The British Sundial Society

BULLETIN

No. 98.2 JUNE 1998

Front cover: Sundial on Ponte Vecchio, Florence (Photo. S. Adam)
Back cover: Sundial made for a wedding by Harriet James (Photo. H. James)

Typeset and printed by Fieldfare Publications, Cambridge. Tel: 01223 311334

BULLETIN 98.2 - JUNE 1998

CONTENTS

BULLETIN

OF THE BRITISH SUNDIAL SOCIETY

ISSN 0958-4315

ISSUE 98.2 - JUNE 1998

EDITORIAL

In this issue, besides our usual mix of history and mathematics, literature, art and science, the much-debated problem of conservation and restoration comes up for consideration. It was bound to happen sooner or later and the correspondence from C. Daniels and A. Smith herein raises the question in an acute form. Our Chairman, who has had first-hand experience of sundial restoration over many years, has set out his views in a thoughtful article. We would be glad to receive the views of other members of the Society on this controversial matter. We in Britain seem to be alone, in the necessity for handling this particular problem. Enthusiasts for sundial restoration in the countries of continental Europe do not seem to encounter our quantities of legal red-tape before starting a restoration project; and gnomonists in North America and Australia have so few dials more than 100 years old that there is little to interest any statutory body equivalent to English Heritage. Do they realise how lucky they are? But it is unlikely that any such body would ever be countenanced on the North American continent.

The views and suggestions of members are sought also on a happier question - how to celebrate our tenth birthday. The British Sundial Society was founded in the spring of 1989, and the first issue of the Bulletin is dated July 1989. Perhaps members of the Society (other than present or past members of Council) whose membership has lasted throughout the ten-year period should be invited to write their thoughts on the matter. Perhaps we might venture, as a one-off birthday treat, on a couple of pages of colour photographs in the Bulletin. We are sure that Council will be interested in members' ideas on how to mark this step in our career.

NEW, OLD AND PROBLEMATIC DIALS IN VARENNA, ITALY

GRAHAM V. LOBLEY

A recent and very enjoyable holiday in the small town of Varenna (Lat. 43deg 59 min N), on the northeast shore of Lake Como, provided an unanticipated and welcome bonus in the form of three interesting and attractive wall dials. All grace the Via Venini, Varenna's largely unspoilt, largely 17th-18th Century, main street. For convenience I have labelled them "new", "old" and "problematic".

Not surprisingly, each of the dials declines. Before going on to describe two of them briefly and the "problematic" one at slightly greater length I should mention that the declination angles quoted are approximate bearings, since no local maps I could find included figures for magnetic variation.

The "new" dial, shown in Fig. 1, adorns one wall of the Farmacia Castelli and overlooks the church and main square of San Giorgio. It declines 30 degrees East of South and is clearly engraved to show hours and half-hours between 8.30a.m. and 4p.m. Decorated with zodiacal pictures representing Capricorn, Cancer, Libra and Virgo, and bearing the motto "PANTA REI", this dial appears modern but may well be a very nicely executed restoration.

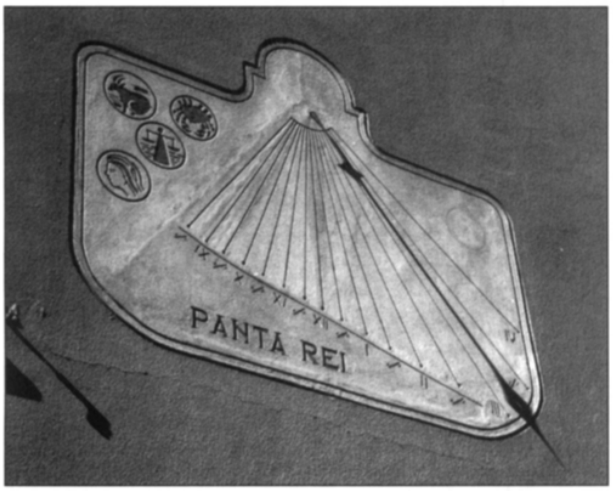


Fig. 1. The new dial in Varenna.

A few hundred yards along the Via Venini, on the wall of a villa at No 31, resides the sadly neglected "old" dial shown in Fig. 2. Declining 23 degrees East of South, its painted surface displays hour and half-hour lines (in the form of arrows) from 8a.m. to 4p.m. and the motto "POST TENEBRAS LUX". Just discernible is a geometrical border with square insets at each corner which may once have contained zodiacal signs now eroded. The gnomon is there, but broken off short. Undoubtedly an attractive dial

Fig. 2. The old dial.

in its day, and sited in a good position for public viewing, it would certainly benefit from sensitive restoration before time and weather erode it completely.

Both the above dials measure some 4ft by 2-3ft. Sitting midway between them, on the wall of a terraced house at 38-40 Via Venini, is a much smaller dial (Fig. 3) engraved on a marble tablet about 12ins wide by 15ins high. This is my "problematic" dial, so named because it has several features which I (very much a newcomer to the field of gnomonics) am unable to understand or explain.

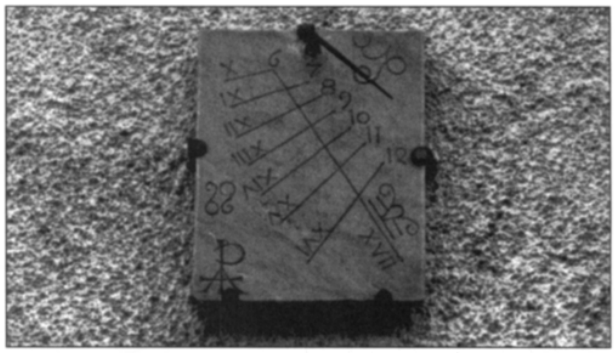


Fig. 3. The problematic dial.

The dial declines 63 degrees West of South and is some 15ft above pavement level. In the diagram (Fig. 4) I have attempted to show more clearly the main features of its face. The tapered style sits at an apparent angle of about 50 degrees to the vertical. Taking account of the camera angle, this is perhaps not too far away from the 40 degrees or so required for a dial at the latitude and declination already mentioned.

The seven inclined lines on the dial face are evidently lines of solar declination. The Roman numerals identifying them,

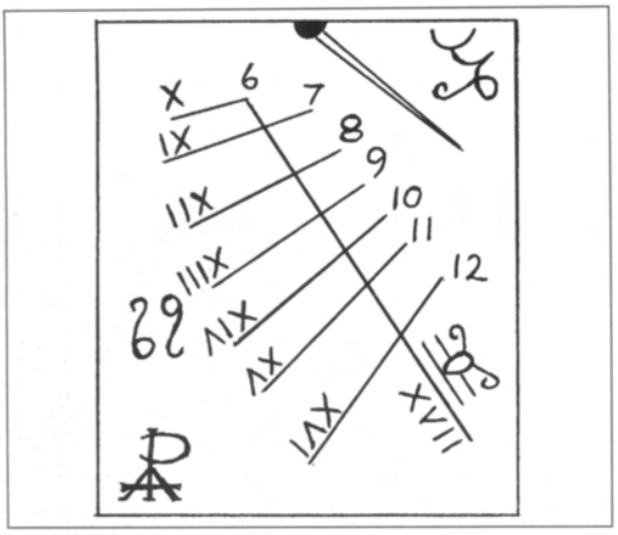


Fig. 4. Drawing of problematic dial.

from X to XVI, appear to be intended to show length of day during successive months of the year. At the latitude of Varenna this ranges from 8hr 26min to 15hr 34min between Winter and Summer solstices, which is not inconsistent with the Roman numbering for a small dial declining heavily to the West.

Assuming the above conclusions are correct, I am left with several unanswered questions:

- What purpose is served by the line on the face which cuts the lines of declination and is marked at its lower end by a merged Libra/Aries sign?

- If the Roman numerals do in fact indicate length of day, why is the Libra/Aries line annotated XVII?

- What information is meant to be conveyed by the Arabic numerals on the lines of declination, running as they do from 6 (Winter) to 12 (Summer)?

- Are the signs for Cancer and Capricorn positioned purely decoratively on the dial face or was the designer intent on drawing attention, seemingly quite illogically, of the 9-XIII declination line?

The "problematic" dial has given me several enjoyable but frustrating evenings poring over Rohr's "Sundials" and the other volumes in my small collection. Although no nearer to solving the unanswered questions, I intend continuing the search and would welcome any guidance fellow-members may wish to offer.

Graham V. Lobley
Maugersbury House, Maugersbury,
Cheltenham, Glos. GL54 1HP

ANCIENT EGYPTIAN SHADOW CLOCKS

DENIS SCHNEIDER

I live near Figeac, a small town in south-west France, where Jean-Francois Champollion was born. The house of his birthplace has become a Museum of Egyptology, and this article was written for a conference of 'Les Amis du Musée Champollion' at which I was invited to speak on Egyptian Sundials.

It is well-known that J-F Champollion was the de-coder of the hieroglyphics. It is less well-known that he was, I believe, the first to have recognised and described an Egyptian sundial.(Fig.1, Fig.2). In a letter dated 30 July 1825 he wrote to his brother Jacques-Joseph about his discovery on opening a new consignment which had arrived at Drovetti's Collection in Turin. J.F. Champollion is wrong about the use of this instrument but the error is excusable because the instrument is broken, and also because it was a novelty. The astronomer Plana in Turin was of the same opinion; the same error was later made, more surprisingly, by the French astronomer Biot.

J.F.Champollion wrote:

> 'I send you a quick drawing. It is a small piece of black basalt, made with the greatest care, and about the height of the drawing. I am convinced that it is a noon line, a solar clock, giving the precise time of noon when it was in place. 'A' is an inclined hole which comes out from 'B' above a small column, cut in relief on this face, and marked by a line

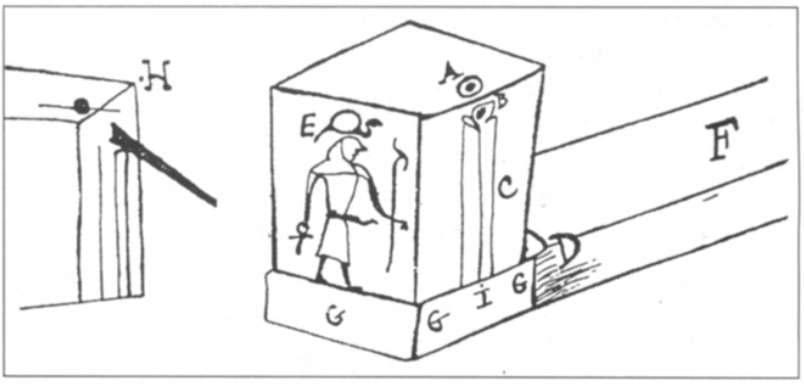


Fig.1 Drawing of J.F. Champollion's broken sundial

perpendicularly cut under the hole 'B'. The style or gnomon went into 'A' out from 'B' with an inclination as in the example 'H', and at noon the shadow of the style covered the line 'I' of the column. On the adjacent face stands a drawing, 'E', of the Sun God...'

Around 1825, meridian lines were numerous, and the presence of the Sun God Re-Horakhty seemed to confirm the hypothesis. We will see later that the hole 'A' did not carry a gnomon, but that this stone was really a solar clock, reading all the hours of sunlight.

Whatever the season, the Egyptians measured the day time as well as the night time as twelve equal hours for a day, but unequal from one day to another (temporary hours). It was also a Chaldean tradition: 12 full lunar cycles in a solar year. Thot, the god of scribes, intelligence and time measurement, personified by a baboon, in his great wisdom urinated twelve times a day and twelve times a night at regular intervals. It was the era of water clocks, the liquid running from a hole, that of the penis of the statue of the baboon standing against the clepsydra. The liquid went up to the heavens thanks to the warmth of sunbeams. Perhaps an obelisk represented this celestial beam. Do not suppose, as sometimes asserted, that the obelisk was always the needle of a gigantic sundial, the gnomon that it will become when transplanted to Europe. In Egypt obelisks were built at the centre of a peristyle in a closed space, as a cult object with an altar at the base.

Egyptian cosmology prevented authentic astronomy. If astronomers raised their eyes towards the sky, it was rather to turn their gaze towards divinity than to make observations. However it was easy for them to correlate the beginning of the annual inundation of the Nile valley (season of the southern African rains where the Nile rises) which marked the beginning of their new year, with the rising of Sothi, which is Sirius in Canis major, the brightest star in the northern hemisphere. Then, each passing day represented the travel of Horus' bark in the two hemispheres, the superior and the inferior: out of the womb of the great celestial body (the goddess Nouit), the boat carries the young god and sails on the celestial Ocean, the Ether, which runs as a river from Orient to Occident, where it forms a waste pool, from which a branch of the river continues, going through the inferior hemisphere from Occident to Orient: a vast procession, now put in its place by wristwatches!

Dating from the Middle Kingdom (2045-1715 B.C.), ancient tablets have been found recording the lengths of the shadows of a vertical rod at noon for each month; and for other hours of the day, a number of feet were added to their length. Studying these tables it is impossible to divide the day-length into 12 equal parts. So we are forced to think that these units were extremely rough and simple, to be memorised. This error also originated in the sacrosanct principle of a shadow which would advance with constant speed like the walk of the Sun God. Even if these measurements had been correct, they would become inaccurate as the years passed. The Egyptian calendar had no more than 365 days instead of 365.25; the Nile would continue to overflow at the time of the rising of Sirius, but in a different month of the Egyptian year. The prime calendar will move back itself after 365.25 times 4 years, that is, 1461 years, and Sothi will set in motion the Nile's inundation in the newly found month! Egyptians will observe with pride the advantage of their fidelity and the perfection of their calendar.

About 15 centuries B.C., instead of the reading of the lengths of shadows from a table, the need was felt to build an instrument to provide a direct reading.(Fig.2). It is this type of instrument that J-F Champollion had unpacked at Turin. But the broken cube lacked a scale ruler about 30 cm long, orientated east-west, such that the shadow of a horizontal edge of the cube would fall on the graduated ruler for each of the hours of the two half-days, the ruler being turned through 180° at noon, the end of the sixth hour of the day. There was obviously no mark for the beginning of the first hour of the day, nor for the end of the last. The cube was pierced by two holes each letting through a plumb-line, so that the observer does not hide the Sun when he turns the instrument at noon. On the ruler, hours are pointed.

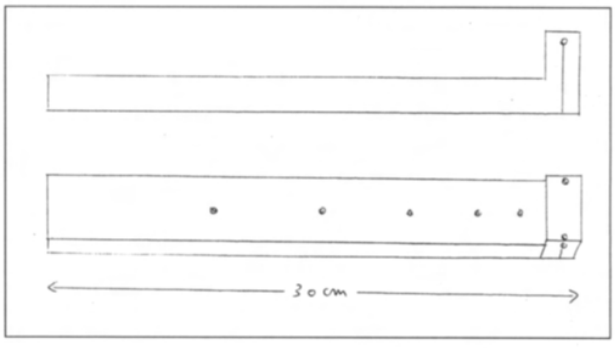


Fig.2 Drawings of the same dial complete, in profile and from above

It is precisely this instrument (Fig.3) which a modern astronomer historian describes in a book, and which is depicted on the Sethi I cenotaph at Abydos (1306-1290 B.C.) The author writes that the use was written below. However I notice that the arithmetical progression 3,6,9 12 did not correspond to hours. What a disappointment when the Egyptologist M. Dewachter contradicted the

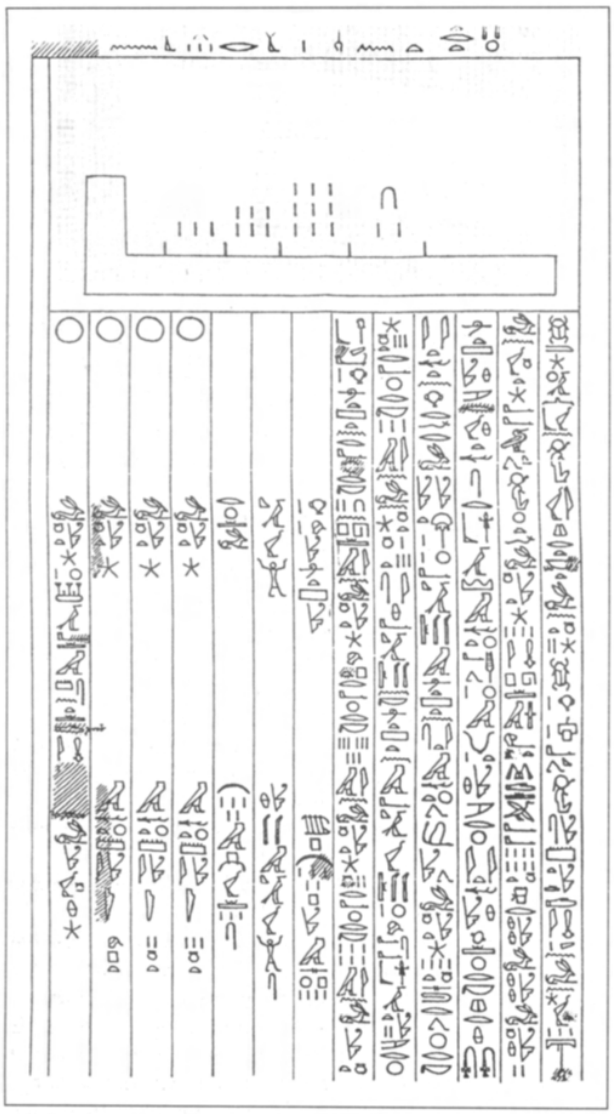


Fig.3 Shadow clock with enigmatic text, in roof of Sethi Sarcophagus chamber

astronomer, assuring me that it was a religious and funerary text reserved to the initiated of the epoch, the meaning of which is lost for ever. It is an exceptional text as the retrograde writing shows: from left to right, when usually signs are read from right to left; this emphasises the value of the text.

With this instrument, if the hour marks were reasonably accurate at the equinoxes (when the sun rises at 6 hr and sets at 18 hr on the east-west line), the hour marks become more and more inaccurate at times further and further from the equinoxes. At winter solstice, the appropriate shadow of the horizontal north-south edge would go off the scale; only the oblique shadow of the vertical edge would come onto the table, giving no more than the azimuth of the sun.

