire.

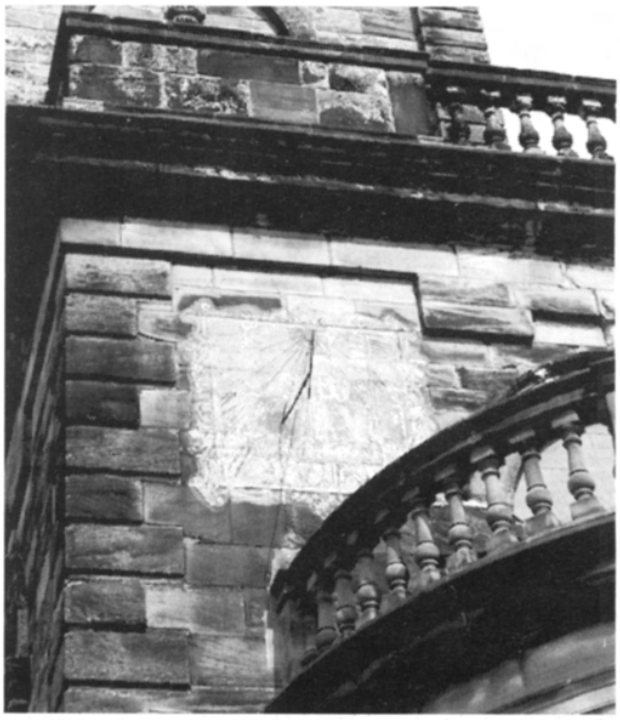


FIGURE 14: The bleached remains of the east declining sundial on Whitchurch Parish church, Shropshire

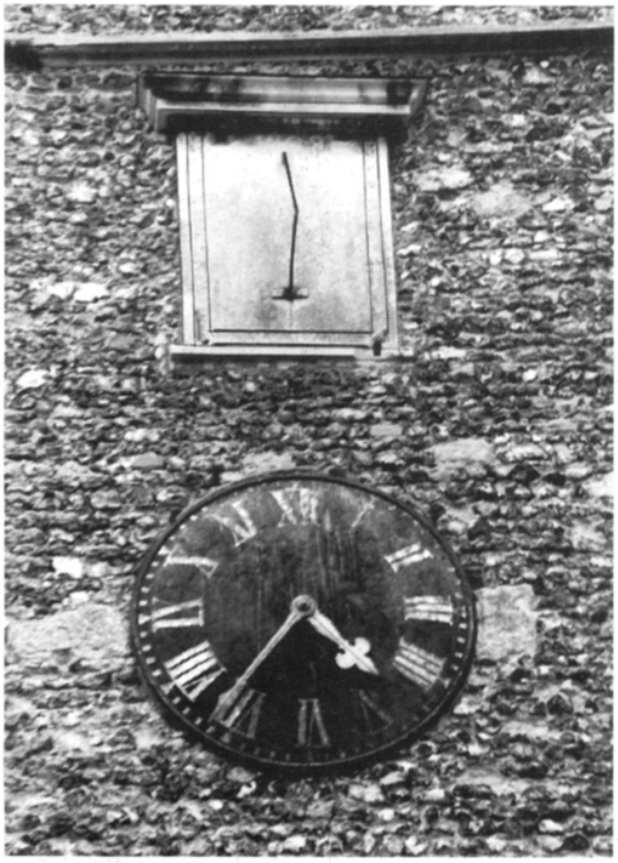


FIGURE 15: Entirely effaced, the sundial on Cookham church, Berkshire

FIGURE 16: Annihilated by the passage of Time, sundial on the Parish church of St. Simon and St. Jude, East Dean

Note: "Stopt" meant informing those charged with keeping the peace, detaining the person considered to the culprit, and taking possession of the suspected item. Those attempting to regain possession of their stolen goods had to satisfy those holding the items by some proof of ownership (and also pay their expenses and give a small reward).

Whereas on Tuesday night last the 25th instant, some person got over a garden wall in Clapton in Hackney parish, and wrenched off from a pedistal to which it was fastened, a brass sun dial plate, of about 9 or 10 inches square, finely engraven with a coat of arms, viz. three pomies (or balls) each charged with a cross, the crest a mural cotoner, with a pomie crossed between two wings; the maker's name Culpeper, the hours and minutes, with the 32 points of the compas. If any person shall discover the thief, so as he may be convicted, he shall on such conviction be paid £5 by Mr. Sam Crouch, bookseller, at the corner of Pope's Head-Alley in Cornhill.

Daily Courant, 29th May, 1714.

The writer finds that the theft of a sundial is particularly detestable when the sundial, as shown in Figures 18 and 19, was erected as a memorial to a loved one. On visiting Ovingdean Church in Sussex in September 1990, the writer was distressed to find the sundial, erected to the memory of Emma Stead, had had the horizontal dial plate stolen. At the base of the substantial pedestal, obviously specially commissioned, is the dedication:

IN AFFECTIONATE REMEMBRANCE OF
EMMA STEAD
WIFE OF THE REV^{D} ALFRED STEAD
RECTOR OF OVINGDEAN

THIS SUNDIAL IS ERECTED BY HER LOVING
FRIENDS **** **** IN THE PARISH APRIL 6 1882

A little of the inscription is unreadable, and the date almost erased. How can anyone be so mean and ghoulish as to steal a sundial dedicated to a departed soul?

There was also a touching inscription on the dial:

SHADOWS CAST UPON THE DIAL SHOW
THE PRESENCE OF THE SUN ABOVE:
SHADOWS CAST UPON OUR LIFE BELOW,
TRUE TOKENS ARE THAT GOD IS LOVE.

APRIL 6TH 1882

Often the writer's journey to examine a sundial has been made fruitless by finding only a pedestal where once a fine sundial stood, as at Ovingdean - a long journey almost completely wasted. The dial is mentioned in Mrs. Gatty's book.

One day a visitor to the Council Offices in Lewes asked where the sundial was in Lewes House garden, see Figure 20. It was not until the following day that it was discovered that the visitor had admired the dial so much that he took it away with him. So when the writer journeyed to Lewes to examine the various sundials, one had been stolen, another had had its gnomon removed, others had just vanished completely.

It is quite obvious that today a sundial by a master craftsman of the past can no longer be left outside in safety. Such a dial might be worth hundreds or even thousands of pounds and can be removed in a twinkling of an eye. The writer found a dial by Elias Allen, and advised the owner to take it indoors, the owner thought it would take some time to remove it from the pedestal - it did - about one minute to remove the holding screws. A thief would not be so careful, one occasionally finds bent plates where a thief has been unable to remove the last of the rusted-in screws and has tried to wrench the plate off. It is very difficult to restore such a damaged plate to normality again because if the plate is folded, it distorts the plate permanently and the stresses set up at the bend may lead to seasonal cracking later, or breakage when straightened again. Old sundial plates are of hammered brass to make them hard, and this leads to a loss of ductility.

Even sundials in well occupied public spaces are not immune to thieves, that is why at such places as Kew Garden, the memorial sundial made by the famous clockmaker Thomas Tompion had to be replaced by a handsome replica and the original conserved in the nearby museum. The changing attitude to the value of sundials is exemplified by the Tompion sundial in the mineral spring room at Bath, installed to rectify the year-going Tompion longcase clock in the Assembly Rooms. This was found on a rubbish heap in a farmer's farmyard, miles away, quite by accident; no one knows how it got there. It was restored and replaced on its original site by Brigadier Nielson some years ago.

Examples such as the Pilkington Gibbs solar chronometers are ripe targets for the unwanted sundial removal specialist. Storage indoors is the only safe way of retaining possession of these desirable objects. It is up to each of us with examples to see that they are passed on to those who appreciate them, and not allow them to be garnered by those who seek to build up a collection of sundials at little or no cost to themselves, but at great mental anguish to the proper owners. Be warned, take action whilst the sundials are still in your possession. Those with collections of portable sundials are at the greatest risk, these are easily stolen, are intrinsically valuable, and generally irreplaceable. At the very least have photographs of all your sundials, a picture is worth a thousand words when trying explain to an untutored person what the sundial looks like.

Recording of such data as dimensions, special features, engraved inscriptions, and so on, are all sensible safeguards in case the worst comes to the worst. Regret is best avoided. It takes time to write and maintain an inventory but how invaluable it can be as time goes by. It is impossible to recall each and every item when your house has been ransacked, the writer has known those who have lost things to be recalling items to mind long after the burglary. Mind the perpetrator doesn't get the inventory too, it would be a most valuable source of information to him!

FIGURE 17: The sundial of Thomas Ore, which stood on the medieval preaching cross for over two hundred years before being stolen in 1995

FIGURE 18: The pedestal is all that remains of the memorial sundial at Ovingdean Church, Sussex

FIGURE 19: Inscription on the base of the Ovingdean memorial sundial

FIGURE 20: The very fine pedestal in Lewes House Gardens, Lewes, Sussex. The sundial was stolen in the 1980's

SUNDIAL SUPPORTERS - PART 1

BY ROGER BOWLING

I have borrowed the term supporter from heraldry. The gods, humans, or beasts supporting the escutcheon are called supporters. I am using the term to describe the figure(s) holding or supporting the dial in place of a plinth. In Part I of this article I shall describe a group of early 18th century lead figures and in Part II the various representations on, or supporting dials, of Old Father Time.

INTRODUCTION

One of the first dials I recorded was at Dunham Massey Hall, 8 miles south west of Manchester. In front of the main door is a life size figure of a kneeling blackamoor, holding a horizontal dial on his head. He is wearing a feather skirt and is nicely painted. The large dial is corroded and unreadable.

Soon afterwards I recorded the dial at Arley Hall, near Knutsford, Cheshire, only 6 miles from Dunham Massey. Here a life size figure of a kneeling Indian wearing a loin cloth and turban supports the dial. Both figures are made of lead. I made the reasonable assumption that there must be some connection between the dials, - but what was it? I asked Charles and Jane Foster of Arley Hall what they knew of their 'Indian" sometimes called the "Indian Slave". I was told that the figure was made at a London foundry and with the nearby Dunham Massey blackamoor was one of a series representing the continents. Also that there were other figures at Melbourne Hall, Derbyshire and at the Temple in London. Later Mr. Foster sent me some notes by John Davis for his book Antique Garden Ornaments. It is to Mr. and Mrs. Foster that I owe thanks for pointing me in the right direction.

THE FIGURES

I have traced six different figures made in the first half of the 18th century. All were lead castings of kneeling life size figures supporting a dial over the head. Representatives of five of the figures remain today.

The most popular figure in the 18th century was the blackamoor. This was first produced by John Nost for the privy garden of King William III at Hampton Court in 1701. The figure rapidly became popular for the large gardens and a copy was supplied to Melbourne Hall in 1705. Many others followed, even 12 years after Nost's death one was supplied to Okeover Hall, Staffordshire, in 1741 by John Cheere who had taken over Nost's business.

Two versions of the blackamoor were produced. I have named them the old and the young black blackamoor. No other authority makes this distinction though I think the difference is obvious. The poses of each one are quite different. The old figure kneels on the left knee the young blackamoor on the right, as in the illustration, and they face in different directions.

Some authorities state that the differences are minor ones as was usual in mass produced castings, but I think this is not correct. The young blackamoor is attributed by Davis to Andries Carpentiere, one time employee of Nost who later set up on his own. There is no firm evidence for this but as Carpentiere worked at Bowden church near Dunham Massey the attribution is possible. The other surviving figure is at the Inner Temple garden, London, dated 1731. This once had attached to it a verse, a very apt

FIGURE 1: The Young Blackamoor

verse considering its situation:

'In vain poor sable son of woe
Thou seek'st the tender tear,
From thee in vain with pangs they flow
For mercy dwells not here.
From cannibals thou fled'st in vain,
Lawyers less quarter give,
The first won't eat you till you're dead,
The last will do't alive.

In 1702 John Nost supplied to Hampton Court a figure of an Indian Slave (see figure 2).