Egypt's latitude is somewhere between the Tropic of Cancer (24° N at this epoch) and 32° N. At solstices, sunrises and sunsets diverge between 25° and 28° from the

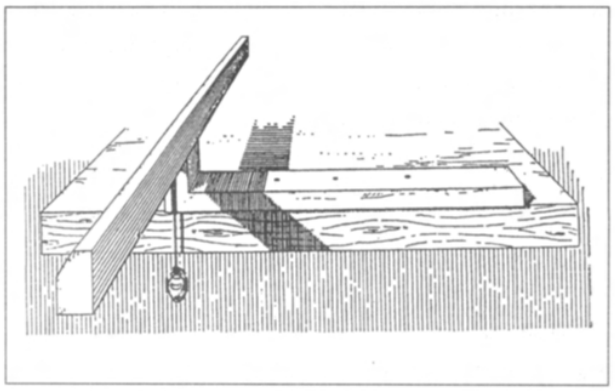


Fig.4 Sundial viewed from south side; the north-south edge is at the west of the instrument, and the shadow is about the end of the 8th hour

east-west line, with advances and delays more or less than an hour according to latitude. (Fig. 4). To avoid the inconveniences of this first sundial with direct readout, the Egyptians lengthened the edge of the gnomon. The length of this gnomon edge was that of Thot's elbow (about 45cm). If the shadow of the horizontal edge of the cube comes onto the scale at all, with this type of sundial it is not the length of the shadow which is pertinent, but its 'depth'. Even with this type of instrument, users could not obtain satisfactory results. They became aware of this, and perhaps tried to vary the profile of the gnomon, which involved modification of the height of the edge throughout the year.

More recent, but unfinished, is the sundial on view at the Cairo Museum, (Fig.5) gathering 3 types of sundial into one. Here, it is the gnomon which is small, and the dial plate is larger for the first hour and the last, of the day. The position of the gnomon avoids the necessity of turning the dial around at noon. There is an inclined table dial-face, which permits folding the instrument. The dial face is on steps, but their height is the same.

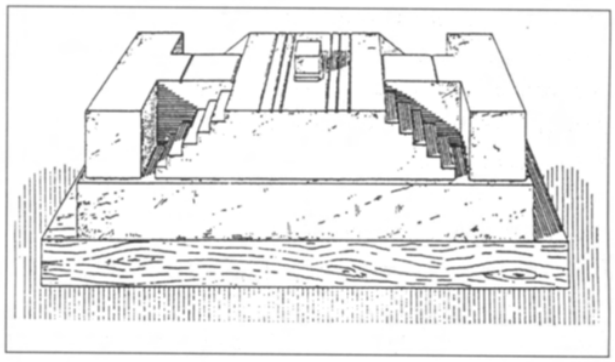


Fig.5 Step-sundial: in the morning the sun goes down the slope of the steps; in the afternoon, it goes up on the other side

On the Cairo sundial, the Egyptian users must ascertain two points:

1. They must assure themselves of its east-west orientation. It was sufficient for them to locate by night the Pole Star in relation to their position, and then to draw the perpendicular line.

2. They must assure themselves of the horizontal level. It was ascertained for use with weighing machines, or a plumbline.

If these sundials were to be easily transportable, as suggested by their small size, they would need a system which avoided the necessity of setting up a permanent east-west line and horizontal surface. The Egyptian users abandoned the idea of the 'depth' of the shadow and considered its length, dependent only on the altitude of the sun. (Fig.6 and Fig 7.)

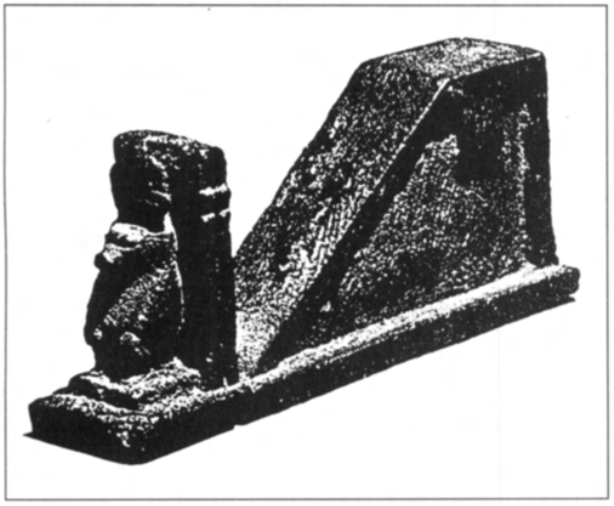


Fig.6 Bronze instrument, Louvre Museum: Thot, the Head of the Dog, watches over Ra's rising and setting, supporting the horizontal gnomon; there is not only the vertical line for aligning the plumb-thread, but also a small cutplane to separate it and even a notched rim to adjust it.

The instrument was orientated in the direction of the sun in such a way that the shadow of the lateral faces of the cube must lie between the two edges of the table. The horizontality was found by means of a plumb line passing through a hole in the instrument: the thread must be aligned along a vertical line.

It is on this type of instrument with direct read-out that we find different scales for each month.Only six or seven are needed, since altitudes are symmetrical about the equinoxes The idea of an altitude sundial was good, but in practice it was not successful. The noon marks for each month were artificially aligned, which cannot be the case: the noon altitude does not move regularly throughout the year.

Going back 13 centuries B.C., the Egyptians also used a vertical sundial with horizontal gnomon, (Fig.8) and 13

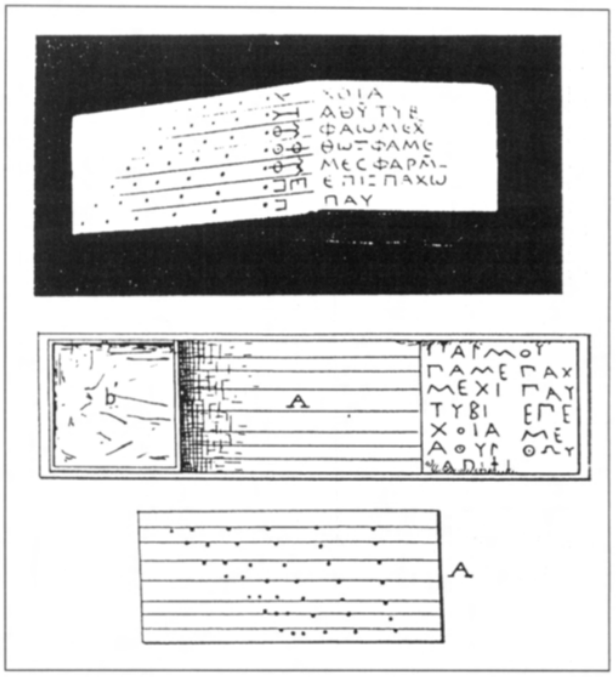


Fig.7 Above: Sundial found by Golenischef
Below: Sundial found by Cledat at Quantarah.

The seven columns for months are written in Greek script; the date must be after Alexander's conquest. The months of the solstices are distinct.

On the upper sundial, Khoia contains the winter solstice and Payni the summer solstice.

On the lower sundial, Parmouti contains the summer solstice and Paophi the winter solstice.

On the upper sundial, Thot's month contains the autumn equinox; but on the lower dial Thot's month is the month preceding the one containing the winter solstice.

From this we may conclude that the upper sundial is the more recent of the two dials, because on the indeterminate Egyptian calendar, (leap-year-day lacking, every four years,) the names of the months have gone back in relation to the solar year, about 60 days. So 240 years separate the two sundials: (240 x 1/4 = 60)

Knowing the date of the beginning of the Sothiac era (1321 B.C.) to which these month-names belong, we can deduce that the lower sundial was made between 375 and 285 B.C.; epigraphic study narrows the range from 323 to 285 B.C. The upper sundial is just B.C.

marks placed at about 15° apart, accurate only at the equator. Canonical hour sundials of western Europe between 8th and mid 15th century A.D., for timing religious offices, were similar to this.

At the beginning of the 20th century, travellers could still see in Egypt, (North Nubia,) farmers who timed the working spells of their beasts walking a circle to draw water, by means of the shadow of a wooden rod placed horizontally between two forked sticks. The shadow fell on marks on a scale similar to that of the first Egyptian clocks. The accuracy was sufficient for most trades; in fact they would have exact time only at noon!

Egyptian sundials may all have been inaccurate, but there

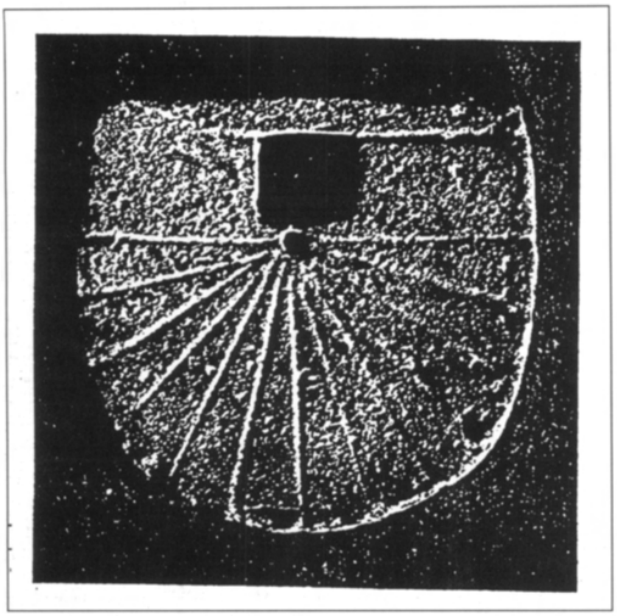


Fig.8 Green earthenware Sundial of the Graeco-Roman period, Berlin Museum. The square hole may be to hold a stick to suspend a plumb-thread. The sundial is pierced on the sides to take a string to suspend it.

was at least some progress in their ideas of time measurement. They understood that it was necessary to abandon the old idea of searching for a regular progression of numbers. For the ancient Egyptians this violation of their conception of harmony represented enormous scientific progress

From the timing of ceremonies of ancient offerings in temples until the timing of replacement of teams of traction beasts in the 20th century A.D., shadow clocks have lost their prestige. But the hieroglyph of the Sun ⊙ always symbolises our star for astronomers, and will do so for many years to come.

BIBLIOGRAPHY

Biot, B.: *Recherches sur l'année vague des Egyptiens.* Paris, 1831

Borchardt, L.: *Die Geschichte der Zeitmessung und der Uhren in Altägyptische Zeitmessung.* Bassermann-Jordan Berlin-Leipzig, 1920

Bosticco: *Studi in ouvre di E. Calderini,* R. Paribeni , Milano, 1957

Bruins, E.M. & Janus S.Z.: *The Shadow Clock* (1965)

Cledat, M: *Recueil de Travaux,* **37,** 38-39 (1915)

Capart, J: 'Horloges Egyptiennes' *Bulletin des Musées Royaux d'Art et d'Histoire,* 3rd series, 10th year No 3, 50-54 (1938)

Curto,S: *L'Antico Egytto al Museo Egyzio di Torino* Torino, 1984

Fabretti, A. Rossi, F. & Lanzone, V: *Regio Museo di Torino* Torino 1888

Frankfort, H: *The Cenotaph of Seti at Abydos* London 1933

George, B: 'Die Bahn der Sonne am Tage und in der Nacht: altägyptische Sonnenuhren and Königsgräber,' In: *Studia Aegyptica,* Budapest, **1**, 101-116 (1974)

Hartleben, H: 'Lettre de Champollion le Jeune' *Bibliotheque Egyptologique publié Maspéro* **8, Vol 1** 246-247 (1909)

Kuentz, C: ' Note sur un gnomon portatif gréco-égyptien' *Recueil de Travaux* **38**, 3rd series, 70-84

Lexikon der Agyptologie, Wiesbaden: Sonnenuhr, pp1105-1106;(1984); Wasseruhr,p.1156(1986)

Macnaughton, D: 'The use of the Shadow Clock of Seti I' *Journ.Brit.Astronomical Association,* **54**, 135-137 (1944)

Petrie: 'The Shadow Clock' *Weights and Measures, B S A E plates 25 26 p. 45*

Scott, N.E: 'An Egyptian Sundial' *Bulletin of the Metropolitan Museum of Art, New York* **30**, 88-89 (1935)

Sottas, H: 'Une petite Horloge astronomique gréco-égyptienne' *Recueil de Travaux*, 1-7 (1916)

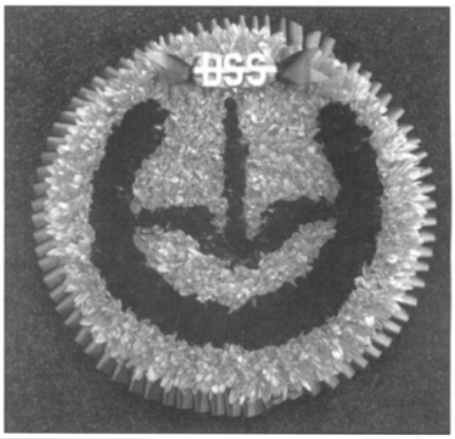
Sloley: ' Primitive Methods of Measuring Time' *Journal of Egyptian Archaeology*, **17** , 166-174 (1931)

Denis Schneider,
Crayssac, 46100 Corn, France

CHARLES K. AKED

Charles K. Aked, who died on 22 April 1998, was a founder member of the British Sundial Society, and became one of the Society's Vice Presidents. He edited the BSS Bulletin from its foundation in 1989 until 1997, and built up its reputation as a leading journal on all aspects of sundial lore. At his funeral on 1 May 1998 the Society was represented by Doug Bateman, who took this photograph of the wreath made in the form of the Society's logo.

A full obituary will appear in a later issue of the BSS Bulletin.



A SUNDIAL AT WINDSOR CASTLE

JANE WALKER

'Sundials and Weathervanes' was the title of a booklet which drew us in to PIC's second-hand book shop in Bridport, Dorset. The owner collects sets of magazines dating back to Victorian times and extracts from them articles on topics of specialist interest from which he produces booklets for sale in his shop. Much later we emerged bearing his last two copies (there has since been a reprint) of 'Sundials and Weathervanes'.

The booklet includes an article taken from Strand Magazine of 1892 which opens with a familiar ring-

> *The fact that sundials will soon be a thing of the past, and the interest which attaches to their usually beautiful forms and their quaint mottoes, makes one wish to put on record at least a few of those that may still be found in out-of-the-way-places.*
>
> *Through the courtesy of General the Hon. Sir J.C. Cowell, K.C.B., and with the kindly help of Mr Nutt, the well known architect of Windsor, I have been able to give the readers of PIC's PUBLICATION a presentment of a royal sundial, which stands on the East terrace of Her Majesty's private gardens at Windsor Castle. It was erected by Charles 11., was designed and carved by the famous Grinling Gibbons, and its gnomon-which is an especially beautiful one-bears the King's monogram and crown. The dial-plate is graven with the Star of the Garter, with its motto, "Honi soit qui mal y pense," and with the maker's name "Henricus Wynne, Londonii, fecit."*

With the kindly help of Mr Nutt? I had no royal architects in my acquaintance and so addressed my enquiry, in the first instance, to 'The Head Gardener, Windsor Castle' requesting information about the dial, perhaps a photograph or better still a visit. I was rewarded with a reply from the Deputy Surveyor of the Queen's Works of Art at The Royal Collection Trust inviting me to make an appointment to see the dial which is in the care of the Queen's Horologist at Windsor Castle, Mr Peter Ashworth-a BSS member. The visit had to take place in the early morning, so that we should be clear of the private garden before the castle is opened to visitors. A date in November was agreed and my husband and I met Peter Ashworth at a side door to the castle at 8.30 am.

The dial stands on the North Terrace with the Queen's private garden to one side and a splendid view over the town of Windsor to the playing fields of Eton on the other. The gnomon is beautifully engraved and carries the King's monogram CR intertwined so that the initials can be read from either side. The dial plate is unusual in that it is made from a thin sheet of brass bolted to a thicker base plate. The surface plate, which is engraved with the maker's name and the Garter Star and motto, has worn through in one or two places and the base plate, of another material, can be seen underneath. Acid rain is no respector of sundials and the problems of restoration are as urgent on the terrace of Windsor Castle as anywhere else. Indeed, with the constant stream of aircraft to and from Heathrow and the traffic that snarls continually round the castle walls, it must be a particularly vulnerable site.

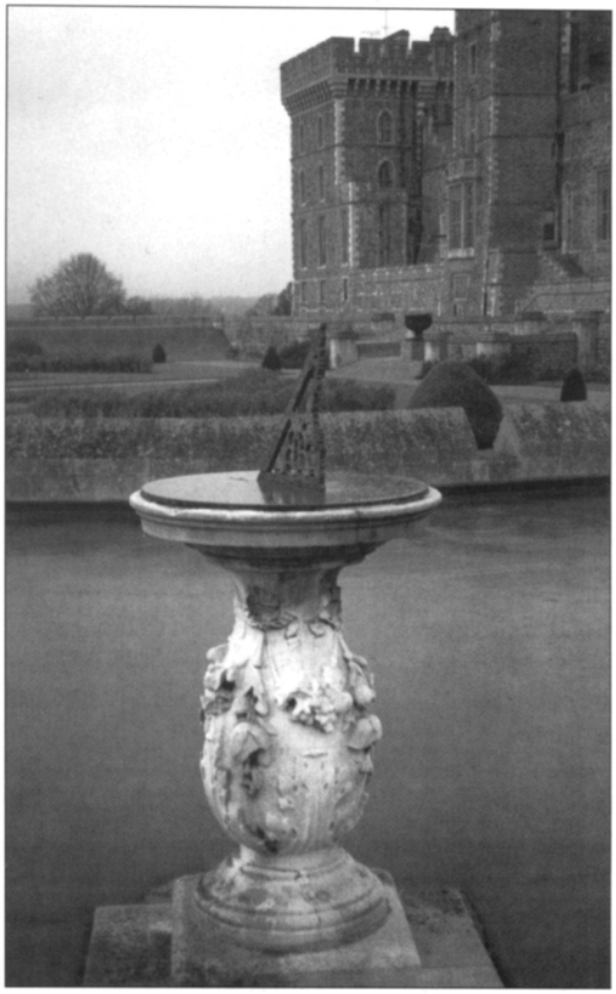


Fig. 1 The Windsor Castle Dial in its setting.

The pedestal differs considerably from the artist's impression which appeared in the Strand Magazine article

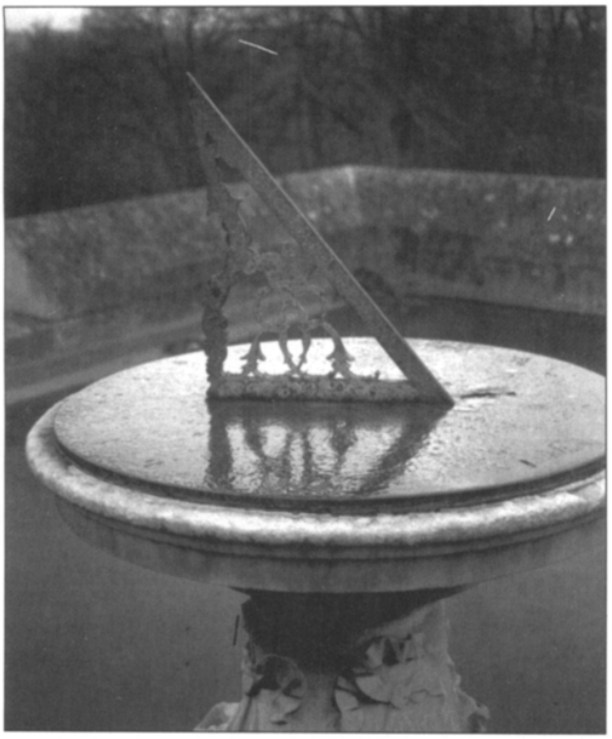


Fig. 2 Dial plate and gnomon.

but is more accurately represented in the drawing which accompanied an article in Country Life in 1913. It stands 3 feet 4.6 inches high and is carved with flowers, fruits and acanthus leaves.

At 9 o'clock on a wet November morning there was barely enough light for taking photographs but we did manage a brass rubbing before taking cover in doors from the persistent rain. Peter Ashworth then showed us several references to the dial from the castle archives which we feel sure will be of interest to BSS members.

In 1891 W.J Loftie describes the position of the dial as 'at the north-eastern (end) where the terrace was extended towards the East over the escarpment, and was furnished with a sundial and a flight of steps which led down into the south garden.'

And adds:-

> 'There is an anecdote worth repeating about this sun-dial which still stands on the Terrace. One day in the summer of 1787, the King, George the Third, and his favourite son, the Duke of York, had walked for some time up and down the Terrace in conversation, when the King, being tired, stopped and leaned his arms upon the dial. A sentry immediately came forward and respectfully, but firmly, told his Majesty that it was part of his duty to prevent any person from touching the sun-dial. The king, instead of showing displeasure, commended the soldier to the favourable notice of his colonel, and he was shortly afterwards promoted.'
>
> ("Windsor Castle" W.J. Loftie. Seeley & Co., London 1891 p114)

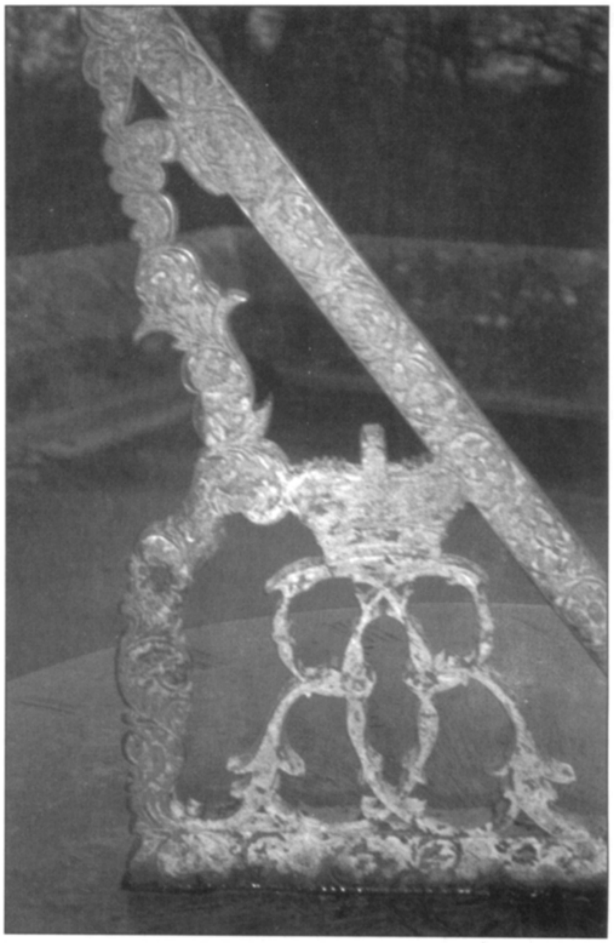


Fig. 3 The gnomon.

W.H. St. John Hope writing in Country Life in 1913 says:- 'On the north side of the enlarged terrace is a sundial upon a handsome shaft of Portland stone carved with swags of flowers and acanthus leaves round the base. The dial is engraved with "Henricus Wynne Londinii fecit," and in the accounts for 1679-80 is an item of £20 paid to-

> *Hen: Winn for a large brasse horizontal dyall placed at ye north tarrace & for a journey to Windsor to place it upon ye Pedestall.*

The latter is the work of Grinling Gibbons, who was paid the same year

> *"for cutting & carveing ye Mouldings and Ornaments for the Pedistall of the large Dyall in the North Terrace."*
> *The height of the pedestal is 3 feet 4 $^{5}/_{8}$ inches.'*
> ("Windsor Castle, An Architectural History" by W.H. St John Hope. Published in Country Life. 1913 p. 319, 320, 327, 580)

There are however several references to another dial, a

double horizontal dial, which is described as standing on the short south terrace.

George Bickham, jun., in 1742 wrote:-

> "At the East End of the Terrace there is a bowling green, and a Draw-Bridge at the Bottom. On the west there is a very curious Sun-Dial erected on a Pedestal, by the order of King Charles 11. which was made by one Henry Wynne, whereon all the points of the compass are particularly delineated, at which Place a Centinel always stands, and when any unguarded Spectator claps his Hand upon it, he claims, by Dint of Custom, Sixpense as a Forfeit."
>
> (George Bickham jun. Deliciæ Britannicæ London 1742, p 142)

W.H St. John Hope also refers to this dial:

> 'The completion of the short south terrace is marked by the setting up of a sundial upon it. This had been bought in 1677-8 and is entered among the taskworks for that year-
>
> *"Henry Wynne for Materialls and Workemanship in making a Large Double Horizontal Dyall sett in the Southest Terras Walke at Windsor Castle according to Contract for the same £25."*

And in the current account 40s is entered among the travelling charges as paid to

> *"Henry Wynne for his Journey and Changes from London to Windsor for setting ye great Horizontal dyall on ye Tarras Walke"*

In the following year John Vanderstraine accounts *"for carveing ye stone Eagles that the brasse dyall is set upon"*

I have no further details about this dial but it certainly seems to have been something special and I would welcome any further information about it.

As we left the yard was filling up with tourists and-wouldn't you know - the sun was shining.

ALMOST DIALS AND USELESS DIALS

In the letters column of B.S.S. Bull. 97.3, I described some recent unhappy encounters with 'Almost' Sundials. I would like to submit two further 'Almosts'. Fig. 1. shows a Quasi-armillary sphere in Alcester, England. Fig. 2. is a would-be horizontal, with dysfunctional gnomon, in an otherwise pleasant area of Nice, France.

John Moir

Fig. 1. Alcester, England.

Fig. 2. Nice, France.

Participants in the 1997 Sundial Tour in Germany observed some strong contenders for the title of 'World's Most Useless', a challenge thrown down by Mike Cowham (B.S.S.Bull. 97.4, p48) when offering a wall dial at St. Johann, Austria. Fig. 3 shows a spherical sundial in a beautiful public garden in Fulda; it is of the type described

Fig. 3. Fulda Gardens, Germany.

Fig. 4. Fulda Cathedral, Germany.

by Peter Drinkwater in B.S.S.Bull.90.3. But the significance of the iron projections top and bottom is baffling; the upper one might be a 'construction line' to help the placing of the sphere, but there is no excuse for the lower one. Fig. 4 shows the sundial on a tower of the facade of Fulda Cathedral. With handsome gilt numerals and a carefully orientated gnomon, the dial face is cunningly painted a dull black, so a shadow cast on it is totally invisible.

Margaret Stanier
(Photos from D.A. Bateman)

A TWIST ON THE HELIX DIAL

GARY ROLFE

Back in Bulletin 95.1 John Moir's article on the Piet Hein helical dial fascinated me with both how it worked and how it *didn't* work. To remind you, the sundial was simply a thin strip of metal (or elastic) twisted half a turn and set on an axis. Time was read from a scale running along the helix made by the twist.

The article by John Moir showed that the curved helix shape worked well at the equinox but gave a fuzzy line or inaccurate reading when the sun was higher or lower. Like John I also had reservations about forming the twist evenly.

I liked the idea of a helix dial, but concluded that the curved surface of the helix would always cause problems. *But how could you have a helix without a curved surface?*

The problem played on my mind until one day the thought `spiral staircase' popped into my head. Instead of a curved surface, the `helix' could be made up of a series of flat surfaces rather like the risers on a spiral staircase.

I remembered seeing a dial at the BSS Newbury meeting. It was made with a conventional horizontal layout but with `fins' along each of the hour lines radiating out from the centre, but I had never seen a flat surface dial set upward in a helix shape.

I felt that I was on to something, so decided to make my stepped helix. Instead of a thin strip or fins it was far simpler to make my prototype out of wooden blocks glued together, each with a 15° rotation from the last. Even as the glue was drying I could see that each block could be made in any shape or size and they could be placed in any position relative to each other.

As long as the faces of the dial were orientated correctly they could take on almost any form. The only limitation seems to be that care is needed not to lay out each face so that the next one will obscure the sun, especially when it is very high or low in the sky.

I engraved the time markings into the faces and found them to be clearest exactly when you want them; with the sun just moving onto or off the face.

With each prototype, I became more adventurous with the shapes I designed. The simple twisted stack of blocks developed into shell, column, sphere and cone shapes. It then struck me that these shapes would be able to be made simply by casting from a mould as you would for any other garden ornament. This, I felt, gave the idea a commercial value, a sundial could be made as easily as you make a concrete urn, statue or garden gnome.

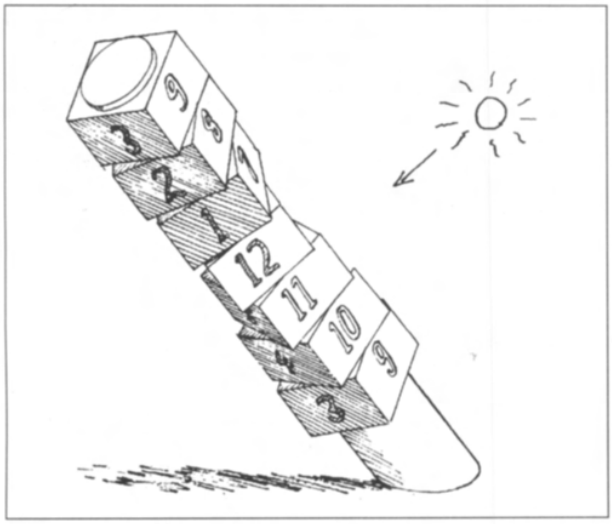


Fig. 1 Basic block sundial. Hour intervals show time between 12 and 1 o'clock. Faces form stepped helix shape.

TECHNICAL DETAILS.

The dial is made by setting a series of faces on a solid object. Each face is orientated to be parallel to the earth's axis, as well as turning regular amounts to indicate a specified time.

A face will indicate the time by both falling into or out of shadow. Through the year the sun will simply be a little higher or lower in the sky as it passes the plane of each face so the face will `turn' at the same time of day all year.

It takes about ten minutes for a flat `face' to turn from full sun to full shadow, which I at first perceived to be a disadvantage, but later found to be of benefit. A dial made with 15 minute `steps' can indicate time to within about five minutes, as you can judge the intensity of shadow on the face as it changes from sun to shadow.

The `face' for 7am, for example, will also read

Fig. 2 Time indicated on Stone cast column with 15 minute divisions. 10.45 is in full sun so has passed. 11 o'clock is just picking up some sun but is still not fully lit. So time is approximately five to eleven. ~~XI just picking up some~~.

Fig. 3 Range of cast sundials

7pm, therefore no more than a twelve hour scale is needed. Each face will move into sun in the morning and then into shadow in the afternoon.

As long as the faces keep their orientation, they can be put on the solid in any pattern or configuration. The only restriction seems to be that they do not obscure each other's shadow.

I searched through endless patents on all sorts of sundials, but found that nothing has been patented like this. By necessity I then had to keep the whole project secret so as not to jeopardise any patent application I made. A long path of development followed, a UK patent was filed to secure a `priority date' followed by an international application, which has now proceeded (expensively) through its international preliminary search.

With the publication of the patent application in the summer of 1997 I finally went public with the project last September. I have had very encouraging responses from a number of garden ornament manufacturers in the UK who are interested in manufacturing a range under licence. With commercial production of the concept lending itself so readily to cast stone, and the sundial not really having a conventional dial I have named them `Sunstone' sundials.

The purist may not readily accept this new breed of sundial, it may be quite radical, but I feel it can only serve to broaden the appeal of sundials and bring them to the attention of a wider audience.

I am very interested in getting any feedback, comments or criticism from BSS members. Also any other applications for the further development of the project are most welcome, particularly a large sculpture incorporating a sundial of this type.

Patent No. PCT/GB97/00004.

Gary Rolfe, The Old Chapel, Newfound, Basingstoke, Hants RG23 7HH

DA BUTI, DANTE AND THE MEASURE OF TIME

MARIO ARNALDI

Many contemporaneous writers attempted commentaries on the 'Divine Comedy', the most sublime work of Italy's greatest fourteenth century poet Dante Alighieri. Few have been as successful in this commendable intent as Francesco di Bartolo da Buti (1324-1406). He completed his Commentary on the 'Divine Comedy' in 1385.[1] Although known to scholars, it was published only five centuries later, and possibly did not obtain deserved recognition. For those of us interested in the history of gnomonics and time-recording, his work presents some points of attraction. In particular, I wish to consider his Commentary on the opening triplets of the fifteenth canto of the *Purgatorio.*

Dante Alighieri[2] in his journey to the three other-worldly places, Hell, Purgatory and Heaven, frequently indicates to the reader the time of his present situation, with expressions related to the hourly system of his own epoch. Da Buti gives his interpretations, but in commenting on the start of the fifteenth canto of *Purgatorio* he gives a detailed explanation, which provides an insight into the astronomical knowledge of the period.
The triplets have been translated as follows:

'As much as between the end of the third hour and the beginning of the day appears of the sphere that is always playing like a child, so much now appeared to be left of the sun's course toward nightfall. It was evening there, but here it was midnight'

That is, at the moment in Purgatory described by the author, the sun is located in the celestial sphere the same distance from sunset as there is from dawn till the third hour; but in Italy, where Dante is at this moment writing his verses, it is midnight. Da Buti in his comment here elaborates on this passage: 'In these lines, our poet depicts the time, telling the space until the ending of the third hour; that means, the sun has mounted up from the horizon to the point where Terce is recited; so called because it is the third part of the way from the eastern horizon to the zenith of the Sun, that is, a half-day.'

He gives a strange etymology for 'Terce' , telling us that it is so named, not because it is the third hour of the day but because it is a third part of the period that runs from dawn to midday. Dante himself considered that the day (daylight) was divided into four segments, each of which was halved to make eight periods of time.[3,4] Da Buti considers instead a division trisected for each half of the period of daylight. He continues:

'To clarify this we must know that our hemisphere is divided into six equal parts beginning from the

eastern horizon and finishing in the western. The ascent of the Sun to the first part tells Terce; to the second, Sexth; to the third, Non, and we have reached half the Day. Then it begins to descend: the first part Half-Vesper, the second Vesper and the third, Evening. This hemisphere has six equal parts and the other too, making twelve in all'.

This gives six periods in the day and another six at night, recognisable in many medieval sundials. Da Buti continues:

' These twelve parts I will mark with ternary numbers up to 36, starting from the end of night and adding three for each segment, making 36 in all.... And to be better understood, I will depict a hemisphere in six equal sectors parted as it appears in space, six in each hemisphere making the sphere round' (Fig.1)

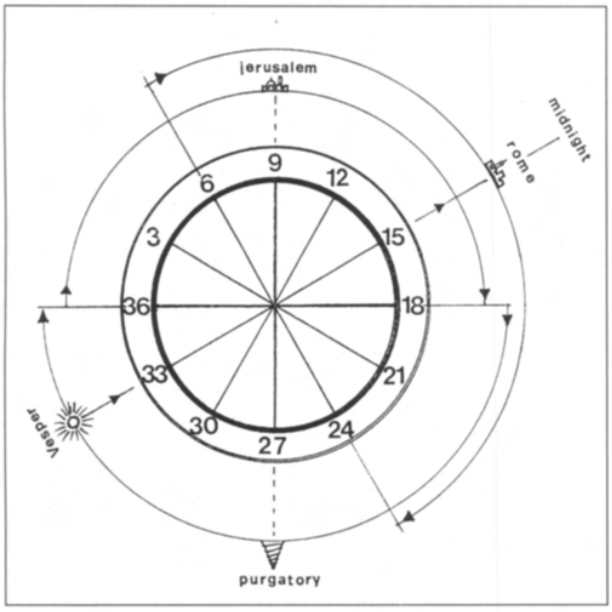


Fig. 1 Mechanics of the Sphere according to Da Buti

Da Buti does not reveal the origin of this division. In fact in other passages of his Commentary he uses the classical twelve temporary hours. Probably this system was used as an alternative to the quarternary or eight-unit system described by Dante.