This is where I believe the story of the Continents and figures arose. I am informed at that time the known Continents were four in number and presumably more figures were to follow. We shall never know as William III died two months after the Indian Slave was set up. Nost in 1705 supplied the Indian Slave to Melbourne Hall. What the King had in his garden, Thomas Coke of Melbourne, and many others like him, had to have in theirs. The figures still stand at Melbourne, though these two differ from all the others by not supporting sundials. On their heads they

FIGURE 2: The Indian Slave

FIGURE 3: Kronos or Father Time

carry salvers and urns. No attribution has been assigned to the Indian at Arley Hall, but the most likely is John Nost.

Father Time, not the cadaverous, cloaked scythe bearing of gravestones but the Renaissance figure called Kronos, the creation of the early Greek poet Hesiod exists in two versions, see Figure 3 for one of these, Kronos is always shown as an elderly, healthy man, stern looking but not evil, with wings, beard and wearing a loin cloth. He may carry a scythe and/or hourglass but these are borrowings from the other Father Time. As with the two blackamoors the poses are very different. One supports the dial with both hands, the other with one hand, resting the other on his knee.

Three of these figures still exist but I know the location of only one. This is at Blair Castle, Scotland, supplied in 1743 by John Cheere. The two other figures appeared in antique dealers rooms in 1986 and 1991. One, because it is identical to the Blair Castle figure is attributed to Cheere, but as all three stand on identical moulded stone bases they are probably in the same group.

No example or illustration of the sixth figure of the group remains. This was of a kneeling Hercules supporting a dial on his head and suggests Davis, wearing the skin of a lion. This figure was at Bloxham Hall, Lincs, then Winton Castle, Haddington, Scotland, but disappeared in the 1950's.

THE SCULPTORS

Jan van Ost (anglicised to John Nost) came to London from Mechlen near Antwerp about 1678 and worked for Arnold Quellin. He married Quellin's widow and acquired the business in the Haymarket, London. Nost was a sculptor ranking with the best, mostly now known for his monumental work. I imagine that to produce a steady income his yard and others turned out vast quantities of garden ornaments cast in lead. His earliest figures were the two for Hampton Court, - 'a Blackamoor kneeling, 5' high and holding a sundial, £30' (P.R.O. Works 5/52). The Indian cost £35. The family relationships become unclear. He employed another Jan van Ost and Anthony van Ost. One was his son, the other his cousin or nephew. None of the figures have been attributed to either of these two. Jan van Ost the younger moved to Dublin in 1750 and became one of Ireland's leading sculptors. John Nost employed Andries Carpentiere 1673-1737 who set up on his own at Hyde Park Corner before 1722 and became another well known monumental sculptor. In addition to the young Blackamoor attributed to him by Davis, his price list also included an 'Indian 5', £8'.

John Nost died in 1729 and presumably his family

carried on the business, between then and 1737 when it was acquired by John Cheere, brother of the more famous Sir Henry Cheere. John Cheere was a prolific garden ornament maker. A description of his yard at Hyde Park Corner states it was full of all types of lead figures and ornaments for the garden including an African kneeling with a sundial on his head which formed the most extensive sale. Cheere died in 1787 and it appears that the figures first produced by Nost were still sold fifty or more years after their first appearance.

SUMMARY

I list all the figures which I have found mentioned in the literature. This is mainly from books written at the beginning of this century. The total is 24 figures, all with sundials except for the two at Melbourne Hall. Remaining today are nine figures, seven of which support dials, and this includes the two lately in the antique sale rooms. There were probably six figures originally, five remain today, three are in gardens open to the public. If 200 years after their first appearance, many remained they were obviously very popular, but many have been lost in the last 80 or so years. I apologise for almost complete lack of any details of the actual dials. It does seem that this information was and still is of no interest to authorities on garden, art or sculptural history - but it does leave something to the B.S.S. to research.

BIBLIOGRAPHY

DAVIS J. - Antique Garden Ornaments: 300 years of Artists, Manufacturers and Materials. Antique Collectors Club 1991.

GUNNIS R. - Dictionary of British Sculptors 1660-1851 1953.

WHINNEY M. - Sculpture in Britain 1530-1830. Penguin.

JEKYLL G. - Garden Ornament. Newnes 1918. Antique Collectors Club 1982.

WEAVER L. Sir - English Leadwork, its Art & History. Batsford 1909.

HUSSEY C. - English Gardens and Landscapes 1700-1750. Country Life. London 1967.

HENSLOW T.G.W. - Ye Sundial Book 1933.

EDWARDS P. - English Garden Ornament Bell 1965.

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Mr. and Mrs. C. Foster of Ardley Hall. BSS members John Churchill for loan of a photograph, Doug Bateman, Silas Higgon for helpful conversation and Anne Somerville for help with the records.

FIGURE	LOCATION	SCULPTOR	DATE	AUTHORITY	DIAL	HISTORY
Old Blackamoor	Hampton Court	Nost	1701	Davis		Produced for William III. Lost about 1830.
	Melbourne Hall, Derbyshire	Nost	1705	Davis	Not a Sundial	Still in original location.
	Okeoyer Hall, Staffordshire	Cheere	1741	Davis		Still in original location. Not in BSS. Please record.
	Glemham Hall, Suffolk			Weaver		Campsey Ash to Glemham Hall. Lost.
Indian	Hampton Court	Nost	1702	Davis		Produced for William III. Lost about 1830.
	Melbourne Hall, Derbyshire	Nost	1705	Davis	Not a Sundial	Still at original location.
	Arley Hall, Cheshire			Davis	Henry Wing, London.	Still at original location. BSS 1724.
Young Blackamoor	Inner Temple, London	Carpentiere?	1731	Weaver		Clements Inn to Inner Temple. BSS 2113.
	Dunham Massey, Cheshire	Carpentiere?	1735	Davis	Corroded, Illegible	Still at original location. BSS 1720.
	Aldenham Hall, Herts.			Jekyll		Existing 1918. Lost.
	Wrest Park	Carpentiere		Gunnis		Lost.
	Enfield Park			Henslow		Lost.
Kronos/Father Time	Blair Castle, Tayside	Cheere	1743	Davis/	Geo Adams, London	Original location. Painted to resemble marble. BSS 1515.
	Saleroom, London 1991	Cheere		Advertisement		Fonthill House, Wilts. Now?
Kronos/Father Time II	Saleroom, London 1986			Advertisement		St. Osyth's Priory, Essex. Now?
Hercules	Lost			Weaver/Davis		Bloxham Hall, Lincs to Winton Castle, Scotland. Lost 1950's.

Weaver writing in 1909 mentions several figures with sundials. He calls them slaves and it is unclear which figures he is describing. But the list contains figures mentioned by other authorities, to be the young blackamoor and the Indian.

Guys Cliffe
Knowsley, Lancs
Norton Conyers, Yorks
Slindon Park, Sussex
Purley Hill, Berks
Ockham Hall, Surrey
} Existing 1909

Sandywell, Glouc
Cowdray Park
} Lost Before 1909

HOW TO DETERMINE TIME BY MOONLIGHT

ING J.T.R.C. SCHEPMAN (NETHERLANDS)

A sundial can be used to determine the apparent solar time by moonlight, providing the moon is bright enough to cast a shadow. This is only possible between the first and last quarters. The conversion from the indicated lunar time to apparent solar time is accomplished with the help of tables which indicate the moon-angle (Dutch: *maanhoek*; French: angle *lunaire*; German: *mondwikel*). Such a table is placed on the vertical sundial of Queens' College in Cambridge, England. They can also be found on Nuremburg diptych sundials such as that of Paulus Reinman of 1604 in the "Zeeuwe Museum" at Middelburg.[1]

The angular position of the moon relative to the sun with respect to the earth's centre is expressed in hours and minutes. As the earth rotates once in twenty-four hours, each 15 degrees is equal to one hour (360/24 = 15°).

It is a curious fact that the Queens' College table commences at moonphase "16" with 0 hours and 48 minutes, and on the Reinman sundial at 11 hours and 12 minutes. After correspondence in 1993 with Mr. C. K. Aked, Editor BSS *Bulletin*, and Dr. M. Hagen, former Secretary of "De Zonnewijzerkring", I found that 0h 48m and 11h 12m are complements of each other, where the first is added and the second subtracted.

Referring to my letter, Mr. Aked marshalled the facts again in an article in BSS *Bulletin* 94.3, October 1994, "The Queens' College Dial, Cambridge" which is very worthwhile reading. In his opinion the moontable is not so very useful, "because there is no hint on the dial itself on how to obtain lunar time". Moreover the shadow of the moonlight can hardly be read because of the light pollution in the Court.

LUNAR CONVERSION TABLE

								FQ							M
LUNAR PHASE		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Queens' College	hours	0	1	2	3	4	4	5	6	7	8	8	9	10	11	12
and Reinman	min's	48	36	24	12	0	48	36	24	12	0	48	36	24	12	0
								LQ								NM
LUNAR PHASE		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Queens' College	hours	0	1	2	3	4	4	5	6	7	8	8	9	10	11	12
	min's	48	36	24	12	0	48	36	24	12	0	48	36	24	12	0
Reinman	hours	11	10	9	8	8	7	6	5	4	4	3	2	1	0	0
	min's	12	24	36	48	0	12	24	36	48	0	12	24	36	48	0

FQ = FIRST QUARTER: FM = FULL MOON: LQ = LAST QUARTER: NM = NEW MOON

Some remarkable moon-angles are:

6 hours = 6 x 15° = 90° or 270° (360° - 270° = 90°). Quadratus = FIRST QUARTER or LAST QUARTER.

12 hours = 12 x 15° = 180° or 360°. Opposite or Conjunction = FULL MOON or NEW MOON.

4 hours = 4 x 15° = 60° or 8 x 15° = 120°. Sextilus or Trinus.

EXAMPLE:

Lunar Phase 3 and 18 - Queens' College Dial is 2h 24m = 36°

Lunar Phase 18 - Reinman Dial is 9h 36m = 144° (180° - 144°) = 36°

If for example at lunar phase 18 the moon-shadow on the sundial is at 5h 0m, then the apparent solar time is:

Queens' College Dial 5h 0m + 2h 24m = 7h 24m

or Reinman (12h + 5h) = 17h 0m - 9h 36m = 7h 24m

The advantage of the Queens' College Table is that the amount is always *added*, a much simpler process then subtraction, with the disadvantage that twelve hours has to be taken away once the amount is greater than twelve.

A PRACTICAL INSTRUMENT

A simple analogue instrument to convert the lunar indication to apparent local solar time is with the Aspectidisc or Volvellum AD 1992-2010 after Paulus Reinman, 1604.[2]

Photocopy of the diagrams of the discs shown here, Figure 1, enlarge these to the required size (I made mine 24cm diameter). Glue these to stout cardboard and cut out. The small disc is made concentric with the large disc by a drawing pin through the centres of both (marked A on the larger disc), and this allows the small disc to be rotated as required. An extra thickness of card at the centre of the small disc will help to reinforce this point.

EXPLANATION

The explanation of the concentric tabulated figures is as follows (see Figure 2):

1. The outer ring: Gregorian Epact 1992-2010. The phase of the moon on the 31st December of the previous year. On 31st December 1994 the epact was 28 and on 1st January it was the New Moon: phase 29½.

2. & 3. The next two annuli going inwards. The moon angle is expressed in minutes "M" and hours "S" (German: *Stunden* = Hours). One hour = 15 degrees. The difference in time is 48 minutes or 12 degrees a day.

4. The moon phases from 1 to 29½ - a lunar month.

5. & 6. The analogue conversion of the lunar shadow to local apparent time. Place the pointer on the moon phase for the required date. Read the lunar shadow on a correctly orientated sundial and find this reading in scale 6. The local solar time is given in scale 5 directly opposite.

7. The aspects.

CITED FROM VAN CITTERT[3]

Besides the planetary hours and planetary houses, the aspects used to play an important part in astrology. By aspects the positions of the various planets, (sun and moon also counted as planets) with regard to each other are intended. The various aspects had either a good or bad influence.

The chief aspects are:

a. **Conjunction:** The planets being in roughly the same location (or rather the same direction) in the sky.

Influence - indifferent.

b. **Opposition:** The planets being 180 degrees apart. Influence - bad.

c. **Third Phase, Trinus:** or Y: Angular distances 120 degrees. Influence - good.

d. **Fourth phase, Quadratus:** Angular distances 90 degrees. Influence - bad.

e. **Sixth phase, Sextilis*:** Angular distances 60 degrees. Influence - bad.

EXAMPLES

Moon in opposition to Saturn: unfavourable for talking to old people or for travelling.

But there were many exceptions, e.g: Moon in opposition to Venus: good for contracting a marriage, or for hiring a servant-girl.

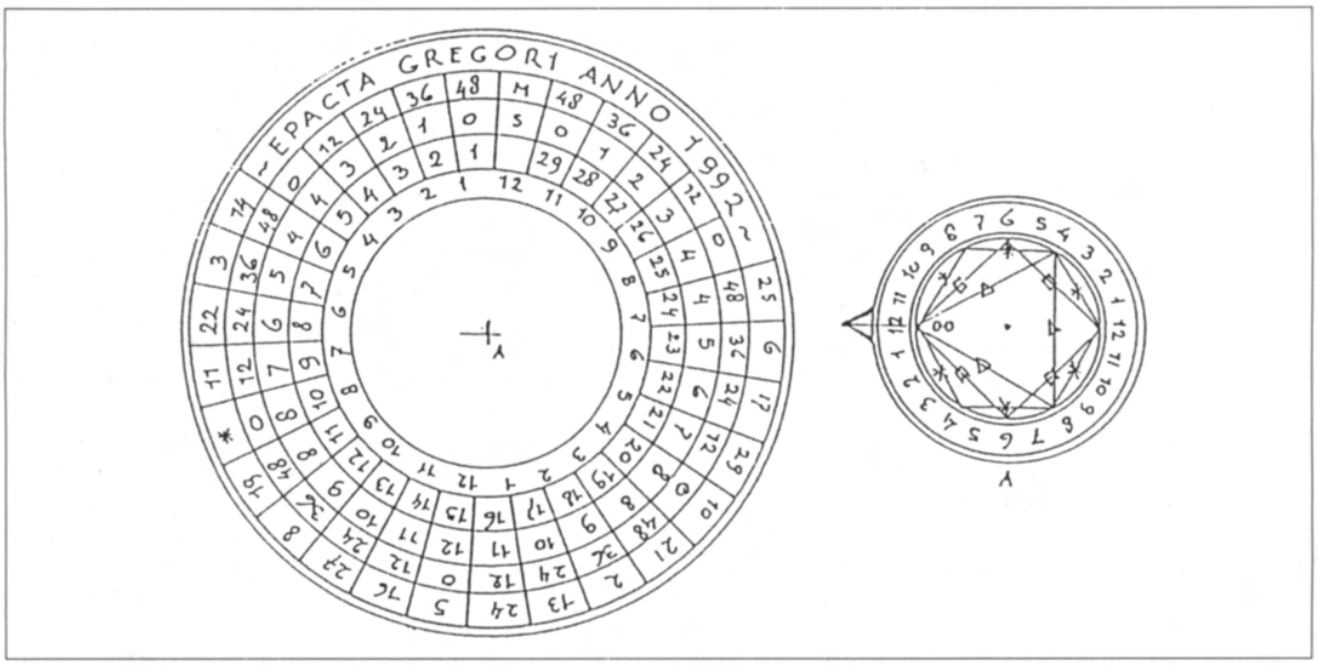


FIGURE 1

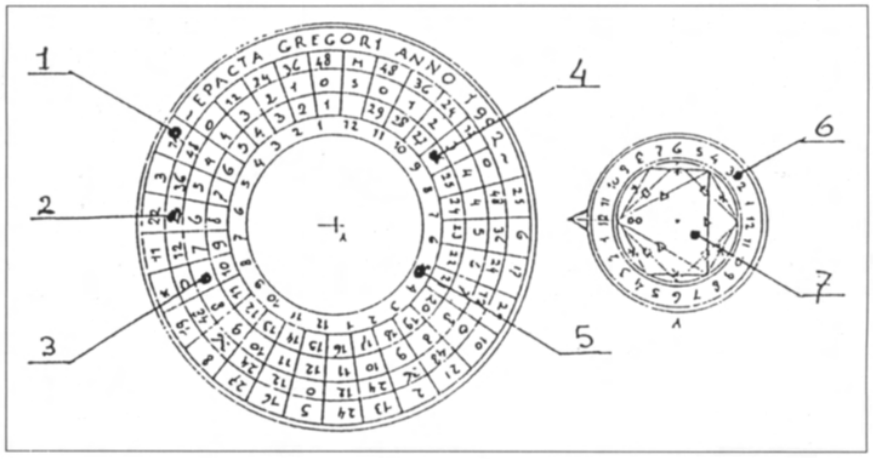


FIGURE 2

REFERENCES

1. Bulletin Zonnewijzerkring 93.1. pp. 17-25. On page 21 is an error in the explanation.
2. GOUK, P. *The Ivory Sundials of Nuremburg: 1500-1700*, Cambridge, 1988.
3. CITTERT, P. H. van. *Astrolabes; A Critical Description of the Astrolabes, Nocturlabes and Quadrants in the care of Utrecht Museum*. Leiden, Brill, 1954.

DERBYSHIRE SCRATCH DIALS

F. N. FISHER

INTRODUCTION

Under the above title, an article was published in the Derbyshire Archæological and Natural History Society's Journal in 1935. The contents are very dated, this being a period dominated by the thinking of Dom Ethelbert Horne and Dr. Arthur Robert Greene. The latter wasted his efforts through being obsessed in trying to make mass dials confirm to a time system which did not even exist when the dials were in daily use. With all due respect, the main contribution by Horne was to find these elusive dials and list them. Those of us who have searched for these shy denizens of a bygone age know just how elusive they can be at times, in spite of the most careful scrutiny of the most likely places. And in using the old lists as a guide, it is soon discovered that so very many have disappeared without trace.

DERBYSHIRE SCRATCH DIALS

A scratch dial, as the name suggests, is a primitive type of sundial, usually consisting of two or more lines scratched, rather than deeply incised, on the surface of the stone and radiating in a downward direction from a central stylehole.

They are to be found on the south walls of medieval churches, usually at about 60 inches from the ground, and are generally some 9 inches in diameter.

Large variations from these measurements, however, often occur: in Derbyshire, at Kedleston, there is a dial as low as 30 inches, whilst that at Repton is no less than 85 inches in height. Also, the small dial at Spondon measures only 5 inches across, whilst at Clowne, each line is extended to 14 inches.

The ends of the lines are often joined to form part of a circle as at Langwith, to form a semi-circle as at North Wingfield, Kedleston and Repton, and, occasionally, to form a complete circle with lines radiating in all directions from the centre, like the spokes of a wheel, good examples of which may be seen a Bradbourne and Spondon no. 1.

Another interesting type of dial is where there are no lines, a circumference being traced, either fully or in part around the stylehole by means of a series of small holes. It is assumed that in most cases these holes were fitted with pegs but, at Steetley, which affords a good example of this type of dial, the holes appear to be too small ever to have held pegs and it may have been the these dials were painted (see below). A further variant occurs, which may be seen at Spondon no. 2 and in both the dials at Alsop-en-le-Dale, where the lines end in small holes. It may be that holes were used for the same purpose as lines, the shadow cast by the style falling upon them, and so recording the passage of time.

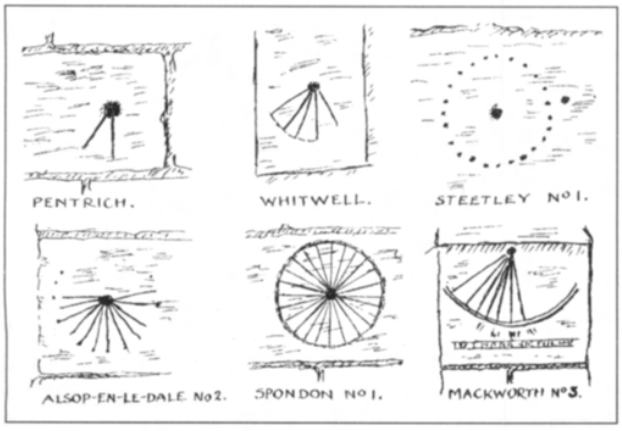


FIGURE 1: Typical Derbyshire Scratch Dials

Owing to restoration or rebuilding, dials may be found which have strayed far from their original position somewhere on the south side of the church and may be seen on the north wall or even in the interior. The writer recently observed at Badenham in Herefordshire a scratch dial on the north porch. This porch was originally erected on the south side but was pulled down and re-erected in its present position during the last century.

The dial at Langwith is inside the the south porch, which shows it is of earlier date than the porch itself, the latter erected early in the 14th century, having rendered it useless.

Even dials in their original positions are found in many differing spots, and, though the vicinity of the south and priest's door is a common situation, our forefathers, who cut these dials, would certainly have put them in a position most easily observed by anyone entering or approaching the church.

There are two lines which are present in nearly every dial. The perpendicular line, immediately below the stylehole, is called the noon line, since, if a pointer or style be inserted in the stylehole in a direction due south, the shadow falling on this line will always register noon, because the sun at its zenith will cast a shadow directly beneath the style.

Then there is the line to the left or west of the noon line at an angle of roughly 45 degrees. This line is very noticeable in most dials because it is more deeply cut in the stone. It is usually termed the mass line, as the shadow, were a style in situ, would reach it at about 9 am, the usual time for celebrating Mass on Sundays and Holy Days in medieval times. From this we get the term 'mass-clock'. The mass line may be seen to advantage on both the dials on the church at Alsop-en-le-Dale.

The other ones vary considerably on different dials but in many cases it will be seen that the lines divide the dial into twelve equal divisions. The horizontal line immediately to the west of the stylehole represents 6 am and the one exactly opposite, 6 pm. This system of dividing the period between 6 am and 6 pm into twelve hours was used in the church in medieval times, the hours being numbered from one to twelve. the important hours were the third, sixth and ninth, when certain offices were recited by the clergy. These offices took their names for the hours at which they were recited, viz, Terce, Sext and Nones. The mass line corresponds with the third hour, since Mass was celebrated immediately after Terce. Another line, bisecting the eastern half of the dial, marked the hour corresponding with three o'clock, when Nones was recited. These lines, then, besides marking the main canonical hours also marked, together with other less significant ones, the ordinary hours of the day.

We have been examining the lines radiating in a downward direction only; how, then, can we explain the line radiating upwards, as in a wheel dial?

These lines could only be of use where the style

projected in an upward direction only, so it may be that such styles were divided into two parts, one part tilted upwards and the other downwards. Yet to record time in the upper part of such a dial, the style must be bent upwards so considerably to form a very small angle with the vertical, in order to cast a shadow even at midsummer. The most probable explanation of these wheel dials is that the designer who constructed them did so merely from convenience of draughtsmanship, the upper lines, of course, being useless for time recording.

Further, we must not overlook the probability that these dials have been interfered with by persons mistakenly trying to confer symmetry on the design; in this connection, it is interesting to note that the lines on the upper half of the dial at Bradbourne are the more distinct.

THE STYLEHOLE

Although no style has yet been found in situ, an examination of the style hole occasionally reveals a small portion of metal as at Horsley no. 2 and Nuthall, Notts, presumably a portion of the original style.

There is a style at Muggington, however, but this dial is of later date that the ordinary scratch dial and is of a transitional type. The stylehole is found either in the stone itself or in a joint of the masonry, which may have been cemented up.

On an average it measures 3/4 inch across and 3/4 inch in depth.