Our commentator is lengthy in his explanation because, according the Dante's image, when the mountain of Purgatory was at Vesper, in the opposite hemisphere Rome (in Italy where the poet was writing) was at Midnight (See Fig.1). In the ancient world and in Dante's vision, the mountain of Purgatory was the antipodes of Jerusalem. Rome was depicted as 45° west of Jerusalem, so midnight in Rome would correspond with Vespers in the hemisphere of Purgatory. Apart from Da Buti, we have few documents explaining with clarity the duodecimal system of the complete 'natural' day (In the Middle Ages the 'natural' day meant the whole 24 hours, though the ancient Romans called the 'natural' day the daylight hours only). However there remain as witness numerous medieval sundials, many just in the province of Siena. Their division into six equal sectors reveals a custom, possibly not orthodox, but rather of a monastic character.

Among the various testimonies, one helps us more than all others. It is the sundial on the Church of Santa Maria della Strada at Taurisano (Lat. 39°58′ Long.18° 13′) in the province of Bari, Italy. The round dial is beautiful and interesting indeed in its execution, in the Greek epigraphs, and in the letters on the hour lines. (Fig. 2). It was described in detail in a lecture by Azzarita[5]

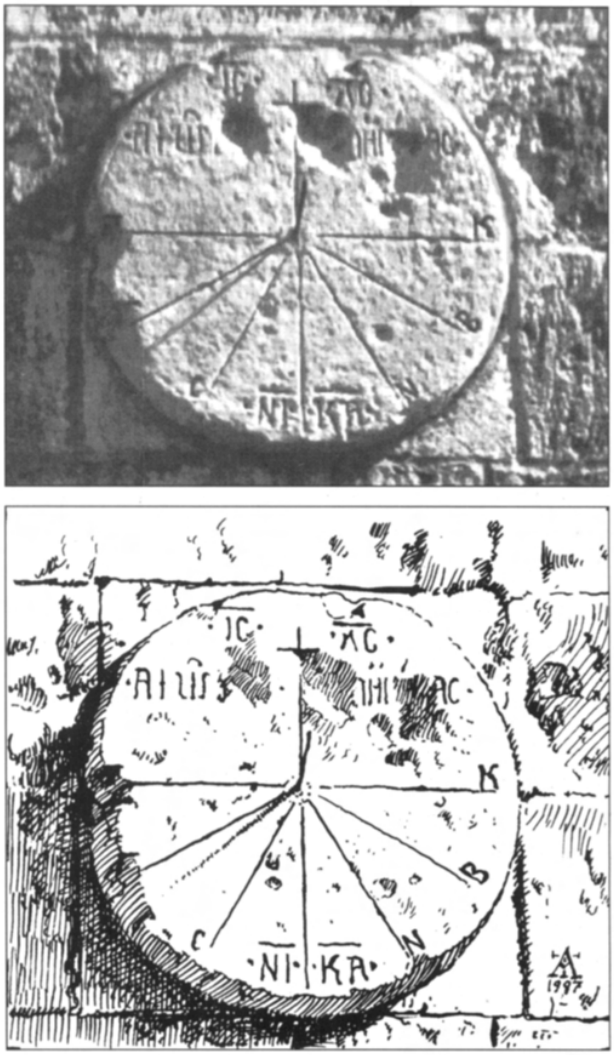


Fig.2 The Sundial at S.Maria della Strada, Taurisano
(a) Photograph (by F. Azzarita)
(b) Sketch showing detail of photograph Only a portion of the 'π' and 'T' letters is visible. The line between the 'T' and 'C' lines is the shadow of the horizontally projecting gnomon.

We cannot say that it is absolutely unique, either as to shape, epigraphs or hour-line letters. But it is, as so far

known, the only sundial in Italy having six divisions marked by letters, and this makes it an interesting and important example.

One epigraph gives the the ancient Byzantine formula 'IC XC NI KA' 'Iesus Christos Nika' (Jesus Christ the Conqueror). A second epigraph reads ' Ai Orai Tes Emeras' (The hours of the day). We also find a series of letters marking the six lines on the dial face. We read on the first line, on the left, the Greek letter π and then proceeding round the lower semicircle the letters 'T', 'C' , 'N', 'B', 'K'. As Azzarita has pointed out, these are the Greek initials of the canonical functions of the Latin Church. At the time of the Taurisano Dial, the Roman Church was displacing the Greek-Byzantine ceremonial, in this region of Italy. The first line marks 'Prime' , the second, 'Terce', the third 'Sexth', the fifth 'Nones' the sixth 'Vesper' and the last 'Compline' The meridian line has no marker. Excluding the letter 'N' on the fifth, and placing it on the meridian, we have almost the exact position of the daily parts proposed by Da Buti in his Commentary; and there can be no confusion about the beginning and the end of the time periods. As Dante and many medieval authors have said, the hourly markers represent the end of a period of time, never the beginning.

REFERENCES:

1. F. da Buti: *Commento alla Divina Commedia* Pisa (1858)
2. D. Aligheri: *Divina Commedia Canto 15*
3. D. Aligheri: *Convivio,* iv. xxiii, 14-16
4. M. Arnaldi: Sundials painted in the cloister of an Italian Monastery *B.S.S Bull* **98**.1 22-25 (1998)
5. F. Azzarita: Quadranti Solari Canonici medievali e Bizantini in Puglia *Atti del III Seminario di Gnomonica* (1990)

Mario Arnaldi
Viale Leonardo 82
Lido Adriano,
48020 Ravenna,Italy

BERNHARDT DIALS

MARGARET STANIER

(FIGURES AND ASSISTANCE PROVIDED BY D.A. BATEMAN)

The sundials designed by the modern German designer M. Bernhardt have an interesting and characteristic shape; an example was shown on the cover of the October 1997 B.S.S Bulletin.

It is a equatorial dial, a polished aluminium gnomon pointing towards Polaris. There are no hour lines; but hour numerals, with half and quarter divisons and individual minute marks, are engraved round the circumfernce of the curved cast aluminium plate. The gnomon is 'cylindrical' but of varying transverse section along its length; and the outline of its longitudinal section reveals the familiar equation-of-time analemma.In consequence the hour scale is for mean time, not solar time, since the equation-of-time correction is built in to the gnomon. The hour is read at the point where the leading edge of the shadow of the gnomon touches the hour scale on the circumference. Close examination of the time markers will show that they are not radial but inclined towards the lead edge of the shadow.

The wide-arc cutouts of either side of the gnomon, and the dished shape of the dial plate itself, mounted at the appropriate angle for the latitude, ensure that sunlight will reach the dial plate even in winter when the sun is below the celestial equator: always a problem with the design of equatorial dials.

There is a screw-thread extension at the bottom of the gnomon, which enables the gnomon to be unscrewed and replaced by another, to operate in its winter or its summer mode; the changeover of gnomons should be made at the solstices. Those who took part in the Sundial Safari in Germany in July/August 1997 saw a Berhardt Dial in the Spa Gardens at Bad Soden still operating in its 'winter' mode; and another, in the porch of the Orangerie in Kassel, which was functioning correctly in its 'summer' mode. The Orangerie now houses a very good Science Museum. This

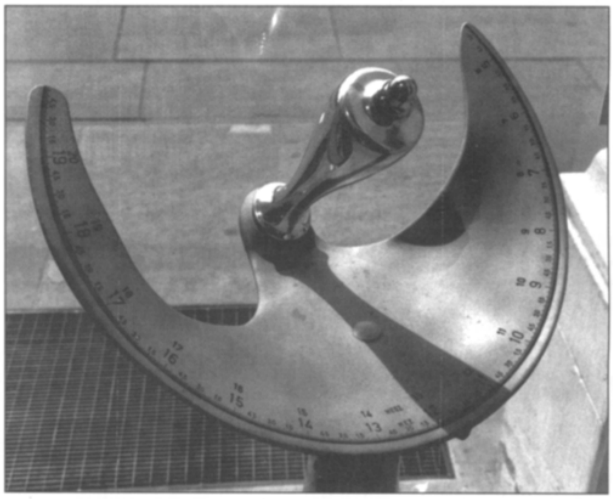


Fig. 1 Dial at entrance of Orangerie, Kassel, Germany.

Kassel dial is not very well-placed because the shadow of a pillar comes across it at certain times of day; but it has a advantage of a curator around who can change its gnomon at the right time. On a nearby wall-tablet is a description of the working of the 'Prazisions - Sonnenuhr' written by M. Bernhardt. It explains the change over of the gnomon at the summer/ winter solstices.

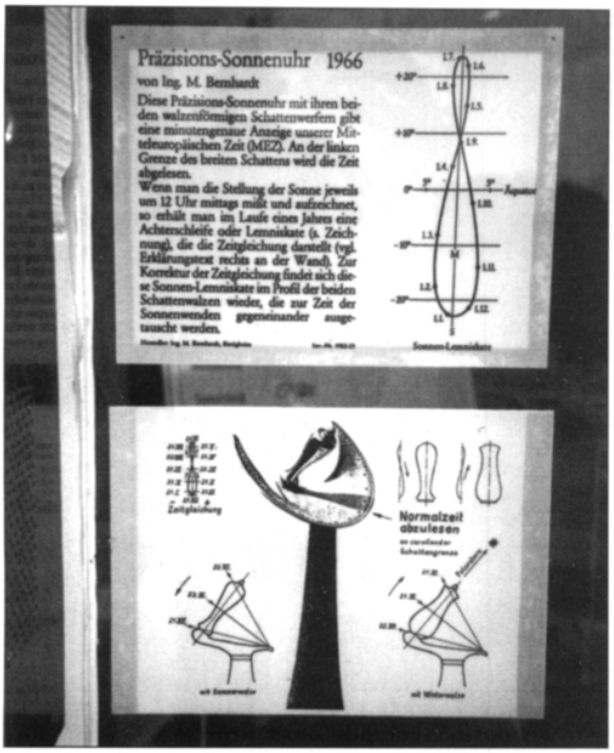


Fig. 2 Wall tablet describing function of the dial.

A photograph of a Bernhardt Dial recently appeared (June1997) in the Horological Journal; so this design may already be familiar to some readers.

A reader who lives in the home counties was prompted by the sight of the photos on the cover of the BSS Bulletin for October 1997 to send us the following interesting letter:

> 'I actually have one of Martin Bernhardt's sundials set up in my garden. The story is that several years ago we came across one of his magnificent dials which was the main feature of a fine war memorial in Alsace, France. I managed to find out his name and address and wrote to him asking if he could make a dial for me in England. This involved of course milling a baseplate to set up the dial to the correct co-ordinates of my garden. His dials are far from cheap, but around my 60th birthday time I decided to get one made as a present to our garden! I also found out that Martin is quite elderly and I was not totally sure that he would pack it up safely and send without risk of damage, so in the end I flew out to Stuttgart and hired

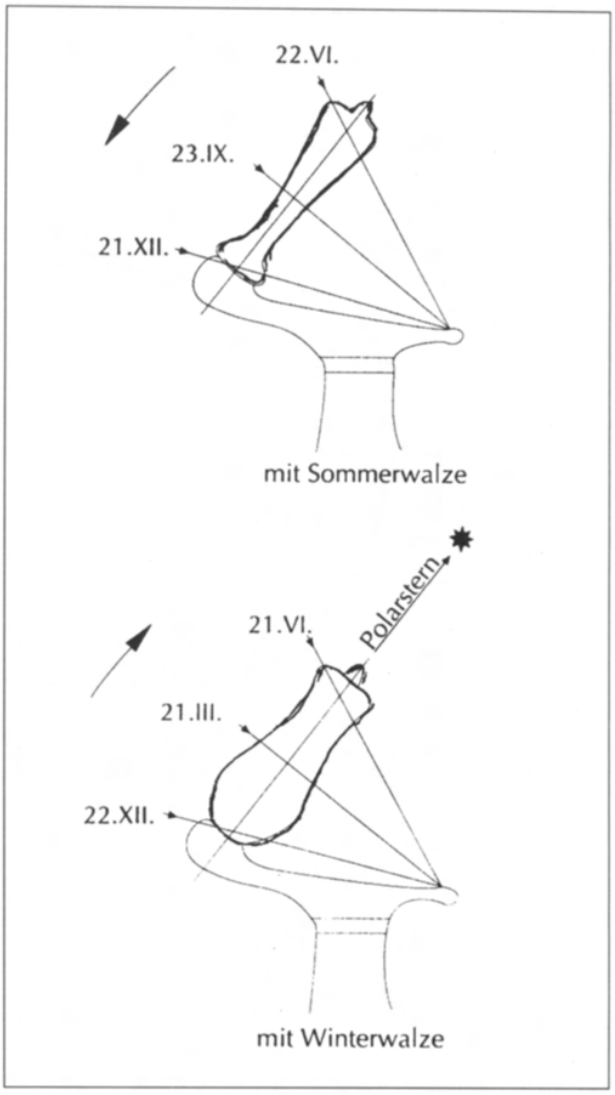


Fig. 3 To illustrate the change of gnomon at the solstice.

a car to go up into the mountains to collect it. He is I think 83 years old and speaks no English at all. His interpreter is a girl from next door. He was obviously thrilled that one of his dials would be in England. He has nearly 100 dials, I gathered, dotted about Europe, but this was his first one in England. He now no longer makes them himself, but has an engineering friend who casts the dial face and mills the base for him. Regretfully I suspect this skill will disappear when he dies.

We have the dial now set up at home and its accuracy to me is quite phenomenal. In the middle hours of the day the time shadow is usually within one or two minutes of agreement with the Rugby radio pulse clock (in fact the edge of a shadow can't really be interpreted with greater accuracy). There is no need at all to wear a watch in the garden when the sun is shining.'

GNOMONIC BIBLIOGRAPHIES

CHARLES K. AKED

Twenty five years ago the writer was given a box full of tatty typewritten slips and told it was Part II of a Bibliography on Clocks and Watches by the renowned horological author Granville Hugh Baillie. Part I of his work appeared in 1952 when the author had reached the venerable age of 80 +. It had been many years in the compiling, for in embryonic form it had appeared as a serial in the now defunct journal *Practical Clock and Watchmaker* in the 1930's. It was the production of a book from this heap of crumpled strips of paper which first aroused the writer's interest in bibliographies.

In Foyle's bookshop in Charing Cross Road, in the early 1970's, in searching through the books on clocks and watches, the first sighting of Baillie's Bibliography Part I was made. It was not love at first sight, indeed the contents induced a feeling of revulsion with its dreary presentation, but of course this was due to the sheer ignorance on the writer's part of the value of the work. Eventually a copy was purchased, for this was a time when titles could be in print for many, many years, because of the slow rate of sales.

It says something for the status of the work when the Astronomer Royal, H. Spencer Jones, wrote the foreword for the book, and he mentioned in passing that there was a extensive literature on the dials and nocturnals. Baillie indicated his own thoughts about dialling thus:

> I have ignored dialling - the art of making sun-dials. Its literature is enormous, particularly in the eighteenth century. It is a simple art, but the older books make it appear complicated. Some small modern books have been written explaining the art simply and clearly and, in comparison with these, the older books are without use or interest.

This rather intrigued the writer, at the time his interest in sun-dials was no more than that they were part of the whole system of time-keeping from the distant past. Although Baillie had a sub-title to his book, *An Historical Bibliography,* it was not actually a bibliography at all, merely a listing of selected works with details of the books' contents, plus publisher's names and dates of publication. It was in fact based upon the extensive horological library he had built up over many, many years.

It took the writer about six months to unravel the tortuous threads of Part II and create a viable listing of the contained works. In the process the writer discovered that his hero had feet of clay, his vaunted accuracy did not exist, and his meticulous work was anything but, for there were omissions and duplications galore. There were no indexes to the listing, nor any of the quoted illustrations, so although it had been presented to the publisher as a completed manuscript, it was a mere shadow of what it purported to be. Nevertheless, it was this project which inspired the writer at a later stage to attempt his own bibliographical listing of dialling references which Baillie had so contemptuously dismissed in his preface to Part I. In passing, Part II never appeared, for the commissioning body reneged on the promise to publish. It may appear in 1988.

As with Baillie, the writer's first listing of dialling works centred upon those he had in his library, it was only modest but it was the germ on which later listings would prosper. It commenced merely as a list of the dialling material held, to facilitate consultation. Ten years later the listing of the writer's dialling material remains uncompleted, it is ten A4 pages in length today, the tedium of logging in small items proved too much.

In 1989, before the foundation of the British Sundial Society, the writer set about producing his first dialling bibliography, having amassed a fair amount of material on the way. Having spent about three months on the project and collated three separate listings of one thousand entries each (because of the limitations of his word processor and computer storage), the lack of interest in the results persuaded him to abandon the work with only the first thousand entries printed out as hard copy.

HISTORICAL PRECEDENTS

The writer, at this point, requests the reader to consult his earlier article entitled "Cambridge 1991 Lecture-Dialling Literature", BSS Bulletin 92.3, page 29, where a brief outline of the history of gnomonic listings is given.

A NEW START

In 1996 a letter from Nicola Severino of Italy was sent to the writer. In the course of the correspondence which ensued, it emerged that he too had been compiling lists of dialling references but in a different way. He had combined

the contributions of many people together instead of ploughing a lonely furrow, but by 1996 he had not reached the number of dialling references compiled by the writer when the work was abandoned in 1989 to deal with the affairs of the newly founded British Sundial Society.

It was suggested by Severino that the two listings could be combined, and when this was done, it brought the combined list to around 4,000 entries, for naturally there was much duplication of material. This inspired the writer to bring his own work up to date, for much had happened in the intervening years. To cut a long story short, it was found possible to collate another 3,000 entries, plus the listing of a great many of the dialling contents of the various journals which had published such articles. It surprised the writer that in 1997 it took only one month to collate 3,000 entries, when it took three months in 1989. The greatest contribution was to list the magazine, journal and bulletin articles, in particular the full run of *De Zonnewijzerkring,* the doyen of sundial bulletins; plus most of the Continental bulletins. This took some five months of searching literature and typing entries into a word processor, over 1 megabyte of information or about 200 000 words, and about 6,000 references in total.