VARIOUS THEORIES

Style at right angles

Mr. Ethelbert Horne,[1] to whose exhaustive research so much of our knowledge of this subject is due, emphasizes the simplicity of the scratch dial, both in conception and purpose, and favours the theory of the style projecting at right angles to the face of the wall. Thus, on such dials, the hour lines would register inaccurately because of the varying elevations of the sun at different seasons of the the year, may have been obviated by the use of more than one dial on the same church, for example, the three dials at Spondon. Moreover, accuracy in time measurement as we know it was neither understood nor desired in those days.

Bent Style Theory

We have to admit the inaccuracy of a dial with its style at right angles, but we are not forced to accept it in that position. Dr. A. R. Greene[2] has carried out much work with experimental dials to prove that, on a dial facing due south, if the style is bent downwards to form an angle with the horizontal equal to the latitude of the dial, this arrangement will register fairly accurately. Also if the church is incorrectly orientated, a lateral deflection of the style towards the south will suffice.

Painted Dial Theory

In the Middle Ages the exteriors of our churches were limewashed and this has suggested to Mr. T. W. Cole[3] that scratch dials were painted, the lines or holes serving as a permanent guide when repainting was necessary owing to relimewashing. The holes on the Steetley dials seem to support this theory, as they appear too small ever to have held pegs, and the only markings on Horsley no. 2, four short lines at a distance from the style hole, would appear to have served the same purpose.

SUNDIALS

Prior to the Norman Conquest, the passage of time was recorded in England by sundials, some of which are still in existence. The dials, which are known as Saxon Sundials, can be distinguished from scratch dials by their superior workmanship. Moreover they incorporate the octaval system of recording time, in which the day-night is divided into eight equal parts. [Incorrect, the day and night periods were equally divided in accordance with seasonal hours.]

Although it is not known exactly, it is thought that scratch dials persisted in use until the 15th century. The introduction of mechanical clocks would have had very little effect on small country churches, owing to the extreme slowness and the expense attendant upon the dissemination of new ideas at that time, but, with the greater mathematical knowledge available, the primitive scratch dial was gradually improved upon, and this improvement, continuing through the 16th and 17th centuries, reached its zenith in such elaborately constructed sundials as the one at Eyam, see Fig 2.

FIGURE 2: Sundial on Eyam Church

Towards the end of the 14th century, Canonical Hours gave place to the newer Clock Hours, as used today, and the dial at Clowne, with its Roman numerals marking the hours, and its equally spaced lines, shows that it is an elaboration of the primitive scratch dial.

The dial at Mackworth, besides having Roman numerals at the ends of some of the lines, also shows them unequally spaced, as found in the sundial of later date. We

are fortunate in this dial, in-so-much it is a dated example, and has, underneath it on the south-east part, an inscription which runs "Ut Hora Sic Fugit Vita Hominis 162-".

The scientific sundial was almost always incised on a single piece of stone and let into the face of the wall. An early sundial which is incised on the wall direct can be seen at Foremark and another good example is at Pinxton.

Where the church is incorrectly orientated, the sundial is often set out at an angle from the wall to make it face due south; or, in some case, this difficulty is overcome by deflecting the style towards the east or west.

DESCRIPTION OF DIALS

Alsop-en-le-Dale (see illustration)

There are two scratch dials on this church which can be seen on the east side of the round headed window in the east of the south Norman doorway of the nave.

1. Is 88 inches to the stylehole and has a noon line of 3½ inches, with two lines to the west and one and part of another to the east. The noon and western lines terminate in small holes.
2. The stylehole is 58 inches high, the noon line is 4 inches and there are six lines westwards and five to the east, some being very faint. Several of the lines end in small holes.

Bradbourne

This dial which is situated on the west side of the south porch (date 1450-90), consists of a very faint circle 12 inches in diameter with fainter radiating lines, none of which is easily discernible. The stylehole, which is 52 inches from the ground, measures 1½ inches across and 2¾ inches deep.

Clowne

This dial is to be seen on a corner stone at the south-west corner of the nave. Height to cemented-up stylehole 67 inches. The noon line measures 14 inches, and is distinct. There are eight lines to the west, four of them quite clear, and one, very faint, on the east side. There are Roman numerals at the end of several of the lines, which indicate it to be of a transitional type.

Croxall, Staffordshire

(Transferred from Derbyshire to Staffordshire in 1894, but still in the Rural Deanery of Repton, and the Diocese of Derby).

On the diagonal buttress at the south-east corner of the nave are two dials, one facing south-east and the other south-west.

1. The one facing south-west is 77 inches to stylehole; has a noon line of 3½ inches and five others of 3 inches to the west. Faint parts of a semi-circle can be seen with a radius of 3½ inches.
2. Facing south-east, a complete but very faint circle can be seen, diameter 10 inches and 72 inches to central stylehole. The noon line is 5 inches and continues upwards to the circumference. There are three lines to the west, and one in the upper half of the circle.

Horsley

1. This dial is on the first buttress east of the south porch. The stylehole was originally in a masonry joint and 78 inches high. The noon line is 7 inches, and there are five lines on the west side and three on the east.
2. The dial on the west buttress of the south aisle has a stylehole 55 inches high, in which can be seen the remnants of the metal style. The dial consists of four scratches about 1 inch long and 5½ inches from the stylehole. *Vide supra* - Painted dials.

Kedleston

Under the south window of the south transept and below the string course is a dial which has a combination of lines and holes - almost dots. The dial is in the form of a double semi-circle, the outer radius being 5¼ inches and the inner 4¼ inches. The noon line is clear and there are four lines to the east and three to the west, one being very faint. The small holes or dots appear where the lines cut the circumferences of the half circles and, also, there are two rings of them between the lines, one being between the circumferences and the other nearer the blocked up stylehole.

Upper Langwith or Langwith Bassett

On the east side of the south door - inside the porch - a mutilated dial of four lines is seen at a height of seven feet. The noon line measures five inches, there are two lines to the east and one to the west, joined by part of a circle.

Mackworth (see illustration)

1. Situated on a buttress east of the south porch. Height to cemented-up stylehole 60 inches. the noon line is 7 inches and is inclined a little to the west. There are two lines to the west and four to the east.
2. A faint dial can be seen a little to the east of no. 1. No noon line can be seen, but there are four lines to the east and two to the west, about four inches long. Very small stylehole.
3. On the diagonal buttresses of the south porch are two excellent late examples of transitional dials. They face south-east and south-west respectively, and were made to be used in conjunction with one another. The one facing south-east consists of a semicircle 8½ inches in radius at a height to stylehole of 95 inches. There is no perpendicular noonline, and there are five lines on the western half and two on the eastern half of the dial. Roman numerals II and III can be seen plainly on the two eastern lines and also fainter ones on some of the other lines.

   Under the dial and somewhat weathered is an inscription:

   "UT HORA SIC FUGIT VITA HOMINIS 162-"
   [As an Hour so Man's Life].
4. The dial on the south-west buttress is of similar size and also has seven lines. No Roman numerals are, however, to be seen.

Marston Montgomery

On the tympanum of the south doorway within the porch is a clearly marked dial. It consists of a complete circle 9 inches in diameter, which is divided by a horizontal line running through the central stylehole, with lines in a downward direction only. Two lines divide the left side into three equal parts whilst the right side is divided into three unequal parts by two lines. An unusual feature of this dial, is that the lines project beyond the circle and end in small crosses.

Muggington
This transitional dial is in two parts, one facing south-east and the other south-west, and is situated at a height of 110 inches on the diagonal buttress at the south-east corner of the south nave aisle. The part facing south-west is particularly interesting, as a metal style is present which is bent downwards at an angle of roughly 55 degrees to the horizontal and also deflected to the right. At the ends of the lines are the Roman numerals XI, XII, I, II, III, whilst just underneath are a corresponding number of dots - : : : : : : : : etc. The style on the south-east face is lacking, but the Roman numerals IX, X, XI, XII, I are present, as are the dots corresponding to these hours.

Pentrich (see illustration)
The example at Pentrich is to the east of the priest's door, in the south wall of the chancel. The style hole is 1½ inches across and at a height of 51 inches; from it, run two lines only. The noon line is 4½ inches, and the other is 30 degrees to the west, which, according to a standard dial, would register 10 am.

Repton
On the south-west buttress of the south transept, at a height of 85 inches, may be seen a scratch dial which has a noon line of 5 inches, with six lines to the west and five to the east.

The stylehole cut directly in the stone is 1¾ inches deep and 1½ inches across.

Spondon (see illustration)
1. This dial, which is situated under the westernmost window of the south aisle, is in the form of a complete circle. The 24 lines, which are very faint except for the noon line, are equally spaced and the stylehole is cemented up.

2. This dial is to the west of the east buttress of the south aisle and is 40 inches from the ground. There is a noon line, one to the east and three to the west, which terminate in holes and appear to have been recut recently. Their length is 2½ inches and the dial is the smallest so far noted in Derbyshire.

3. Situated east of the east buttress of the south aisle. The stylehole in this example is in a joint of the masonry. The noon line is very distinct and measures 8½ inches. There are three lines to the west.

Stanton-by-Dale
On the tympanum over the south entrance is carved a cross patée, on the central boss-like part of which is a dial. This appears to be of the Saxon sundial type.

This central boss is 5½ inches in diameter, and is divided into two equal parts by a horizontal line running through the small central stylehole. The noon line is vertical, and is continued upwards to the upper edge of the dial, the lower half of the dial is thus divided into two equal parts, which parts are again equally divided by lines at 45 degrees. The division of the dial into four equal parts is in accordance with the octaval system, whereby the day-night was divided into eight periods.

It was some time after the Conquest before the octaval system finally gave way to the present duo-decimal system, so that it is probable that many Saxon dials were made after the coming of William [the Conqueror]. As the dial is faint and rather small for a Saxon-dial, the explanation may be that the cross was cut and the stone re-dressed at some later date.

Steetley Chapel (see illustration)
1. This dial is seen at the south-east corner of the choir and is contained on a single stone. It consists of a central stylehole ¾ inch across and 1¼ inches deep , at a height of 54 inches from the ground, around which, at a radius of 3¼ inches is a circle of small holes, 24 in number. The holes are very small and it would appear that they were not meant to hold pegs. This dial I consider as confirmation of Mr. Cole's painted-dial theory.

2. Seen on the south-east corner of the nave and extending over three stones. The stylehole is blocked up and was in a joint of the masonry at a height of 66 inches. The circle of small holes is 9½ across, and there is a faint noon line to be seen.

Taddington
This dial is on the centre buttress of the south aisle. It is much weathered, and all that remains is the cemented-up stylehole and portions of four lines to the right or east. It is 57 inches height and 4 inches from stylehole to end of lines.

The stone on which this dial is cut is flaking vertically, and it is possible that the dial will disappear altogether in a comparatively short time.

Whitwell (see illustration)
This dial is to the west of the doorway of the south porch. It is 56 inches to the stylehole and has a noon line of 5 inches, also three line to the west and a faint one on the east side. Part of a faint circle connects the lines on the west side.

North Wingfield
An interesting dial is to be observed on the easternmost buttress of the south side of the chancel, at a height 63 inches and consists of a double semi-circle of 6 inches diameter, between which there may have been Roman numerals. The lines seen are mostly to the east, the west side being badly weathered.

Although over 150 of our country churches showing medieval work were inspected, only 17 of them have scratch dials. To these must be added Croxall, as although now in Staffordshire, it is still in the diocese of Derby.

It has been assumed that all our churches has them at some time, but "restoration" and weathering have destroyed many, whilst others may still be hidden under ivy and creepers which unfortunately are present on many of our churches. Some of these dials are quite faint and very small, so it is quite possible that others have been missed, even though each church visited was given a close scrutiny.

As regards their preservation, it is unfortunate that little can be done, beyond putting a weather moulding above them, but in any case they should be kept free from dirt and mould which has a deleterious effect on the stone.

* * * * * *

REFERENCES

1. Horne, Ethelbert, *Scratch Dials,* 1929.
2. Green, A. R., *Sundials,* 1926.
3. Cole, J. W., *Origin and use of church scratch-dials.*

SUNDIALS BASED ON LATERAL THINKING

MAURICE J. KENN

Having, on safari, purposefully photographed a diversity of simple sundials[1] my mind has perhaps become subconsciously programmed.

In any event when I was recently washing up a plunger-type "Café Royale", coffee maker, I suddenly realised that this common household utensil was normally being totally under-utilised. Indeed, merely by inverting the handle; inserting an appropriate inscribed, translucent, curved, plastic card; and mounting the article on a fully-adjustable camera stand; the "Coffee Maker" was instantly transposed into a simple "Universal, translucent, equatorial sundial" as shown in Figure 1.[2,3,4] Later, as shown in Figure 2 and 3, the sundial was mounted on a stand having just two settings, one for use at Latitude 51° 30' (e.g. in London) and one for use at Latitude 30° 55' (e.g. Sydney).

This "Coffee-time" sundial was seen by some Members when it was exhibited at the B.S.S. Annual Conference at West Dean, in Sussex, on 3 - 6 May, 1996, and also at the Regional Gathering at Great Saling, in Essex, on 18th May, 1996.

More recently, when browsing in a local garden centre, my subconscious mind was again aroused, this time, by some vaguely hemispherical flower pots. The outcome is shown in Figure 4, viz. an equatorial sundial with a gnomon plus nodus, and with its hour, equinox and solstice lines. The dial is indeed similar in principle to the more elegant version which may be seen on the University of Toronto Campus, shown in Figure 5.[1]

For simplicity, the sun's hour lines on the "Flower-Pot Dial" were inscribed, in pencil, using a watch; the equation of time; the sun; and the gnomon's shadow. The noon-shadow was marked firstly, on centre, in order correctly to orient the dial. In practice, because of the speed of movement of the gnomon's shadow, the left-hand side of each hour shadow was marked one minute before the hour and the right-hand side was marked correspondingly one minute after the hour. Ultimately each hour line was suitably defined by "Flower-Arrangers' Tape" which is weather-proof and of an appropriate width.

The sundials described here, and previously, have provided much pleasure and interest during their production. They may, however, also be considered as prototypes for the future development of larger, more prestigious and more elegant dials.

FIGURE 1

FIGURE 2

REFERENCES

1. Kenn, Maurice J. 'Simple Sundials Seen on Safari', *The British Sundial Society,* Bulletin No. 96.2, pp. 22-25, June 1996.
2. Kenn, Maurice J. 'Sundials can be Simple and Legible', *The British Sundial Society,* Bulletin No. 91.3, p. 33, October 1991.
3. Kenn, Maurice J. 'A Large Translucent Universal Equatorial Sundial, *The British Sundial Society,* Bulletin No. 94.2, pp. 37 - 38, June 1994.
4. Kenn, Maurice J. 'A Large Translucent Universal Equatorial Sundial (Part II)', *The British Sundial Society,* Bulletin No. 95.3, pp. 27 - 28, October 1995.

FIGURE 3

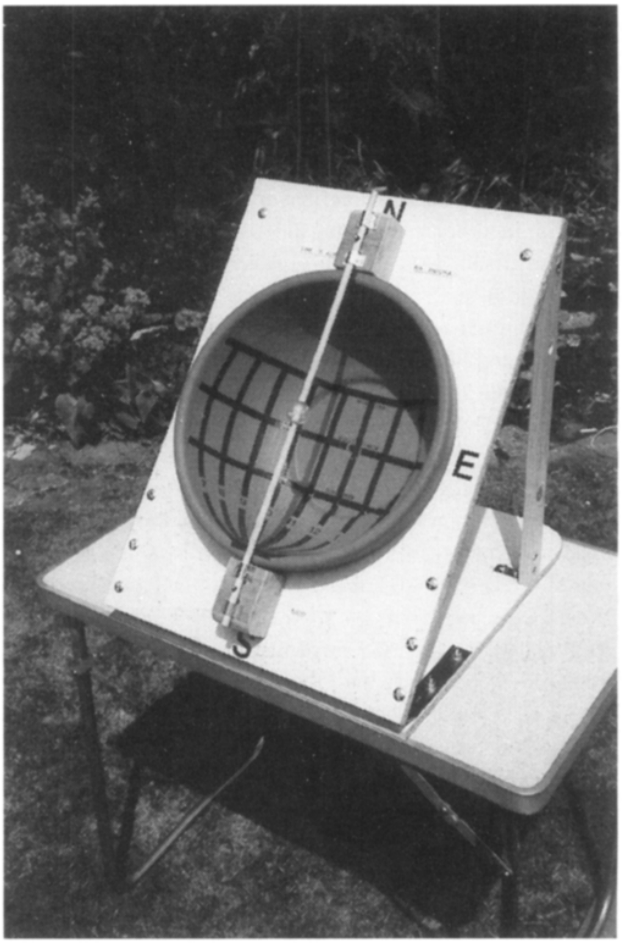


FIGURE 4

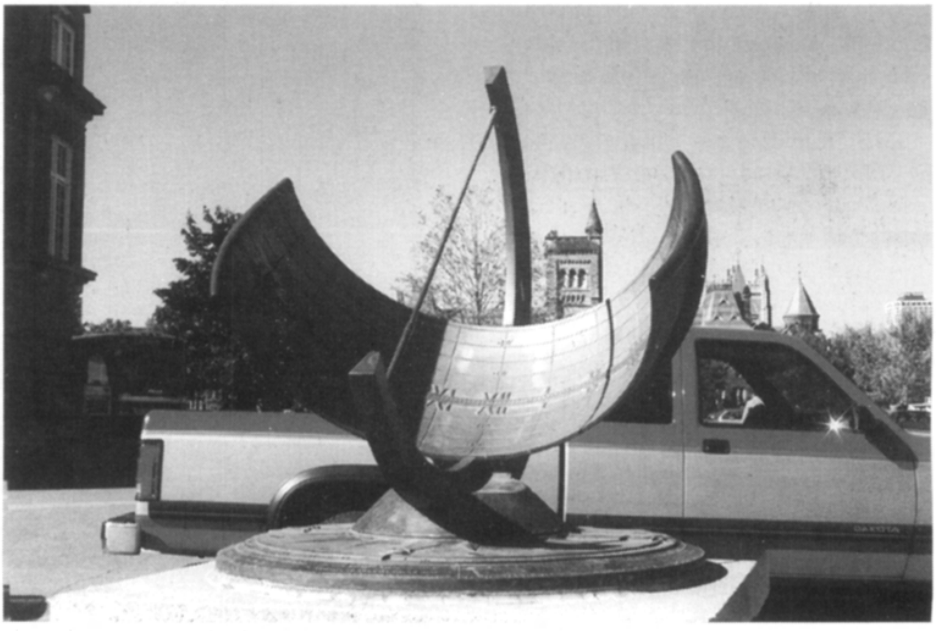


FIGURE 5

SUNDIAL HOUSE

CHARLES K. AKED

Going along to the supermarket in Culcheth, Greater Manchester, formerly Lancashire, one day, the writer was interested to see that the building was called Sundial House and that it contained some "independant" businesses, see Figure 1. There was a sundial on the building, see Figure 2, a direct south-facing dial although the wall is not truly aligned east-west. Strangely enough, there are no indications on the dial, so as far as the average person is concerned, it is quite useless as a time-of-day indicator.

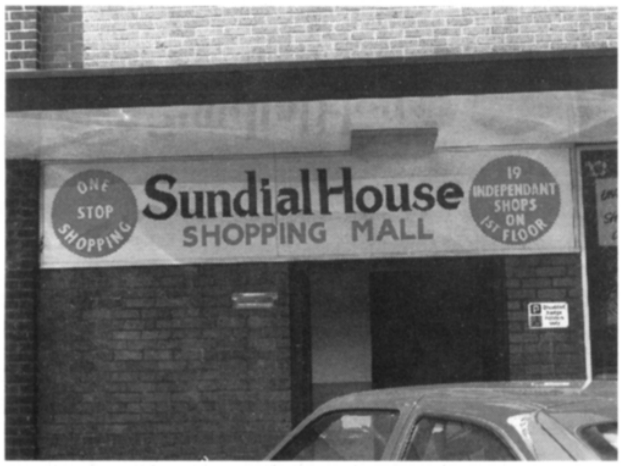


FIGURE 1: One of the entrances to the modern building

Enquiries elicited the information that the reason for the name is that the old building, which stood upon the site before the modern building was erected in 1972, was known locally as "Sundial House" because of the sundial fixed above the front door. Alas, although the removal of the sundial was attempted before the old building was razed, it was found that the dial was painted upon plaster or stucco and could not be recovered without destruction of the dial (it could be with proper techniques). Measurements were taken of the old sundial and a replica made on a board, that which now adorns the southern aspect wall of the building. There were no figures on the old dial, probably these had disappeared with the passing of the years. The iron gnomon was recovered but appears to have lost about half its original length.

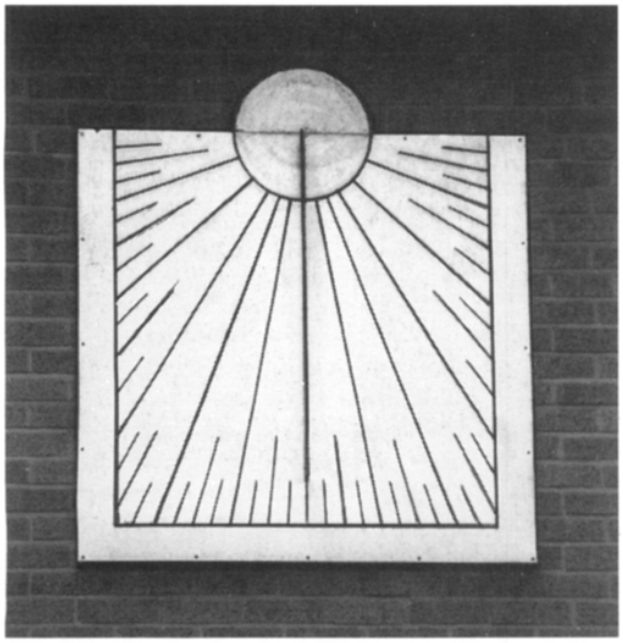


FIGURE 2: The modern replica sundial

The old Sundial House had a long and varied history, it was built circa 1691 because that was the date carved into one of its oak beams. Figure 3 shows the old building as it was earlier this century, unfortunately the dial is not visible because someone allowed a large shrub to grow in front of the house and completely obscure the part of most interest to diallists.

The owner of the building, Mr. Nelson, kindly helped the writer with information and had a large number of photographs of the old building and the progress of the new building on the site. Above the second floor of the building, in the office area, was a pen and ink drawing of the old Sundial House by a local artist, shown in Figure 4. The writer could not photograph this square on because of lack of space and because a flash unit was used to illuminate the drawing, which would have resulted in just a white-out through reflection from the glass. It was attempted to photocopy the picture but reflection from the glass completely obscured the drawing, a pity since the drawing is very finely delineated. Comparison of Figures 3 and 4 will show that the later drawing is a faithful representation of Sundial House, with the added advantage of showing the sundial above the front door. In both cases, the house next door was already demolished and only a small stack remains through being built into the wall of Sundial House.

Sundial House was originally used as a school, but soon, according to the Enclosure Map of 1751 for Twisse Green, became the Parish Workhouse and had a single cell to imprison wrongdoers. It was mentioned in a Report of the township of Culcheth that Captain John Risley "gave £60 to the poor in the workhouse of Culcheth", and he died in 1702. A researcher, Mr. G. N. Gandy, recorded that in 1821 that the school was transferred to a new building, and from that time Sundial House housed only homeless people. In 1841 there were 44 children and 44 adults in the workhouse out of a population of 2,091 in the township of Culcheth. It boggles the imagination as to where all these were put, looking at the exterior of Sundial House.