All this, with a further large contribution by Klaus Eicholz, enlarged the listing of what was to become the *Bibliographia,* to around 12,000 entries, necessitating putting the material in two separate volumes, the first to include all the dialling works, the second the manuscripts and material from magazines and bulletins, making a total of about 470 pages. Because of the huge enlargement of this new bibliographical listing, many problems have been encountered, so that although a trial publication has been made, there are many corrections to be made to reach a desirable perfection of presentation.

The writer printed his own listings out in January 1997 for the first time and entitled it an *Opusculum of Dialling References,* and sent out ten or more free copies of this to the most prominent of the doyens of gnomonics. During the further work of this year, in order to eliminate any possible duplication of entries, the three lists were collated into one and reprinted as *A New Opusculum of Dialling References.* This proved a much more difficult task than the original typing of the entries had been, but no duplicate titles were found other than those intentionally entered to upgrade the information. Having only one listing of course considerably simplifies the searching for information. This latest work is quite sufficient to meet the needs of most diallists, whereas the *Bibliographia* is much more comprehensive and will more fully meet the needs of future gnomonic researchers.

ARRANGEMENT OF LISTING

There are a number of alternatives in presentation, Author-Alphabetical, Titles-Alphabetical, and Chronological. The writer favours the first of these since it forms an index in itself, whereas the beginning words of titles are chosen haphazardly and often begin with the definite article "The" or the indefinite article "A". No meaningful listing can be made on this basis. A Chronological listing has some advantages, and this is what Baillie adopted, with sub-sections for a particular year then placed in Author-Alphabetical listing. If an Author-Alphabetical listing is adopted, then some means has to be provided to give order when there are multiple entries in the case of prolific authors such as Christopher St J.H. Daniel, Réne R.J Rohr, Nicola Severino and others. The writer prefers to place these multiple entries in chronological order. The aim is to make it easy for the person consulting the list to know when his search is complete. Often a vague idea of the date of publication of a reference is known, and once the period has been searched, the result is known with certainty. But if there are a hundred or more entries in random order, one has to search, quite needlessly, the entire grouping to be sure.

In his *Opusculum,* the writer gave a number to each entry, which enabled him (with great difficulty) to produce a chronological index to each list. But this made the listing completely rigid, entries could not be inserted or erased without disturbing the numerical sequence. To produce a chronological index using author identification makes for a very unwieldy index indeed. So this method has been quietly forgotten as it is not a practical solution.

There is also a need to separate books and associated material from the more ephemeral gnomonic literature such as journals, magazines and bulletins. The former is fairly static, for new books only appear at a relatively low rate, plus the occasional discovery of an old work; whereas the latter is in a constant state of flux, with tens of new items appearing each week. This is where the use of computer disks is the best solution, so that the information can constantly, and cheaply, be updated periodically. Of course, if the information is put in data base form, then a program to retrieve selected areas of information can be used to save the consulting reader from the toil of searching entry by entry. This seems to be the way forward, for the cost of setting and printing the information in book form cannot be met from likely level of sales. Reference books are rarely best-sellers.

INDEXING

Since most of the general dialling works are composed on the same basis, it is difficult to index these from a contents

point of view. There are special treatments and these can be classified, eg astrolabes, nocturnals, etc. But the indexes occupy much space without adding much to the usability of the work.Chronological indexes are of passing interest only, and if the author's names are used to identify the entries, become unwieldy and add greatly to the cost of production. As a point of interest, the name and subject indexes of Baillie Part II, occupy 72 pages, which is almost a quarter of the main work, and adds most substantially to the cost, but this work would be valueless without the indexes to help locate the required data. In general the form of listing dialling entries has also to act as a guide to finding the sought-for information in order to reduce the costs of publication to a minimum when a hard copy version is produced. The limitations of disk storage are naturally much less, whilst the cost of duplication and publication but a fraction of the hard copy version.

TRANSLATION OF TITLES

Most of the original dialling works were written in the universal scientific language of the times, Latin. The vast majority of dialling books are written in French, German, Italian, and other Continental languages and are thus meaningless to the majority of English readers. In the writer's *Opusculum* and *A New Opusculum of Dialling References,* the titles have been translated into English, with a short commentary on the author where this has proved possible. The entry on Sacrobosco is given here as an example:

> *Sacrobosco, Joannis, Johannis de Sacrobusto Libellus de Spaere accesit eiusden autoris computus ecclesiasticus, et alia quaedem in studiorosum gratium edita. Cum praefatione Philippi Melanthonis.* (John Holywood's little Book of the Sphere, to which is added the ecclesiastical computer of the same author, and certain other works set out for the benefit of students. With a preface by Philip Melancthon). See other Sacrobosco entries. Sacrobosco's influence continued after his death, through his works and his many pupils. His treatises were phrased in clear elementary terms, incorporating the old Arabic works then recently translated into Latin, Vitebergae 1545.
>
> John Holywood was probably born in Halifax, Yorkshire, and studied at Oxford becoming a professor in Paris. He was one of the first mathematicians to have made use of the astronomical writings of the Arabs. The work listed here is a paraphrase of part of Ptolemy's *Almagest* and it went through 40 editions between 1472 - 1647. John Holywood died in Paris at some time between 1244 and 1256.
>
> A portrait of Sacrobosco is incorporated *in Les Vraies pourtraits et vies des hommes illustres Grecz, Latins et payens, recuillez de leurs tableaux, livres, medailles, antiques et modernes,* (The true portraits and lives of illustrious men, Greek, Latin and others, recalled by their paintings, books, medals old and new). In two volumes. See volume II, Folio 545 recto. The portrait was not taken directly from life, it is merely a copy from another unknown work. The books were produced by André Thevet, Paris 1584, centuries after Sacrobosco's death. Paris 1584.

The English Language occupies the same place in the world of today as Latin did in the Middle Ages, it is the universal means of communication in the modern world. However, about 80 per cent of the extant dialling material in the form of books in unavailable to English readers because of the language barrier. Few people today seem to want to spend time and effort to translate the old works into the English language.

Similarly the greater part of dialling material published today is in languages other than English, eg Dutch, French, German, Italian, Spanish, whilst some of the Eastern European languages are impossible for English readers. This is a great pity for much of the continental literature such as *De Zonnewijzerkring* contains articles of real interest and value. The writer does not know how it is possible to overcome this language barrier.

COMMENTS

Severino, in the foreword of his last publication of the *Bibliographia,* gives a history of the development of his bibliographical work and lists a total of over thirty people who assisted him. But it is indicative of the isolation of those working in gnomonics, when several people were working on individual bibliographical listings, long after the present writer had reached well over 3,000 references in 1989, and this was not to be surpassed until 1997. The only substantial assistance was given by A.V. Simcock who supplied a list of the dialling works in the Museum of History of Science, Oxford. However in his work 1997 the writer must acknowledge the assistance of a number of people providing raw material.

Allan A. Mills, Christopher St.J.H. Daniel, Manuel Lombardero Soto, John R. Millburn, Réne R.J. Rohr, F.J der Vries, Eileen B. Doudna, the NAWCC Librarian and Nicola Severino for processing the huge amount of data I sent him and actually printing out the vast new list of dialling references. I am sure I have forgotten to include some names, it is the penalty of growing old; if so I apologise unreservedly.

As I pointed out in a recent letter to the BSS chairman, I have made my contribution to this out-of-the-way but necessary aspect of gnomonics and intend to retire gracefully from the scene. It would be a very great help if a small panel could be formed to take care of the on-going additions to dialling literature, for it is beyond a single worker on his own to keep abreast of all the information now being published, regardless of the cost of subscribing to the multitude of dialling publications now being disseminated.

Although the number of dialling references has been so greatly enlarged this year, a great deal of work remains to be done. Many of the libraries on the Continent have gnomonic manuscripts which have not been examined for years, the ancient monastical libraries are another source, much unique dialling material is in private hands. Many years ago the writer forecast that there must be at least ten thousand dialling references, this target is well and truly passed, and possibly the next target of twenty thousand references is not so far away. Many people have, in the course of the last fifty years, spoken of the need for a comprehensive listing of gnomonic works, but very few have actually done anything practical about it. Such a listing may not make very inspiring reading, but it is infinitely more tedious collating it in the first place.

It is hoped that these brief notes may have clarified the subject of a dialling reference listing, and the practical problems of producing one which is easy to consult and use, at a cost which brings it within the purchasing power of the average dialling enthusiast. The months and years of work in producing it, are alas, without any financial reward whatsoever. This work is a classic case of a labour of love. After such a huge personal effort, the writer realises that Baillie made a wise move in not including dialling works in his bibliography, he would never have made it, for it took him a lifetime to produce part of his brief.

Dr Allan A. Mills, of Leicester University, has kindly brought the attention of the writer to a group in Europe interested in producing a gnomonics bibliography, so it might be possible in the course of the next few years to see a printed version of the *Bibliographia.* However I am convinced that publication in the form of disks or CD ROM disk is the way forward, combined with search programs which can operate down to a single word selection. Hopefully, amongst the members of the British Sundial Society, there may be someone willing to step into the breach and continue where I have left off, brought to a halt by age and ill-health.

At the moment Nicola Severino is the world's leading exponent in the production of bibliographical listings of dialling references. He is a young Italian man, very enthusiastic and has gone to great lengths to learn English to be able to communicate with the writer of this article. He is the Baillie of the Gnomonics world.

This article was submitted for publication before the author's death on 22 April '98. An obituary will appear in a later issue.

'ARS MAGNA LUCIS ET UMBRAE' THE INCREDIBLE SUNDIALS OF ATHANASIUS KIRCHER

NICOLA SEVERINO

Athanasius Kircher was a Jesuit priest who lived in the 17th Century and who was the greatest gnomonist of the period. His magnum opus *Ars Magna Lucis et Umbrae, (The Great Art of Light and Shadow),* first edition published in Rome, 1646, is the only dialling work included in G.H. Baillie's *Clocks and watches: An Historical Bibliography.* It is a very large work, of 870 pages, with many plates, but because it is written in Latin, the technical Language of the age, and has never been translated into English, its contents are little known to present-day gnomonists. There was a later edition published in Amsterdam in 1671 with xxix + 810 pages, but again it was the Latin Language.

Athanasius Kircher was a cultured man, speaking 18 languages fluently, including Chinese and Japanese. His work on the understanding of hieroglyphics was of fundamental importance, as was his work in science.

From 1636-1646 Kircher devoted himself to experiments in gnomonics. He set to work to invent new types of sundials, for which he had to introduce a new dictionary of gnomonic terms. Together with his students in the Collegio Romano in Rome, he constructed the 'Sciatheric Tables' which today are preserved in the Museum of Astrophysics and Astronomy in the Observatory of Monteporzio Catone, Rome. His sundials have remained little known till the present day. Rene R.J. Rohr has given some information on Kircher's sundials but very few have commented on them.

In this article it is impossible to describe all the sundials which are contained in Kircher's great work. I intend to concentrate on Book VI of *Ars Magna Lucis et Umbrae,* dealing 'Gnomonica Physico-Astrologica' At this period, even for theologians, astrology was very important and learned men believed in it implicitly. Thus many of the

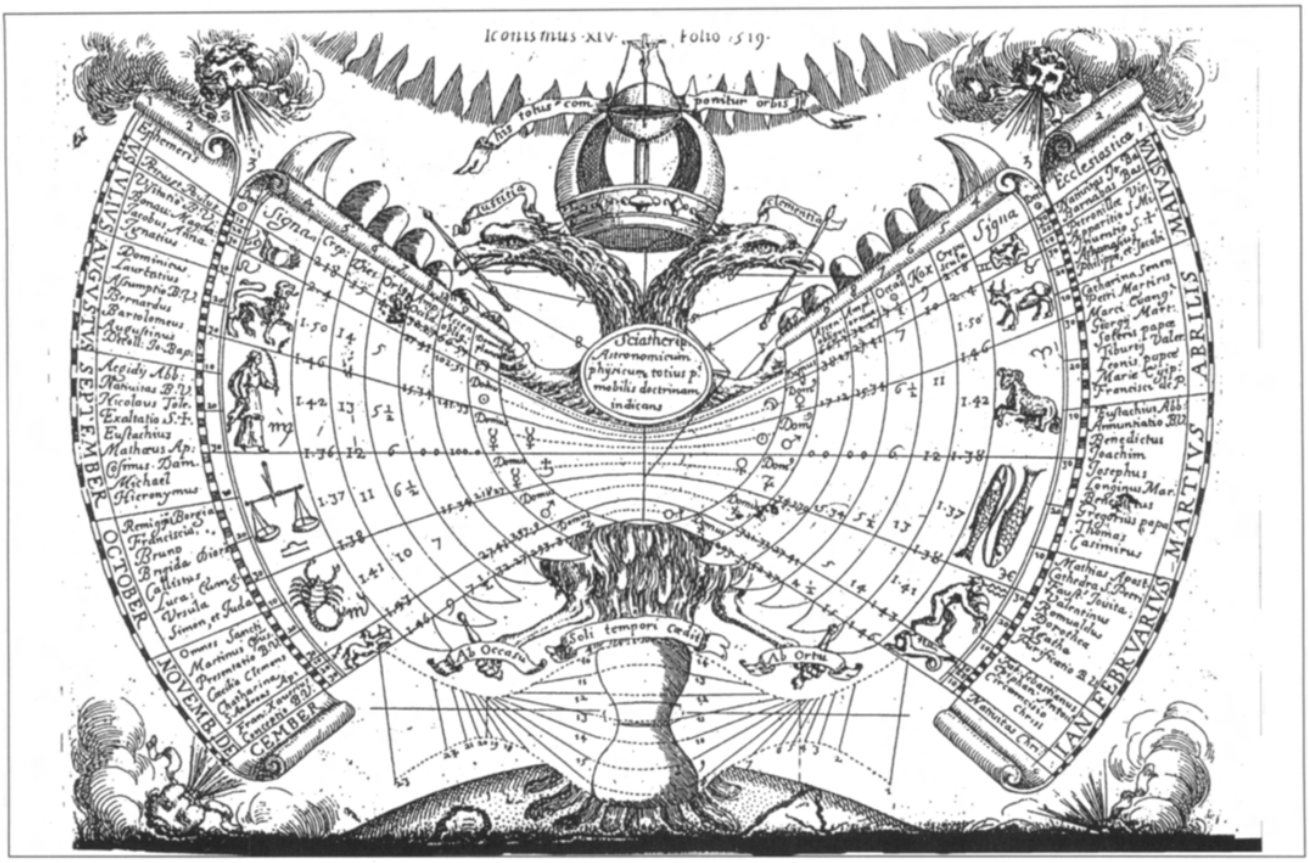


Fig. 1 Sciathericum Astronomicum Physicum

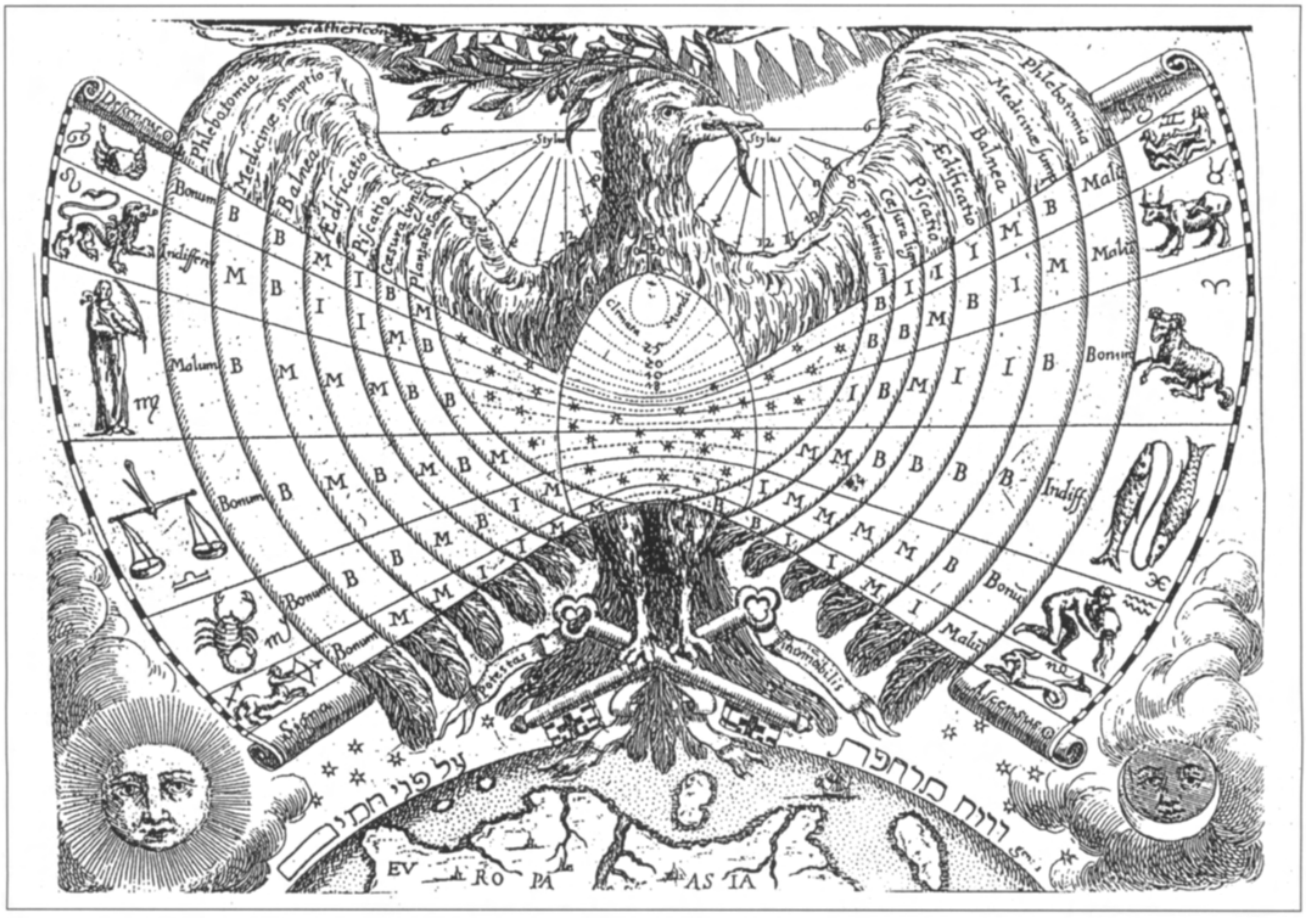


Fig. 2 Sciathericum iatro-Georgico-Oeconomicum

sundials designed by Kircher not only gave the usual information of normal sundials but also gave the information on related disciplines such as Astrology, Alchemy, Religion, Botany, Ephemerides and so on.