There was little charity in those days for pregnant women going to Sundial House incurred a charge of five shillings for nourishment, plus the expense of delivery. If the stay was longer than thirteen months, the unfortunate offspring were automatically reckoned as "half-paupers". All this caused the Reverend Joseph Jones to produce a pamphlet in 1829 condemning the laxity which allowed these out of wedlock children to be produced so freely, pointing out that only a few male surnames were involved in this depravity, but adding that the employment of Irish navvies in building the new railway was suspected of compounding the problem.

Gradually Sundial House fell into decay and the district increased in prosperity with the creation of the huge Munitions Depot at nearby Risley during the last war, later to become the Admiralty Storage Depot, and the later

FIGURE 3: A sketch of the old Sundial House

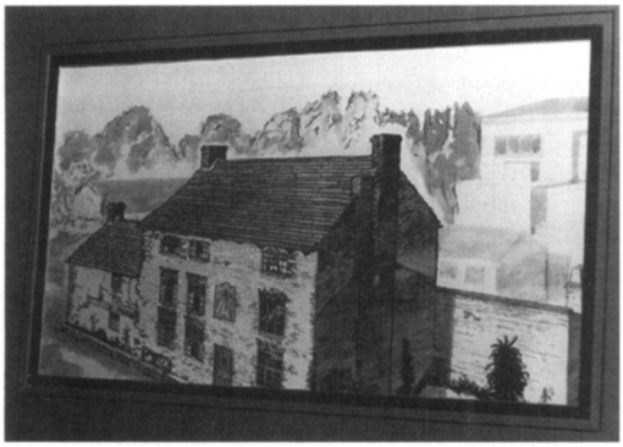


FIGURE 4: A pen and ink drawing of the old Sundial House

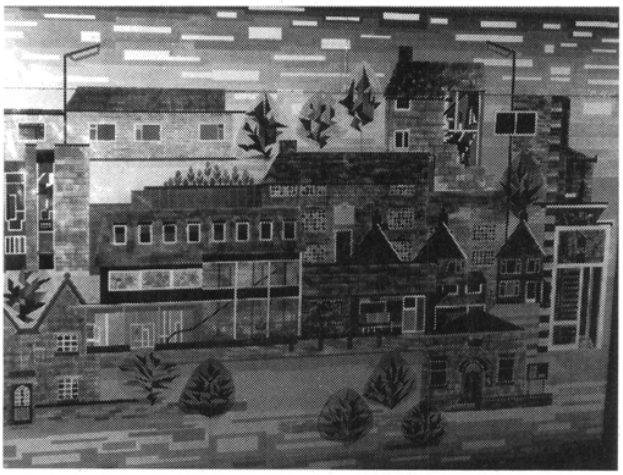


FIGURE 5: A modern mural depicting the changes around Sundial House, with the old Sundial House standing behind its sucessor

taking over of this enormous site by the Atomic Energy Authority in the late 1950's. The influx of young intelligent people into the area created a demand for housing in the villages all around, and the shopping facilities to match the rise in population and the increased purchasing power. So in the early 1970's the decision was made to demolish Sundial House and erect a supermarket complex, with a shopping arcade for individual (and *independent*) shopkeepers on the floor above. In order to maintain the connection with the old Sundial House, a replica sundial, modelled on the old as far as possible, was erected on the new building.

The original gnomon was retained, however it is far shorter than it should be, so it must have corroded away whilst on the original dial.

On speaking to the present owner of the complex, it seems that it was quite impossible to preserve the original sundial, the writer having been told that the original had been preserved. It was mistakenly thought that the dial was painted on a slab of stone; when the workmen made a start on removing it, it crumbled to pieces, being painted on stucco only.

On the stairs landing between the second and third floors there is a huge mural illustrating the "progress" of Culcheth, see Figure 5, in fact it is entitled "Culcheth's Progress" and was painted by Dorothy Yates, the artist who produced the pen and ink sketch of Sundial House. The original is rather colourful, and in the centre mid-ground of the collage, the old Sundial House can be seen; with the frontage of the new development shown in front of it. No doubt it conveys much more to those who were familiar with the old building.

The writer rode past the junction where Sundial House stood for about ten years whilst it still stood, in those days (the late 1940's), his interest in sundials was minimal, his only camera was a prewar Agfa folding model using 120 film, bought when a boy (the camera that is). His main effort in life was keeping his head above water. Fifty years later it is a matter of regret that a golden opportunity to record history was lost.

The present-day shoppers scarcely bother to glance at the sundial, nevertheless little effort would be needed to make it a useful instrument again, for example a correct gnomon and numerals against the hour lines. Even as it stands it is a reminder that a sundial has stood on this site since the late seventeenth century. What optimism for a County which enjoys so much rain! The changes in county boundaries have robbed Culcheth the honour of being in Lancashire, and the industries which formed the back-bone of daily toil, such as coal mining and textiles, have gone for ever. For the people working in such industries, Sunday was probably the only time they ever had a chance to see a sundial in operation. Perhaps the paupers in Sundial House, who could see their sundial each and every day, were actually better off than those in employment.

ACKNOWLEDGEMENTS

Thanks are expressed to Mr. Nelson for his help in locating the required information and permission to use the illustrations in Figures 2, 4 and 5.

NORTH DECLINING VERTICAL DIALS REVISITED

PETER J. MEADOWS

In my previous article on north declining dials, I restricted the hour lines to those above a horizontal line which passed through the point where the style intersects the dial face.[1] However, it has since been pointed out that, for north declining dials, certain hour lines can also be present below this horizontal.[2,3,4] Figure 1 shows all the possible hour lines for a dial which declines towards the east by 15° 42' and is at a latitude of 51° 43' N (i.e. for the author's northward facing garden wall). The sub-style line is also shown (the long dashed line) and it has been assumed that the gnomon has zero width. The maximum range of times when the mean sun strikes the dial face occurs at the summer solstice and are now between 03h 47m (sunrise) and 08h 34m together with between 18h 03m and 20h 13m (sunset) (all times given here are local). This gives a maximum duration of 6h 57m (compared to 4h 26m previously[1]). At the equinoxes, the times when the mean sun strikes the dial significantly reduces to just between 06h 00m (sunrise) and 07h 19m - duration of only 1h 19m (compared to 50m previously[1]). At the winter solstice, the sun does not strike the dial face at all.

The time limits of a style shadow being in a north declining dial face are set by (i) the time of sunrise/sunset and (ii) the time when the azimuth angle of the mean sun is the same as the azimuth angles of the dial face (provided the sun is above the horizon). The dial face azimuth angles can be calculated from its declining angle (θ). For dials declining towards the east, the two azimuth angles are given by ($90°+\theta$) and ($270°+\theta$), while for west declining dials, the two azimuth angles are ($90°-\theta$) and ($270° - \theta°$. In all cases θ is in degrees, positive and measured from north.

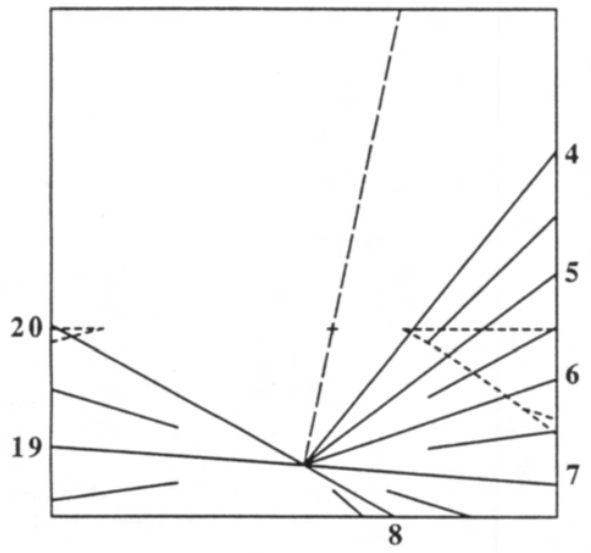


FIGURE 1: Dial face for a north declining angle of 15° 42' east at a latitude of 51° 43' N

For a direct north dial ($\theta = 0°$), for example, the time limits are, firstly, between sunrise and when the mean sun is at an azimuth angle of 90° (i.e. due east) and, secondly, between the time the mean sun has an azimuth of 270° (i.e. due west) and sunset. For all but one azimuth angle, the time when the mean sun is at a particular azimuth angle depends on its declination and thus on the time of year. The exception is for an azimuth angle of 180° which always occurs at a local time of 12 noon.

The variation in the time when the mean sun is at a particular angle makes the diagram of possible time limits a little more complicated than presented previously.[1] A revised diagram is shown in Figure 2. Here, the unshaded region within the three solid curves show the time limits at the summer solstice, the equinoxes and the winter solstice. The horizontal portions of the curves are determined by the sunrise/sunset times while the curved portions are determined by the time when the azimuth of the dial face is the same as the mean sun. Note the convergence of the three curves towards the 12 noon time when a dial declines directly towards the east or west (i.e. when one of the dial face azimuth angles is 180°).

Note that the dial furniture, also shown in Figure 1, is the same as given previously.[1]

ACKNOWLEDGEMENTS

The author would like to thank the BSS Bulletin readers who pointing out the limitations of my previous article on north declining dials.

REFERENCES

1. Peter J. Meadows, 'North Declining Vertical Dials', The British Sundial Society, Bulletin 95.3, p.41, October 1995.
2. Colin Thorne, British Sundial Society, Bulletin 96.1, p.48, February 1996.
3. F.J. de Vries, British Sundial Society, Bulletin 96.1, p.49, February 1996.
4. Harold Brandmaier, British Sundial Society, Bulletin 96.3, p.50, October 1996.

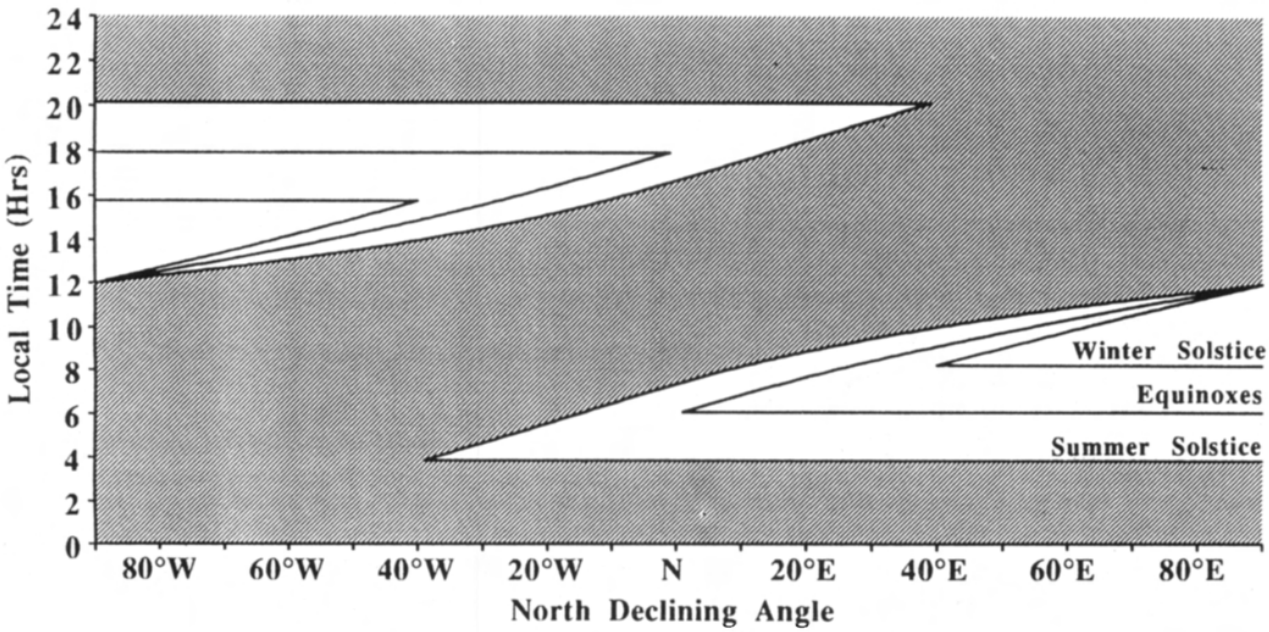


FIGURE 2: Time limits (unshaded portion) for north declining dials at a latitude of 51° 43' N

BOOK REVIEWS

RELOGES DEL SOL PRIMITIVOS, Reloges canónicos o de misa. Manuel M^{a} Valdes. 199 pages, very many b & w diagrams and 28 colour photographs. Board covers. 22 x 15.5cm. Privately published, 1996. Spanish text.

This little book has the same format as that produced by Laurence Price, 1991, but Mr. Valdes is more knowledgeable on the subject.

He commences with vertical dials with equal angular division, Egyptian, Greco-Roman, Greco-Byzantine, and Europe. He then progresses to the evolution of gnomonics, times for prayer, the theory of these primitive dials, mentions the Manuscript 225 de Ripoli, and calculations for the inclination of the gnomon.

Part II deals with the distribution of mass dials, from page 47 to 59 is a listing of the 195 dials discovered by Mr. Valdes. Many of these are shown as line diagrams with brief details, but for most there is only the reference to obtain details from the listing.

Part III, commencing on page 137, takes us into a magical world of colour photographs of the actual dials. One can only say that the photography is superb, and it is like making a personal visit to the dial. The missed opportunities of the reviewer when a visitor to some of the places mentioned, made him feel like gnashing his teeth.

Part IV, maps of the areas where Mr. Valdes has visited in search of these dials, rather spoilt the standard of the book, for they are so blotched by the photocopying process as to be useless. One requires simplified maps for this purpose, it is difficult to squash a quarter of Spain in detail on to an A4 sheet.

To sum up, a splendid little book, and a great achievement for one man to have done do much on his own, for which the reviewer must congratulate the author for his zeal. It is the best book on canonical dials to date. For all those interested in canonical or mass dials, a copy of this book is essential. When further details of publication are known, BSS members will be advised, the review copy was a hand-made one-off example.

CHARLES K. AKED

* * * * *

STORIA DELLA GNOMONICA, La storia degli orolgi solari dall'Antichatà alla Rinascenza, Nicola Severino. 115 pages, line illustrations in text. Published by author, First Edition, Second Version, Roccasecca 1994. Thin plastic front cover, rear cover card, A4 format in comb binder. No ISBN. Italian text. Price not known.

The work is divided into seven main chapters, commencing with a foreword and acknowledgements to those who helped the author in his research.

Chapter 1 deals with the events of antiquity, and includes a section on the etymology and definitions of gnomonics in ancient times, antique hour systems, and so on; it includes the story of the miracle of Ahaz. Ten illustrations supplement the account.

Chapter II deals with the Hellenic (Greek) period, the most important part of which is concerned with the classification given by Vitruvius of all the known sundials of his time. The thirteen main types are then discussed in detail. Also receiving mention, is the Tower of the Winds, Athens. A view of the site, the frontispiece of Libro XX of Aulio Gellio, *Noctium Atticarum,* shows a very fanciful view of the Tower of the Winds which was never like that in reality. The tower appears to have gone from octagonal to hexagonal. 34 illustrations complement this chapter.

The sundials of Rome form the theme of the third chapter. Here the most important example is that of Augustus - the Campio Marzo obelisk. Two illustrations only are given for this important era.

Chapter IV - Gnomonics of the Middle Ages - brings the English reader to more familiar territory and the first page shows the well-known sundial at Kirkdale, the sub-title of the chapter being the Benedictine Sundial. Bewcastle Cross is included and several of the early Anglo-Saxon sundials, the text is accompanied by 9 illustrations. From a British point of view, the Middle Ages span from about AD 1000 to AD 1500, whereas a broader view on the Continent is from about AD 500 to AD 1500.

We now come to the Arabian Gnomonics of the Middle Ages, in which it would be disconcerting to find the account opening with The Venerable Bede without the proviso of the last sentence. For most English readers, the dialling world of Islam is practically unknown apart from the wonderful examples of Astrolabes created by the Arabs. The concept and realisation of these marvellous instruments was a wonderful achievement. Nine figures support this chapter. Considering that the Prophet did not want to use the time derived from the sun to determine the time of Islamic prayers, since he wanted to break the link with sun worship; it is remarkable that the art of Arabic dialling was not annihilated. Obviously the simplistic thinking of the reviewer is through not being aware of the true facts.

Chapter VI deals with the revival of dialling in the West in the sixteenth century, dealing with the events leading up to this before passing on to the Little Ship of Venice. Curiously there is no illustration of this dial at the end of the chapter but it can be seen as Figure 16 in the next.

Christopher Clavius forms the central theme of the 7th chapter, 21 illustrations complement the text, included in which is the Canterbury pendant sundial.

An Appendix deals with dialling after Clavius and the first trigonometrical methods. There are a number of illustrations, these are not numbered, several are plates taken from Bion and Ozanam. This appendix concludes the account by around the middle of the eighteenth century.

The book needs an Index although the Contents are well detailed, and a complete List of Illustrations is needed at the beginning of the book to make it easier to find the one being sought. The illustrations are listed at the end of each chapter. But most all it needs to be set out by a printer in a proper book form to do justice to the contents. The most important reason is so that the reader can assimilate it easily, it is too much to expect a reader to traverse the complete width of an A4 page, scanning each line in turn. Of course it all comes down to the cost of production.

READERS LETTERS

C. ESSEX & CO.

I read with interest about the dial by C. Essex & Co. referred to by Mr. de Vries in Bulletin 96.2.

The Directory of Scientific Makers by Gloria Clifton tells us little except that C. Essex & Co. were working in London 1824-1828.

I have consulted my database of Portable Dialmakers and this has revealed five entries. I am therefore able to give Mr. de Vries the following information about these dials and makers.

1. Christies Sale, 6 May 1993, illustrated.
2. Philip & Sons Catalogue No. 3, Summer 1985, illustrated.
3. The Whipple Museum Catalogue.
4. Eggestorf Collection, Dublin.
5. Private Collection.

I enclose a reprint of the first three entries.

There is little more that I can add to these details except to say that the dials of Porter seem to be more common than those of Essex, but are generally very similar in most details. I have added the details of Mr. de Vries dial to my database for future reference.

MIKE COWHAM

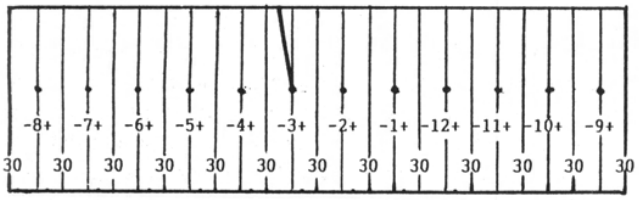
* * * * *

SPHERES AND CYLINDERS

The Alençon dial described by John Lester (BSS Bulletin 96.3, page 50), is an interesting reminder of the difficulty of producing a well defined timing shadow on a sphere or cylinder.

An alternative to the movable gnomon is a plurality of radially protruding gnomons at hourly intervals round the circumference. On the hour, the shadow of the relevant gnomon lies over the hour line (vanishing to a point at the equinoxes). Also it is convenient to specify that on the half-hour the shadow will extend halfway towards an adjacent hour line (albeit in the 'wrong' direction!). In theory this requires a gnomon height virtually equal to the radius of the cylinder (or sphere), although in practice a slightly shorter length is necessary.

The instruction always to use the *shortest* shadow may be incorporated in a motto, e.g. 'Time is Short, Likewise my true Shadow'. Perhaps a rider should be added: 'Heed the Sign, When you read my Time'.



Scale for a cylinder, and relevant shadow at 2.45 p.m. in mid-winter.

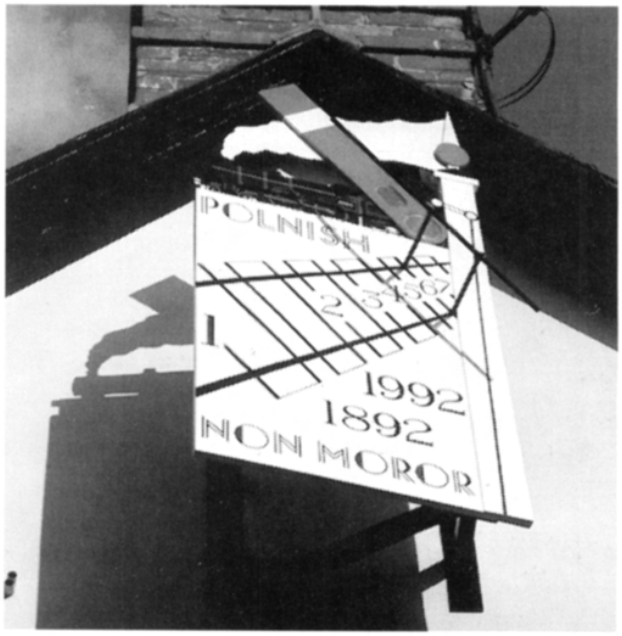
JOHN SINGLETON

* * * * *

A RAILWAY DIAL

I have been a BSS member for a year and and half now and am a confirmed enthusiast. I enjoy the Bulletin and think it is a very fine production.

My main interest is in making sundials - mostly carved in stone - and I thought you might be interested in the one I have just made for John Ingram. It is a very eccentric piece incorporating his enthusiasm for railways and Charles Rennie Mackintosh. It is made out of fibre glass and mounted on an iron frame to face directly West. At the moment is telling the time absolutely accurately.



Would you be interested in a short article about its manufacture for the Bulletin?

HARRIET JAMES (Mrs)

This letter revealed another facet of the Editor's ignorance, for he cannot detect any connection whatsoever with Charles Rennie Mackintosh. I fail to see any of his "Glasgow Style" in this sundial. No doubt some more erudite and perspicacious BSS member will be able to overcome my myopia. The motto, I suppose, must be in connection with the railway, - 'No Delay'.

* * * * *

TEMPLECOMBE

Driving into deepest Dorset for a 'Steam up' on a friend's 1:20 scale garden Railway, I paused for a while at Templecombe to investigate the refurbished Railway Station.

The improvements include a garden, complete with an unusual sundial!

The figure/gnomon, is very finely sculptured, and an explanation of the dial, and the reasoning behind it, is posted in the waiting room. It reads:

> 'Sundial' is an allegory of time, derived from the concept of the sponsors, British Rail. It is constructed to form a working sundial which makes reference to man's need to order and contain time and explores how the environment and the elements, like our perception of time, constantly change and move.
>
> The figure of a railman holds a large ringbound timetable. Blown by a tempestuous wind, his clothes billow around him, the stone 'leaves' of his book are lifted and carried away, rolling and curling. As he reaches to catch a page, this page and his raised hand form the gnomon of the sundial whose shadow indicates the time. Around the railman some pages have fallen, along with some leaves, creating an arc which marks the hours. As the pages tumble down the garden a transformation takes place, time, although captured on the pages, is escaping.
>
> Commissioned by British Rail.

The gnomon figure is not movable, so I'm not sure if the sundial can be correctly termed an Analemmatic Dial.

A set of detailed photographs has been sent to our Registrar.