Kircher introduced the zodiac to sundial indications, using the space divided by the seven declination lines for the purpose. In Fig. 1 the use of the gnomonical zodiac is clear. It is divided into ten principal sectors centred around the foot of the gnomon. This Kircher described as 'Sciathericum Astronomicum Physicum, totius primi mobilis doctricans' The operation of this is simple. In the left half, the ten sectors are subdivided thus:
1. Months. 2. Ephemerides of the Saints of the Jesuit calandar and the days of dedication. 3. The value of the sun's declination. 4. The zodiacal signs. 5. The hour of twilight (crepusculum). 6. The duration of the solar day. 7. Sunrise. 8. The Western amplitude. 9. Right Ascension. 10. The celestial houses (domus celestis).

On the right side is the same subdivision with the difference of: 6. Duration of the night. 7. Time of sunset. 8. Eastern amplitude.

Naturally the sundial operated on the right hand side for the first six months of the annual cycle 23 Dec to 21 June (shadow of the gnomon descending) and on the left hand side for the other six months (shadow of the gnomon ascending). It is important to note that in the gnomonical zodiac the lines denote the start of the zodiacal signs only. There are no hour lines delineated.

In Fig. 2 is shown the 'Sciatherium iatro-Georgico-Oeconomicum', which operates in a similar manner but six modes only. On each is engraved the letters B (Bonum)-good; M (Malum)-bad, and I (Indifferentia)- indifferent or neutral. These indicate various states; for example when the shadow touches the second sector on the left corresponding to the sign of Virgo, it indicates the letter 'B' (Bonum) and at this time it is beneficial to apply the appropriate medical remedy. Conversely, when the shadow of the gnomon touches the third sector in April, corresponding to the sign of the Scales, it indicates 'M' (Malum), which shows it is not a good time to apply the remedy.

Similarly, Kircher delineated 'Botanologia Sciatheria' which indicated the influence of the stars on the human body and the most beneficial time for applying remedies; and also 'Sciathericon regiminis planetarium' a dial with a human figure in the centre, showing planetarium influences on every separate part of the human body.

The best of Kircher's sundials, an astronomical almanac designed to be consulted directly in sunlight, is shown in Fig. 3. Kircher called his 'Planetographia Sciatherica'. The explanation of its function is as follows:
The seven declination lines are divided into 30 vertical sectors by a winding line starting in the upper left, at the figure '43' representing the year 1643, descending and ascending alternately. At the top, the reversal loops encompass the figures 43 to 57, (the years 1643 to 1657). The shadow of the gnomon traverses these lines, descending and ascending in an annual cycle. This indicates the constellation in which a particular planet is located by the shadow of the gnomon.

The top dial of Fig. 3 shows the ephemerides of the planet Saturn. If the shadow of the gnomon descends on the winding line and touches the symbol (Aries) immediately above the equinoctial line, this indicates that Saturn is visible around 25th April in the constellation of Aries. Immediately after that point Saturn travels to the 1° of the Aries constellation,...2°, 3° and so on. The winding line points out that Saturn has changed position to the new constellation of Taurus in the year 1645 then to Gemini on the equal declination line, but in July/August of the year 1647, the letter 'R' indicates that the planet has a retrograde motion as seen from Earth. The Letter 'D' means Motus Direct, or direct motion.

Similarly the lower dials deal with the major planets Jupiter and Mars, the whole providing an astronomical almanac for the principal outer planets known in medieval times.

Fig. 4 shows a similar sundial but it indicates sun and moon eclipses only. For example, when the shadow of the gnomon touches the area between the two declination lines of Capricon and Aquarius in the upper left of the dial, the indication is of a partial eclipse of the moon.

No other diallist in the history of gnomonics has designed such remarkable sundials. The work of Kircher is very important, for he forged significant linkages between the classic gnomonics of the 16th and 17th centuries and the esoteric disciplines of alchemy, entertainment, magic and science. On the basis of these theories Kircher brought together his new ideas; and in 1636, with the help of his students in the Collegio Romano, he made the 'Sciatheric Tables' which are four table-tops made of slate, bearing these same sundials, together with other sundials to beautify the tables.

Other Dials

Also in Book VI of his great work, Kircher describes many curious sundials. Some portable sundials are shown in Fig. 5. At the top is a sphere with a two-armed gnomon termed

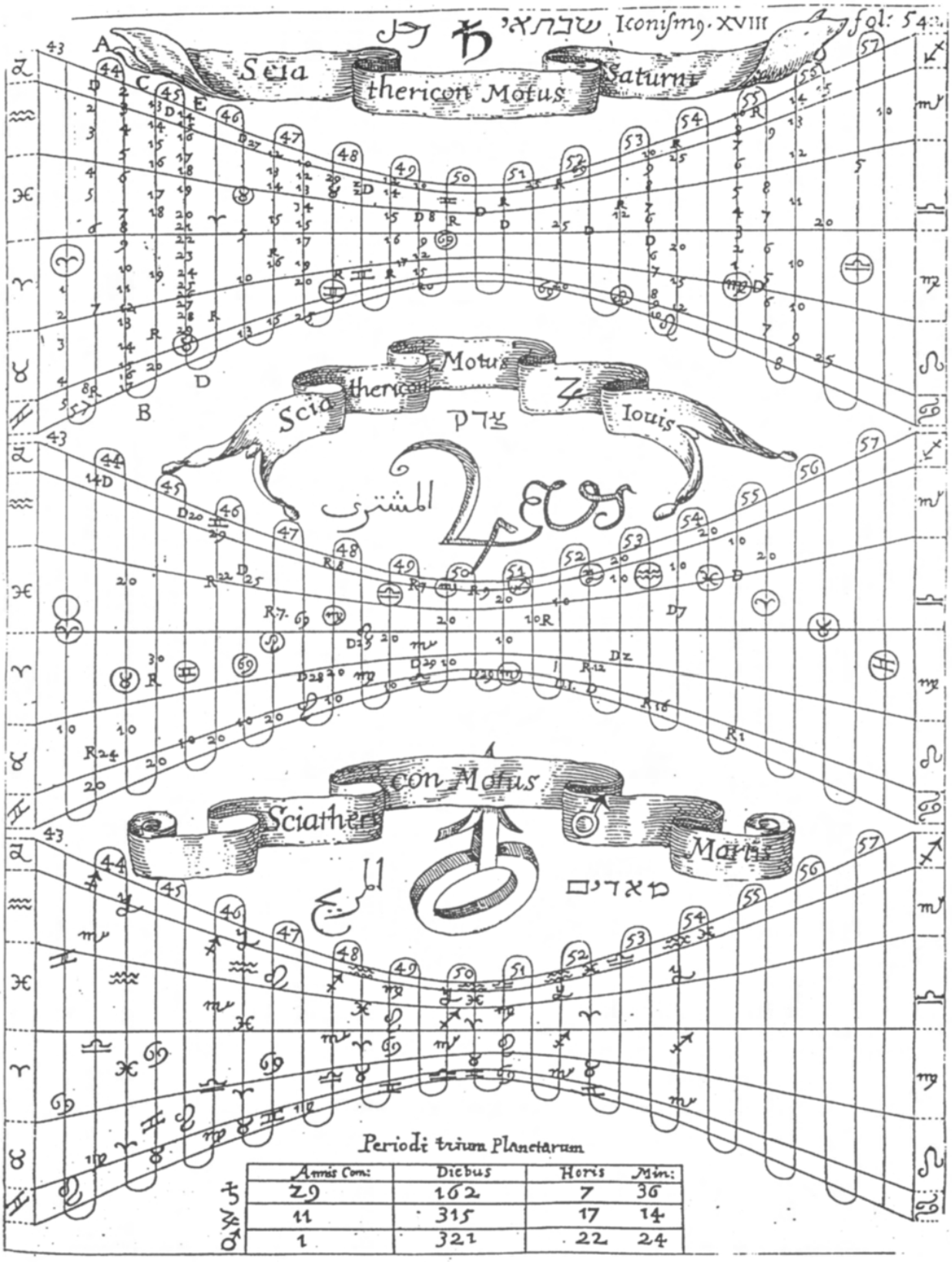


Fig. 3 Planetographia Sciatherica

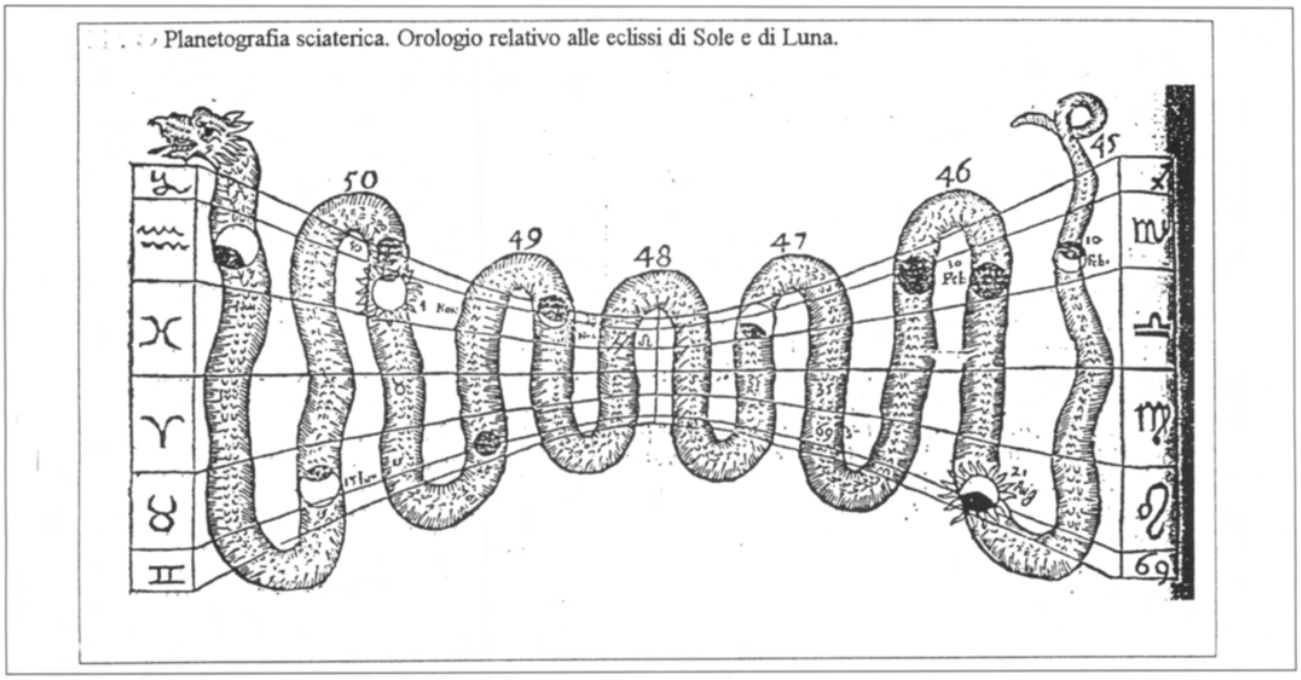


Fig. 4 Dial for eclipses of the sun and moon

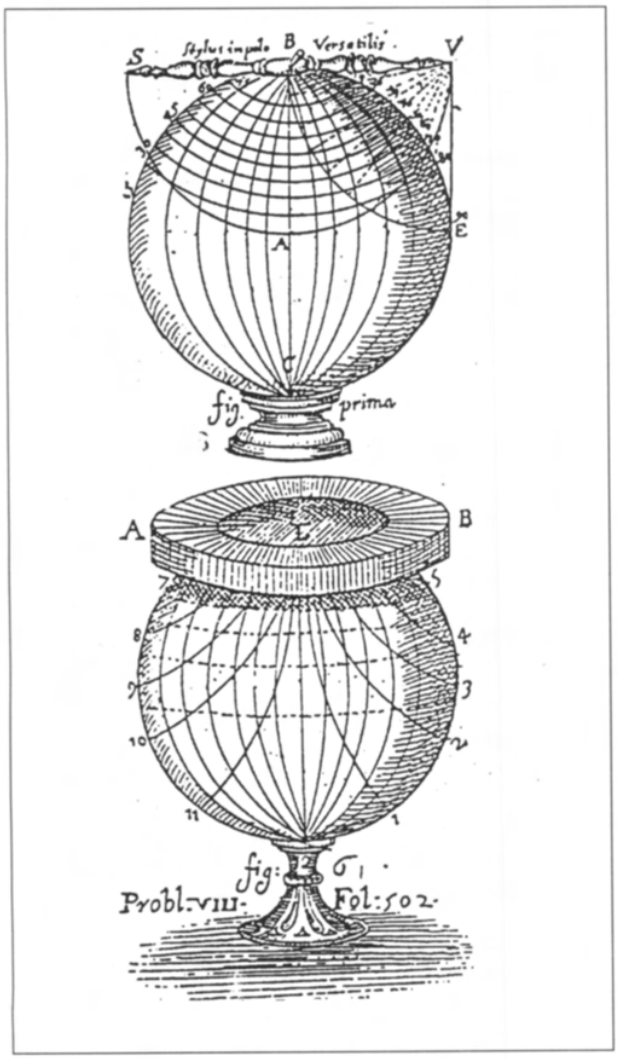


Fig. 5 Some portable dials

by Kircher 'stylus impole versatilis', and below this is a sphere with a disc gnomon. Rohr refers to this as 'hat-strained' (cappello filtrante); Kircher himself calls it 'stylus in modum pectinis denatum' or serrated comb stylus.

In Book X of the *Ars Magna,* Kircher describes many magical sundials such as magnetic gnomons, reflection, light projection with sound and fire! For example, the 'Orologio Solare Eliocaustico' (Fig. 6) is based on a Goblet or hemispherical bowl. Standing vertically at the centre is a rod bearing a small glass globe acting as the gnomon. The hour lines are charged with gunpowder, and the sun's rays are focussed on these, so that at the hour there is a flash and a bang. In this example the sundial is designed to indicate Italian hours. It is certain that this sundial was made for some Prince or Royal House as an ingenious novelty, although no actual example is known today.

The great sundial designs of Kircher have been little discussed over the last three centuries. In this short article I hope I have given a glimpse to my readers into the ingenuity and genius of Athanasius Kircher, and by so doing have made a contribution to the study of Kircherian gnomonics.

Acknowledgments

The author gratefully acknowledges the help given by the Library of Montecassino Abbey, and the Biblioteca Provinciale dell' Aquila, Italy; also by Charles K. Aked in editing this article into correct English. This article is a great simplification of the work originally in the Italian language. All the figures are taken from the author's book *Gnomonica Kircheriana.*

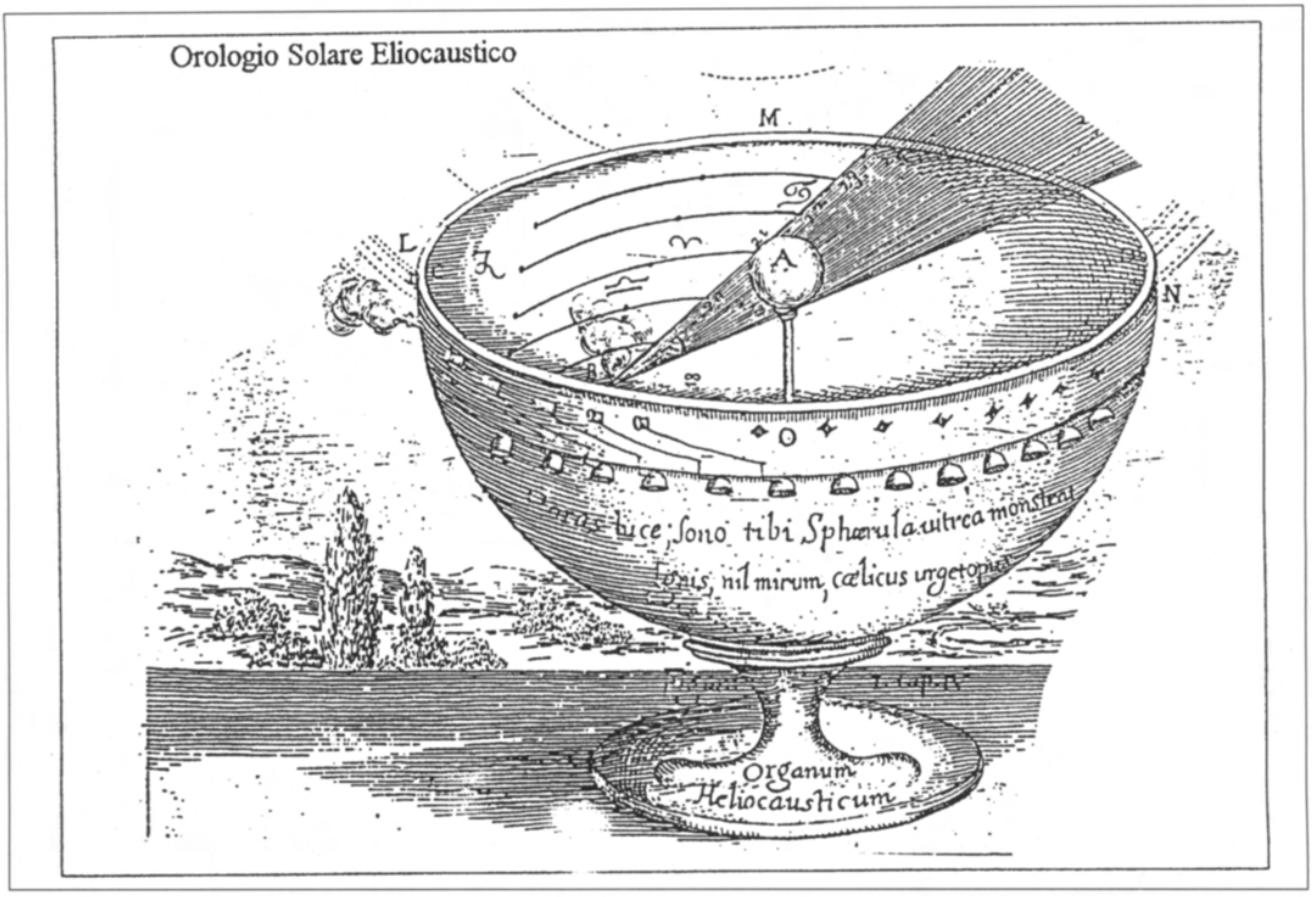


Fig. 6 Orologio Solare Eliocaustico

BIBLIOGRAPHY

Nicola Severino: 'Quattro tavolle gnomoniche di A Kircher' *Atti del VI Seminario Nazionale di Gnomonica,* S Benedetto del Tronto, 1994