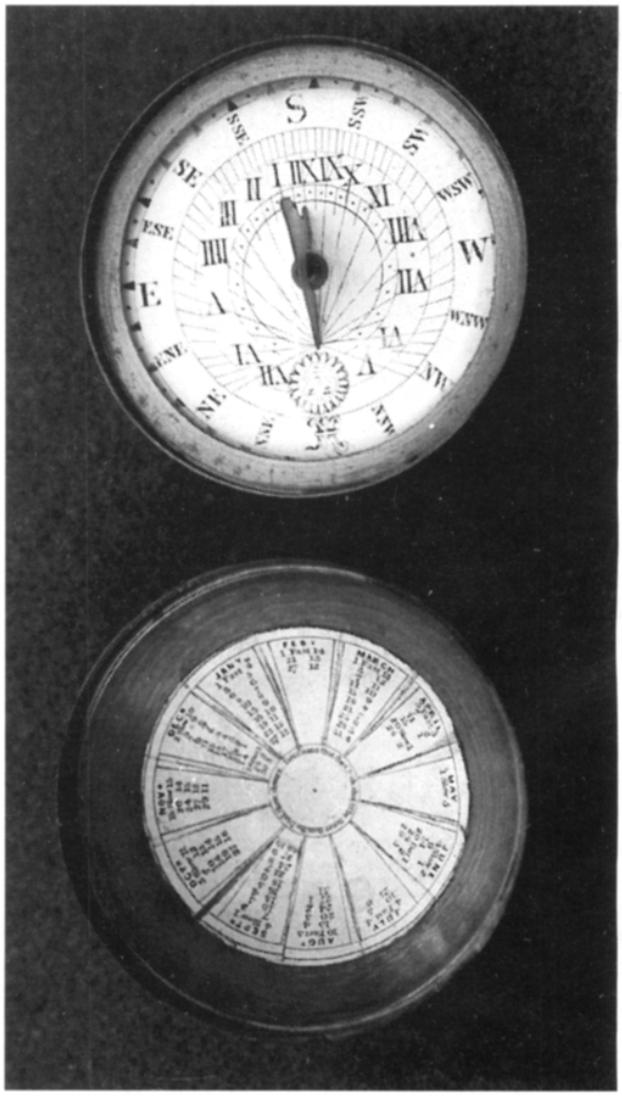
JAMES SLATER

EDITOR: Mr. Slater sent three photographs, but only one suitable for reproduction in the Bulletin. To save members trying to decipher the words on the timetable, it says "PASSENGER TIMETABLE". Obviously the sculpting achievements visibly exceed the concept of dialling principles exhibited here, it is a very fine figure indeed. At the time of the photograph (14.00 BST) the time shown was just past one (GMT evidently), on 22nd September 1996. The noon mark is shown by a much larger page.

* * * * *

POCKET SUNDIAL

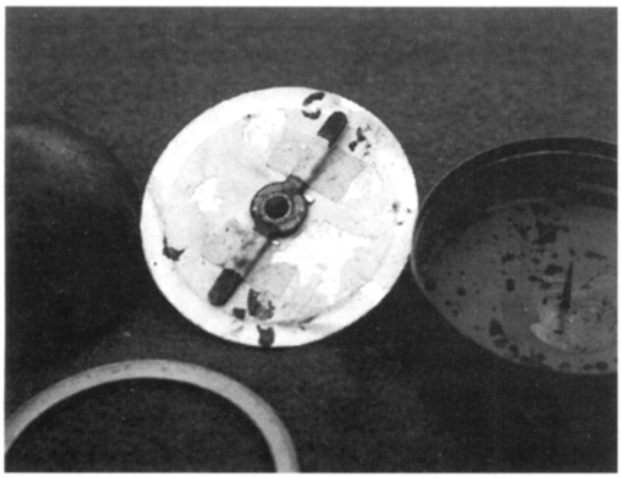
As you will see from the enclosed photographs, the dial is pivoted, with a jewel, and has a magnetic "needle" to orient the gnomon automatically. The brass case is 50mm in diameter, and the domed cover has an equation of time



pasted inside, with the explanation, "Fast means the Clock should be faster than the Dial".

The dial is made for the southern hemisphere and the gnomon angle is 42°, which would be suitable for Hobart in Tasmania or Christchurch in New Zealand. I have previously seen one similar but slightly smaller marked "A. Beverly/Dunedin" on a paper ring pasted on the dial. The card seems have two layers, the upper thickly covered with white paint, the lower is a disc of mica. I think the dial is hand drawn.

The inside of the case is covered with red paint, unfortunately it lacks its locking or damping mechanism, which I would like to replace. My main question is, how did the mechanism operate? I have seen somewhat similar mechanisms in pocket compasses but they have involved a lever with a fulcrum, of which there is no mark here, and have not needed the round hole present in this case.



I am hoping the dial is of a well known type in the UK so someone can explain to me how to restore it. I am also in need of reassurance that it did not have a glass domed cover. The dial is retained by a brass ring which shows no sign of glue, but I have seen photographs of dials by Porter which did have glass covers. Actually the brass ring is a bit mysterious anyway. I cannot see what would hold it in place against the pressure of the locking mechanism.

Finally, in view of the small size, and problems of magnetic deviation. I find it hard to believe that the dial could be used to tell the time with any accuracy. So, why was it made? I would be very grateful for any comments or information you could give me, or suggestions where I might be able to find any more information on such dials.

NORMAN HECKENBERG

Director, Physics Museum, The University of Queensland, Brisbane. Qld 4072. Australia.

EDITOR: Information has been sent to Mr. Heckenberg by John Moore and myself. This request has also appeared in the NAWCC Bulletin.

* * * * *

MOONDIALS

With reference to my article in Bulletin 96.3, Welper's figure was not included and for the benefit of readers I enclose a copy which is illustrated here. On page 19 an error has occurred in Table B, lower row; I enclose a corrected version. I shall be happy if these corrections can be included in the next Bulletin.

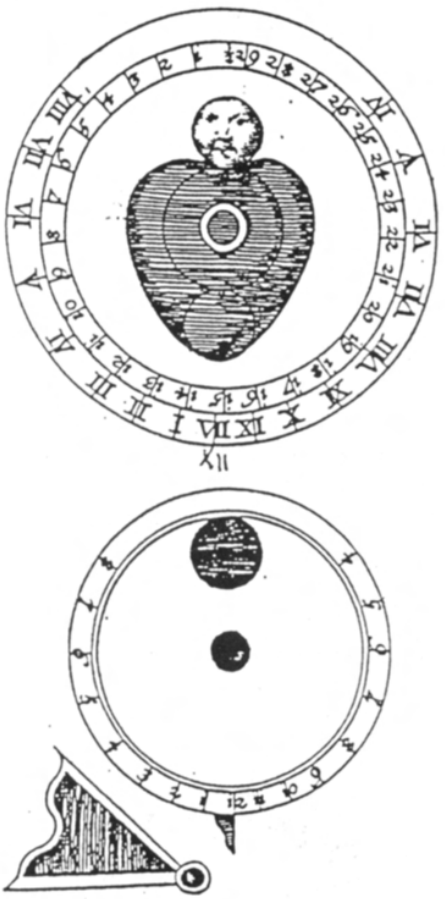


TABLE B1

Days after New Moon

NM ±	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	048	136	224	312	40	448	536	624	712	80	848	936	1024	1112	120
	29	28	27	26	25	24	23	22	21	20	19	18	17	16	

B: Corrections, identical for the top and bottom rows, but with inverse signs.

1 Corrections: to add to lunar hour from 1st to 15th day
to subtract from lunar hour from 16th to 29th day

DENIS SCHNEIDER
France

EDITOR: Unfortunately Welperr's diagram was lost somewhere in its various journeys but it was not essential to the explanations in Mr. Schneider's article.

* * * * *

DIALOGUE

LA BUSCA DE PAPER

Issue number 22 of the Bulletin of the Catalan Gnomonic Society is for Spring 1996, commencing with an article by Ko Tazawa on the language of dialling in the Land of the Rising Sun. The reviewer must confess to being a trifle bemused at the brief vocabulary linking Catalan and Japanese terms, and I am sure that Stratford Repro could never find the fonts for the Japanese symbols. Evidently gnomon is "shijishin", azimuth is "hooikako", shadow is "Kage" and so on. There is a little guide to the correct pronunciation of these words. Eduard Farré i Olivé writes on the Nocturlabe of Roman Llull called the "Sphaera Horarum Noctis".

As each article is published in Catalan and Spanish, this cuts down the available room in the Bulletin, rather like publishing the BSS Bulletin in English and Gaelic.

A review of the Deutchen Gesselschaft Für Chronometrie, includes the visit paid to Grenoble in Lyons at the invitation of the French Society ANCAHA, of course to see the famous indoor dial in the Lycée Stendhal.

There was also an Exposition of sundials at Wilhelmshaven 1-14 September 1995, plus commemorations on the 400th anniversary of the death of Gerard Mercator.

Details are given of the Journal of the Trebail Group having a conference in the city of Stadkyll in May 1995.

On the back page is a brief note on the Internet, reference http://glen-ellyn.lit..edu/clocks/clocks/sundial/catalana.html

A cartoon depicts two footmen carrying a litter, on the side of which is a vertical dial! Inserted in the main Bulletin is another section of the ongoing vocabulary of dialling terms, this time going from Latitude to Longitude. The length of this listing calls for a computer disk listing on a data base, it is far too tedious consulting the written word on so many sheets of paper, a mere eighteen terms cover over a page.

The address of the Society is: Societat Catalana de Gnomonica, Atenes 3, 08006 BARCELONA, SPAIN. The editor is Josep Maria Valhonrat.

* * * * *

AN EARLY MILLENIUM?

A news item on television recently featured the Meridian Line at Ramsgate, which was described by Mr. Norris in his article in Bulletin 96.2, page 26. Evidently it has been decided that Ramsgate could be the first to welcome in the New Millenium on 1st January 2000 because Ramsgate's local mean time is about 5 minutes 40 seconds ahead of Greenwich Mean Time.

Of course, on the basis of being most easterly of Greenwich, Lowestoft easily beats Ramsgate because it is over seven minutes faster than Greenwich, so all BSS members can usher in the Millenium earlier than anyone else in Britain by paddling into the sea off Lowestoft. The exact time will have to be determined by a nocturnal, or an astrolabe; it would be cheating to employ a quartz crystal watch.

However Ramsgate will be almost a year ahead of the correct start of the Millenium if it chooses 1st January 2000 because of the peculiarity of the Christian Calendar which commenced with AD1. Two thousand years later the Third Millenium will commence on the first moment of the year AD 2001. The majority of those celebrating the Millenium have decided upon a year earlier, and it does seem to make much more sense to include the year 2000 in the new Millenium.

This matter should have been resolved by the Church, which is still the guardian of the Gregorian Calendar, in which His Holiness the Pope holds the sole copyright as it was commissioned and paid for by Pope Gregory in 1582. Those who employ the Gregorian Calendar in daily life have had plenty of time to sort out this particular problem but it is fast running out. Popular opinion favours the moment of the year 2000 and will probably decide the issue without guidance from any authority. Those who are in any doubt whatsoever must celebrate both possible dates to be absolutely certain. Not very many members of mankind are able to pass from one millenium into the next, it is a rare privilege.

* * * * *

DE ZONNEWIJZERKRING

A visit was made to the Belgian Sundial Society in Rupelmonde in June 1996. The first venue was the castle of Wissekirke, the party then moving on to Rupelmonde, the birthplace of Mercator, where there is a statue to him, and a number of sundials. The Belgian Society has arranged for a number of dials to be placed in the town, the visitors were able to see some of these. Later the town of St. Niklaas was visited, where there is a museum devoted to Mercator.

There follows a description of a dial based upon a half cylinder, where points on the half cylinder are represented by the layers of a number of plates clamped together. A German member adds to material on Hermann the Lame, the inventor of the pillar dial, and comments on the dearth of literary references to him. A few of these are given. A sundial park is planned for Genk, in Belgium.

Réne R.-J. Rohr writes on Arabic gnomonics. Time was important to the Arabs so that the five compulsory daily prayers could be observed correctly. Six illustrations of sundials from mosques are given. There is a brief description of the Arabic method of time measurement, with an illustration of a page from a Turkish tear-off calendar for 1973, showing the hours of prayer according to clock time, and also to Arabic time. The discussion then moves on to the astrolabe as used in time measurement by the Arabs, the article concluding with some literary references.

The construction of an analemmatic dial on a sloping surface is discussed, with diagrams, and this is followed by an illustration of a dial by William Blaeu of 1622, and two of design by M. C. Escher in 1931, which have certain errors. Errors in a gallery in Utrecht are pointed out, and then the question of moving a sundial to a different latitude is dealt with. Details are given of the time signals from the German radio station DCF 77.

E. J. TYLER

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