Nicola Severino: *Gnomonica Kircheriana,* Roccasecca, 1995

Nicola Severino: *Dizionario di Gnomonica,* Roccasecca, 1996

Nicola Severino: 'Il mondo sulla punta di uno stila' *Astronomia UAI* (1995);(No. 3 1996)

Nicola Severino: 'Gnomonica Kicheriana' *Atti del VII Seminario Nazionale di Gnomonica,* Bocca di Magra, 1996

Nicola Severino: 'Gnomonica Kicheriana' *Cortina Astronomica* Association Cortina d'Ampezzo, 1996

N. Severino, Via Lazio 6, 03030 Roccasecca Stazione (FR), Italy.

CONSERVATION: THE RESTORATION OF SUNDIALS SOME NECESSARY QUESTIONS

CHRISTOPHER ST J H DANIEL

Conservation may be described as the act of preserving the material structure of an object in shape or form. This is not an official definition: it is simply my understanding of the meaning of the term. Restoration, ie the act of restoring an object to its original state, so far as may be possible, comes within this discipline.*

As an art, conservation is as old as any such activity, but, as a scientific study and practice, it is a comparatively young discipline. Indeed, the year 1998 marks the 40th anniversary of the establishment of the *United Kingdom Institute for Conservation,* which currently has a membership of some 1,200 members. In relation to other disciplines, conservation policies are still very much in their infancy, in a field that is fraught with complex ethical and practical problems. Furthermore, the field comprises innumerable intertwined technical roots, from studies of different materials by individual conservators and

institutions: cloth, glass, metal, paint, paper, stone and wood being just some of the principal categories. In these circumstances, even the most experienced conservators necessarily tread warily through the minefield that surrounds them, conscious that the eyes of their world are upon them! Whilst not wishing to be trailing in the field, they are understandably cautious in their desire to be in the lead: a step too fast, or too far, and they might suffer the consequences. Inevitably, this situation encourages a critical approach to the work of others, especially of those who seem to be outside the field.

The British Sundial Society has always been well aware of the problems and difficulties in tackling matters of conservation, including the preservation, restoration and, where applicable, the reconstruction of sundials. A conservation section was formed under the directorship of Graham Aldred, who had the unenviable task of formulating a policy for the Society. With skill and perseverance, despite many obstacles, he has now achieved this goal and provided the Society with a policy document, that will be reviewed on a regular basis. Nevertheless, the conservation of sundials, particularly their restoration, remains in the hands of individual members of the Society, who take full responsibility for the work that they may carry out, or may recommend to be carried out. In these matters, the Society cannot lay down the law, take responsibility, or endorse the work of its individual members, nor should it do so. It can only give guidance and endeavour to set standards, in order that a code of practice may be followed.

One of the fundamental problems with the conservation of sundials is that, unlike a building, a piece of pottery, or a painting, the sundial is a working scientific instrument, the purpose of which is to determine the time from the apparent motion of the sun. As such, as with a clock, for which, historically, the sundial provided the means of regulation, the mere preservation of the visible remains may not be enough to achieve a standard that allows the instrument to function as originally intended. This poses the principle question, as to how far should one go to restore the sundial to full working order?

My introduction to conservation came in the environment of a national museum, where a conservation department was formed in 1974, within the realm of pictures and picture restoration. It gradually evolved over the ensuing years to become, in museum terms, a large, dominant organisation, with over thirty staff, divided into some nine sections, including antiquities, archives, prints, drawings, paintings, textiles, models, horology and gallery maintenance. Although its individual members gained very high reputations for their work as conservators, the department acquired much of its status in a climate of power politics. Conservators and curators were not always at one in their views. Thus it was that, in one instance, conservators proposed that maps should be removed from the scientific instrument collection to the care of printed books. Curators maintained that maps, as such, were effectively working instruments, by which the individual could work out his or her position on the map and the directions that must be taken to reach the intended destination. Conservators countered that, in any case, members of the public engaged in research should not be permitted to handle such maps directly: copies should be made for this purpose. Curators responded by pointing out that the means of producing printed copies from the original plates were readily available! This little episode highlights the controversies that exist in the practical aspects of this 'new' science.

On one occasion, I asked a conservator if he would be prepared to restore a sundial manuscript for me, in his own time, which he agreed to do. Technically the result was excellent; but, aesthetically, it was not pleasing to the senses, since, using modern paper, it had to be shown that the restored article *had been restored.* It would have contradicted the conservator's ethical code to have restored the work in such a way that it could be mistakenly taken to be wholly original. Whether, in such institutions, this approach has changed, I do not know; but, with hindsight, I would have had the manuscript restored by commercial experts, to be in keeping with the original!

As a professional sundial designer, I have been commissioned on various occasions to participate in the restoration of historic sundials. In each case, I have been acutely aware of the particular problems and difficulties involved. However, I have been fortunate, perhaps, in that my work principally concerned *design reconstruction,* rather than physical restoration. Nevertheless, there were times when it was necessary to press the authorities to comply with the traditions of the *art of dialling.*

It may be useful to provide a synopsis of various commissions:

Grey Court, Northumberland:
Horizontal sundial 18th c.
Restored by the Department of Conservation, Tyne & Wear Museums, 1983. The new owner inherited the original 18th century pedestal and the gnomon, without the dial-plate. The missing dial-plate was reconstructed in keeping with the period, but recording the fact with an appropriate inscription. There were no ethical problems.

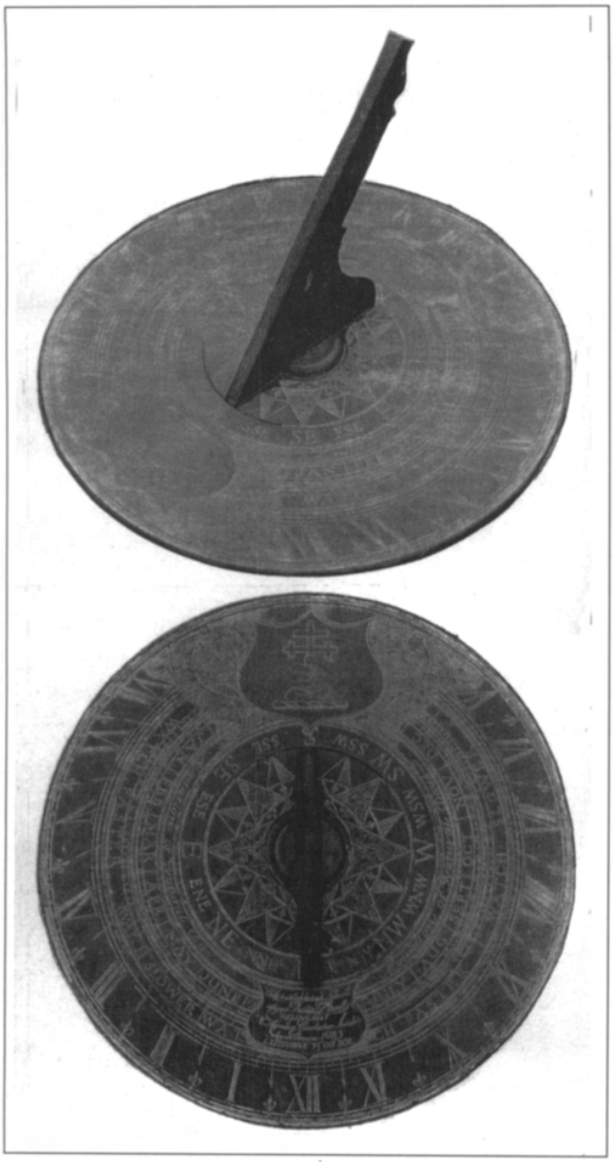


Fig. 1 Grey Court, Northumberland (18th c) (Dial-plate Reconstruction Delineation)

Penrith, Cumbria – The Countess's Pillar: Vertical Multiple sundial, 1656
Restored by English Heritage, Historic Buildings and Monuments Commission, 1985.

The sundial was known to have been restored previously c1950. In this case, a new brass gnomon was fitted to the south dial and the sundial was repainted, without correcting for 'drifting', ie the drift of the delineation, due to the over-painting of previous restorations. *(not illustrated)*

East Grinstead, Sussex: Horizontal sundial 18th c. by Benjamin Martin
Restored by Messrs Plowden & Smith, Fine Art conservators and restorers, 1987.

This sundial lacked the gnomon, which, evidently, had been stolen some years previously. The gnomon had to be

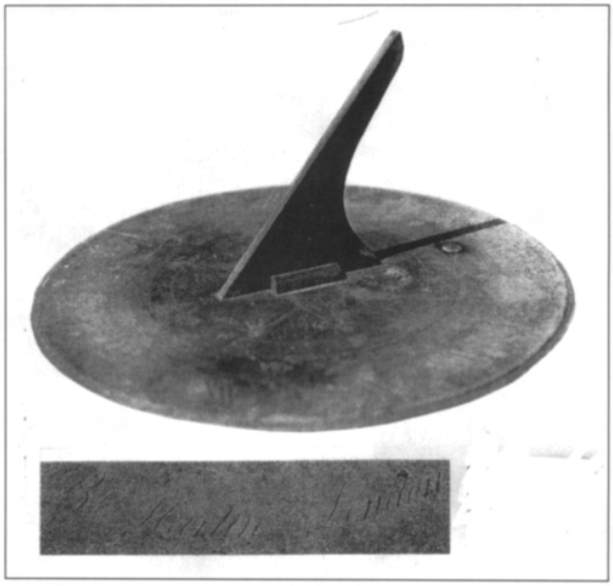


Fig. 2 East Grinstead, Sussex: Horizontal sundial 18th c. by Benjamin Martin (Gnomon Reconstruction Design)

reconstructed to a design that was in keeping with a sundial of the period. There were no photographs, illustrations or records of the dial in its original state. Subsequently, I received photographs of a similar instrument by the same maker, and was gratified to find that the reconstruction was a close match.

Hampton Court: Double Horizontal sundial 18th c. by Thos Tompion
Restored by Messrs Plowden & Smith on commission by English Heritage, 1988.

A large section of the gnomon had been broken off, at the time of a major fire, when the sundial was badly damaged.

The missing section had to be reconstructed to a design of the same proportions as the original and scarfed to the remaining part of the gnomon. There were no proper records for this purpose and only one poor quality illustration, from a magazine, could be located, showing the dial from a bad angle.

Some years later the original missing section was found, when the reconstructed piece was found to be a remarkably satisfactory replacement. Nevertheless in the interests of authenticity the original was scarfed back into position, with only a small piece of the reconstruction remaining.

H M Tower of London: Vertical sundial [17th c.]
'Restored' by English Heritage: Messrs Plowden & Smith commissioned 1988.

The original sundial had completely worn away. A new stone 'dial-plate' was affixed over the original and the sundial was reconstructed to a '17th c.' design, being

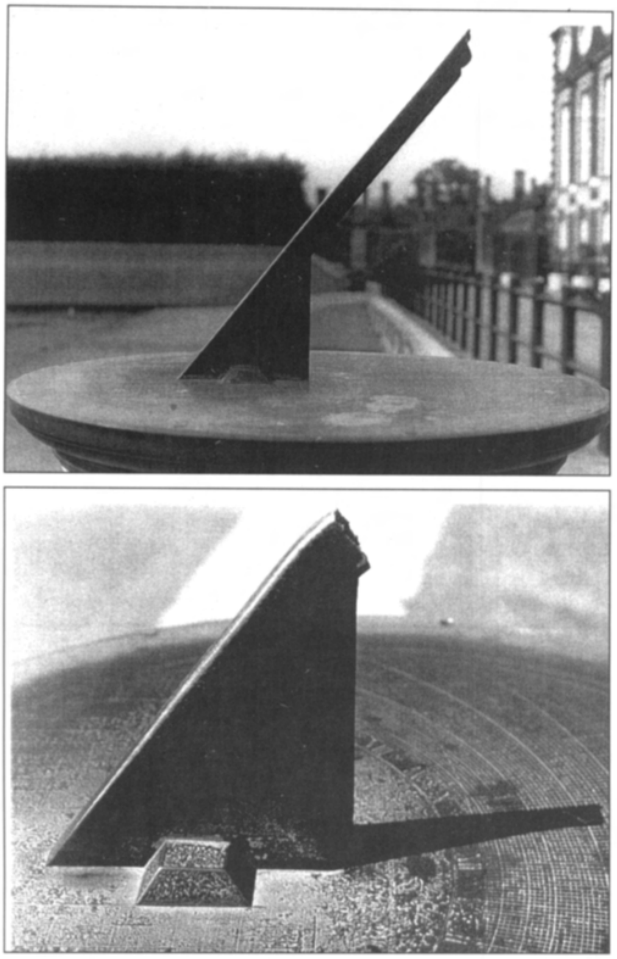


Fig. 3 Hampton Court: Double Horizontal sundial 18th c. by Thos Tompion (Gnomon Reconstruction Design)

painted white with gilded hour-lines and numerals. Initially English Heritage were reluctant to allow the sundial to be painted and gilded, preferring the effect of natural stone; but they duly accepted the historical arguments for this treatment.

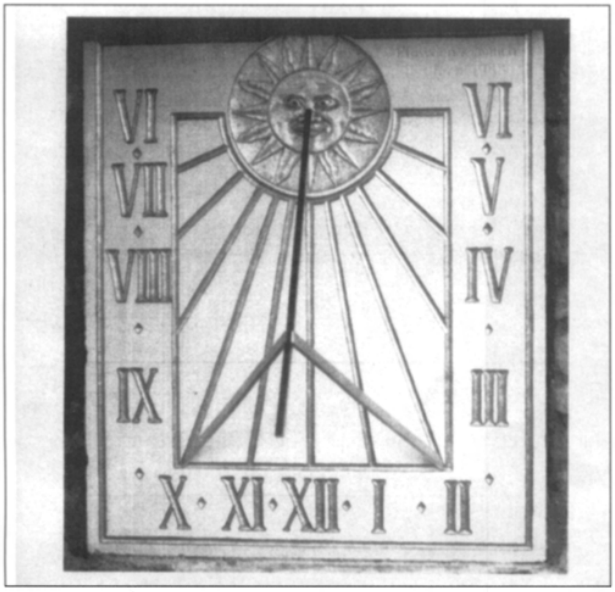


Fig. 4 H M Tower of London: Vertical sundial (17th c) (Reconstruction Design)

Castle Bromwich parish church, Birmingham: Vertical declining sundial, c1731

Restored by Messrs Hesp & Jones on commission by Rodney Melville & Associates, Conservation Architects, 1988.

An original early 18th century painted stone sundial was discovered under a later 'black and white' period painted dial-plate, during the process (to my horror!) of burning off the old paintwork in the traditional manner. The paintwork was analysed and the sundial was restored in the earlier style to its proper delineation.

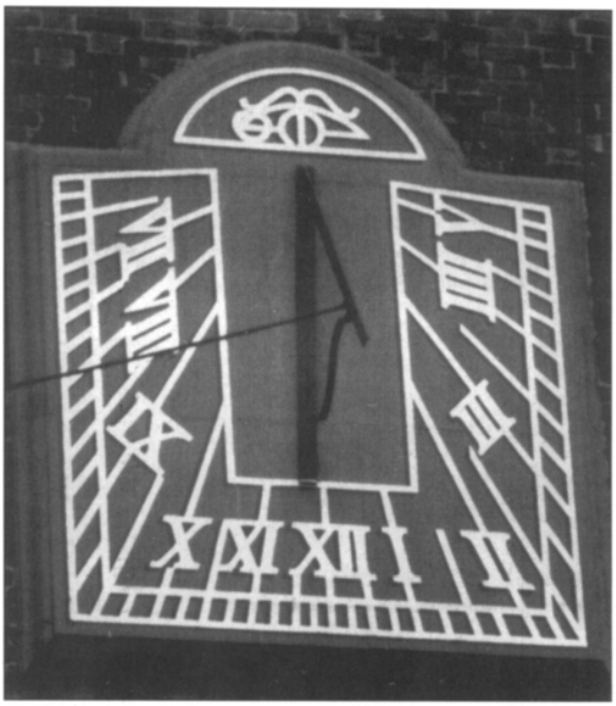


Fig. 5 Castle Bromwich parish church, Birmingham: Vertical declining sundial, c1731 (Gnomon Reconstruction Design)

Weavers House, New Wanstead, London: Vertical declining stained and painted glass sundial, c1669

Restored by Messrs Plowden & Smith, 1988.

The sundial had been removed from its original site in the Hall of the Worshipful Company of Weavers, in the City of London, many years previously and had been in store ever since at New Wanstead. The sundial was cleaned and restored with a new gnomon (fitted in a brass frame), and was set up appropriately, making the necessary allowance for its declination, in a new site in the Weavers House, in New Wanstead.

Ripon Cathedral, Yorkshire: Vertical mural sundial, c17th c.

Restored by Messrs Brookbrae Limited, 1992.

Evidence was found of at least two previous restorations with marked 'drifting'. The dial was restored with incised hour-lines and numerals, painted black. The missing gnomon was reconstructed. The original dial-plate of the sundial would almost certainly have been painted, as was the custom, both for its preservation and to make it more visible, as well as readable from ground level.

Fig. 6 Weavers House, New Wanstead, London: Vertical declining stained and painted glass sundial, c1669 (Gnomon Reconstruction Design)

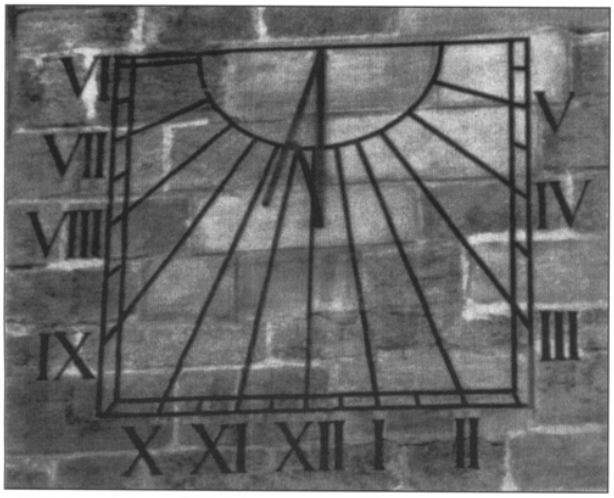


Fig. 7 Ripon Cathedral, Yorkshire: Vertical mural sundial, c17th c. (Gnomon Reconstruction Design)

Fig. 8 The Fountain, St James's Street, Dublin: Vertical declining polyhedral pillar dial, c17th c. (Redelineation)

The Fountain, St James's Street, Dublin:
Vertical declining polyhedral pillar dial, c17th c.
Restored by contractors commissioned by Dublin City Council, to the advice of Owen Deignan, 1994.

The dial-block of this splendid, elegant Georgian pillar sundial, comprising four declining dials (declining a mere $1^{3}/_{4}$ degrees from the cardinal points), had evidently not been restored in many years, if at all, and was very worn. The dials were cleaned, re-delineated in some cases, re-incised, and restored to working order. Unfortunately, the terms of the contract necessitated the dialling survey and subsequent work to be carried out in undue haste, a situation that had some undesirable consequences. Whether in fact the dials should have been re-incised is a matter of debate.

•

These individual cases almost all involved reconstruction design work, in one form or another, if not the re-delineation of the sundial. There have been occasions, however, when I have been invited solely to give an opinion. One such case, which dates back to 1991/1992 and of which I have lost track, concerns a sundial that was in the care of the conservation department of Ipswich Museums and Galleries. The sundial consisted of two whitewashed and degraded wooden boards that had been nailed over an

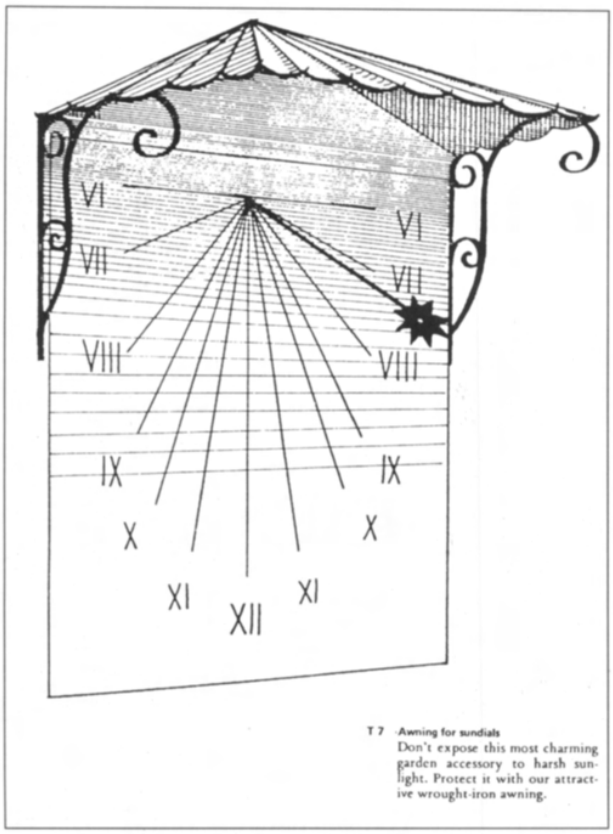


Fig. 10 From the Jacques Carelman catalogue "Drawing the line?"

earlier and better preserved sundial. In fact, each sundial appeared to comprise a declining dial with a southern aspect and a declining dial with an eastern aspect, probably having been fixed to a corner of a building. The earlier of the two sundials had characteristics that would seem to have dated it from about 1620. Both dials had been 'restored' in their history, having been over-painted a number of times. I do not know how these two sundials were treated, whether they were simply stabilised, or whether they were restored. As wooden objects, it would not have been difficult to reconstruct one of the dials, to replace the original on the building from which it was taken. Thus, the originals could have been put on display in the Museum.

Recently, Professor Alan Smith has been taken to task for the manner in which he restored the St Helen's dial (see BSS *Bulletin* 97.2 34-36). Professor Smith's response to such criticism was dignified and to the point. Nevertheless, this was not just a challenge to Professor Smith; but a challenge to the policy of conservation itself, since it raises the inevitable question: "Where does one draw the line?"

In the case of the sundial, as with other objects requiring attention, our forebears would have re-painted the dial, without thought to its 'conservation', or, if made of wood, they would simply have nailed another one over the top! I am not suggesting that this is the manner in which restoration should be carried out; but I would pose the question: "At what stage in the life of a sundial does one say that it is an historic object and that it should be conserved, ie where the original is preserved off site, to be replaced by a copy?" Sooner or later, modern sundials must fall into this category! And, where some form of restoration work has previously been carried out, if badly, does this not constitute part of its history, so that it should be retained? Should the 'drifting' of over-painted hour-lines be rectified or not? Such questions apply, at some stage, to every sundial.

There are no simple answers. The practical resolution of the problems, that arise from these questions, inevitably provoke criticism. However, one would do well to remember the edict: "He that is without sin among you, let him first cast a stone …"

Christopher St J H Daniel

** Since writing this article I have received the following note from a member of the UKIC: "Another definition of conservation, 'All actions aimed at the safeguarding of cultural property for the future, including interpretation' (UKIC Code of Ethics). I like your definition better."*

DIAL DEALINGS

MIKE COWHAM

In the last few months there have again been some great dials on offer through the various auction houses.

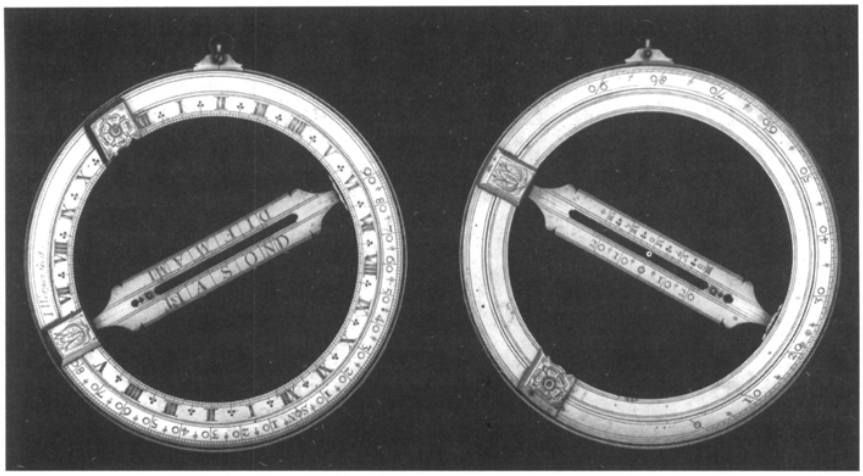


Fig.1 Both sides of the ring dial by I. Worgan

Fig. 2 Tulip and Rose motifs on the Worgan dial

The year started well with an offering from Philips on 10 March. They had a few small dials, but one was the star of the show for me. It was a large ring dial signed I:Worgan fecit. Fig.1. Worgan is a well-known maker and his workmanship is legendary. In particular he nearly always adorns his instruments with an English rose. I have only seen one of his instruments without this motif. In the case of this ring dial, it has a rose and a tulip adorning the hinge blocks on each side. Fig.2. This dial carried a conservative estimate of £1,200 - £1,800. In the event it made a healthy £4,600.

The other great sale was at Christies on 8 April. The first dial in the sale was a gilt brass Regiomontanus Altitude Dial made in Prague around 1590 by Erasmus Habermel. It was sold for an incredible £221,500! Several other dials of similar age sold for between £20,000 and £50,000. A nice ivory diptych in book form by Hans Tucher of Nuremburg sold for £9,200, and another by Paulus Reinman made £19,550. An unusually shaped elliptical dial by Reinman, Fig. 3., although quite simple in its design, reached £7,475.

The dial that really took my fancy in this sale was a finger ring dial in gold, Fig. 4. This dial was unsigned and probably made in the 16th Century. It is engraved inside with the hours, and on the outside with the initial letters of each month. Its gnomon is a small hole in the ring that slides around the outside of the dial. This is the first time that I have seen one of these dials offered for sale. This one made £14,950.

There were 5 fairly standard fine dials by Johann Martin and Johann Willebrand from Augsburg, but the dial that created the most interest was signed Jac. Ema. Laminit a: Augsp: 48gr, Fig. 5. This is the only dial known by this maker, and this helped it make a healthy £5,750.

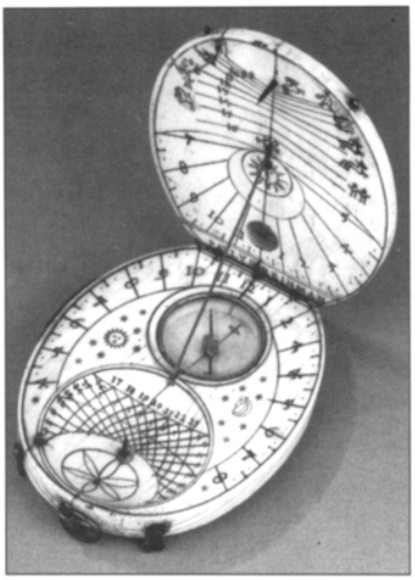


Fig. 3 Unusual oval ivory diptych dial by Paulus Reinman

Fig. 4 Rare gold finger ring dial

The sale also included the Melvin slate dial from Salisbury that Members will remember from the visit to The Close a couple of years back. This dial stood just inside a wrought iron gateway, and was admired by thousands of passers-by. I would always peer through the gate on my visits to Salisbury. It was such a perfect setting for it. However, the dial proved too tempting, and one night it was removed in the back of a van. Luckily the villains were recorded on cameras, and the dial eventually recovered for its owners. However, due to the security risks, they decided to sell

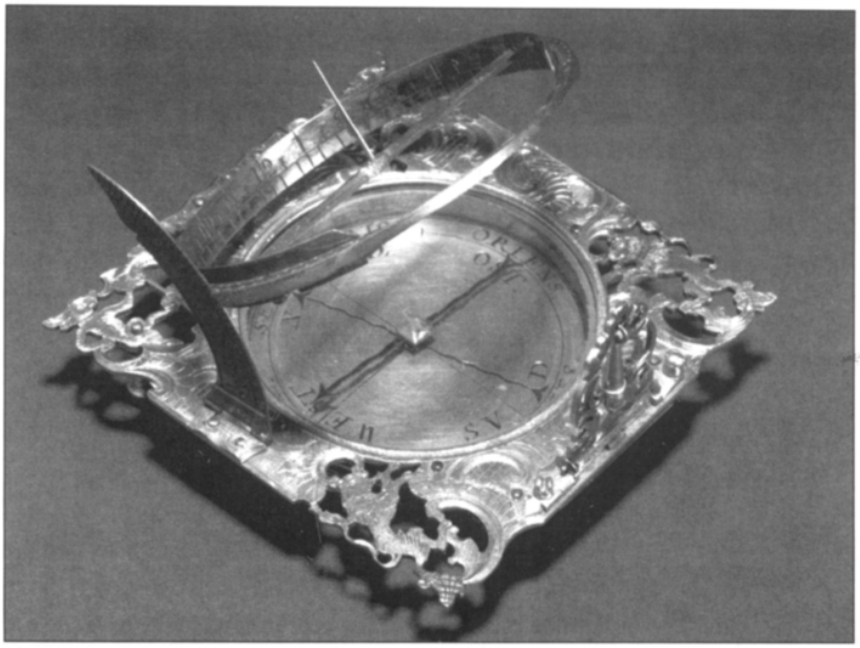


Fig. 5 Augsburg dial by lesser known maker Laminit.

the dial, and it found its way to Christies saleroom. A Melvin (or Melville) slate dial of this complexity will normally make around £1000, but this one was complete with its pedestal. It was therefore much sought after as a 'garden ornament', and it was sold for the sum of £7475. Will we ever see it again through a gateway? Who knows? I hope that its new owners take good care of it for the future.

The Scientific Instrument Fair on 26 April had a good crop of dials. A nice magnetic dial by Fraser, London was sold by Stuart Talbot. Tesseract from New York had three unusual ring dials including the Worgan, Figs. 1 & 2. Other dials included a snuff box with a dial on its lid, possibly Spanish c1600, and a French dial by Baradelle. Around the room were one or two garden dials and Bertrand Thiëbault from Paris had a rather nice Ivory Diptych dial from Nuremburg. This fair is always a good event for finding odd dials. There are usually some for all pockets starting with dials such as the Ansonia

Fig. 6 Snuff box dial in gilt brass. Spanish? c1600.

Sunwatch for just a few pounds. It is well worth a visit.

FORTHCOMING SALES IN 1998.

Christies South Kensington.

28 May	16 July	17 December

Sotheby's

30 September	22 or 23 October

Philips

2 June	15 September	8 December

Bonhams

21 July	November

Scientific & Medical Instrument Fair.
The Radisson SAS Portman Hotel,
Portman Square, London W1.
Sunday 25 October 10:00 - 16:00

I would like to thank Philips, Christies South Kensington and Tesseract for their permission to use the photographs shown.

BSS AWARDS SCHEME 2000

It is now three years since the last **Awards** (1995)were made, when Sally Hersh won the major award for her dial at West Dean College. The BSS Council has now decided that it is time to prepare for new awards for the best dials made since 1995, and entries will be timed to coincide with the Millenium in May 2000. Dials with a Millenium theme will therefore be appropriate, though not, of course, essential.

Modifications have been made to the conditions for making awards, based on the judges' experience of three years ago. Dials of **any** category (horizontal, vertical, equatorial, portable etc.) may be entered, and the principal changes involve the basic classifications, which will now be:

(a) Professional dials commissioned and funded by a person or organisation,

(b) Amateur dials designed, made and set up by a private individual, either for him/herself or as a gift,

(c) Restoration: the restoration of an existing dial, done with sensitivity, quality and understanding

(d) Junior dials designed and made by persons under the age of 21

One major award will be considered from the above categories, and a number of commended awards will also be made, hopefully at least one being from each class. Although a monetary prize is involved it is presumed that the honour of receiving certification of merit from the BSS will be considered the most important part of the award.

Full details regarding the **rules and conditions** for the **BSS Sundial Awards Scheme 2000**, including an entry form, are available by sending an S.A.E. to: Alan Smith 21 Parr Fold Avenue WORSLEY Manchester M28 7HD

READERS' LETTERS

EUREKA SUN COMPASS

Some years ago I acquired an intriguing, plastic, double-sided, credit-card-sized, analemmatic, 'Eureka Sun Compass', intended for use at Latitudes 52° N, as shown in Fig.1a for G.M.T. and Fig.1b for B.S.T.

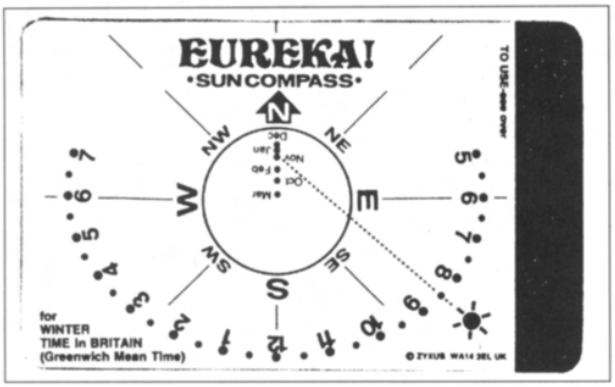


Fig. 1a

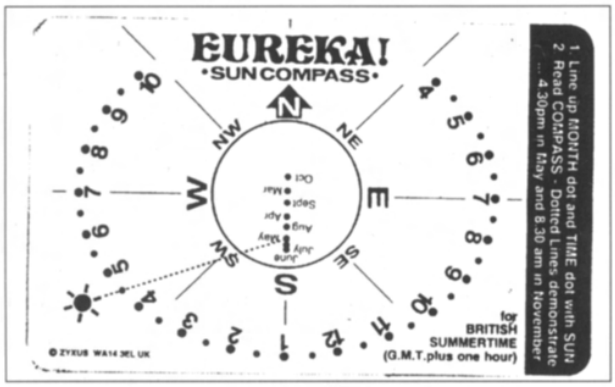


Fig. 1b

However when I recently attempted to use this device, I discovered in great surprise that the compass markings are arranged unconventionally and that in consequence any readings made from this particular instrument should be interpreted with extreme care.

Interestingly, even with its current unconventional arrangement of cardinal points, this instrument is not immediately suited for use in the Southern Hemisphere (at corresponding Latitudes of 52° S) because neither the (pin) gnomon settings nor the hour markings are suitably arranged for the purpose.

Maurice J Kenn,
38 Corkscrew Hill,
West Wickham,
Kent BR4 9BB.

RESTORATION AND CONSERVATION OF HISTORICAL OBJECTS

After reading, with extremely mixed feelings, the article 'Restoration of an 18th century vertical sundial' Bulletin 97.2 April 1997 I feel compelled to address some of the contentious issues that it raises and which will temper, I hope, the approach of the future 'restorers'.

Obviously Alan Smith and all involved felt that they were acting in the best possible interests of the sundial, its setting and owners, but there are ethical, practical and moral rules that one must adhere to when undertaking a project that involves such a historical artefact, some of which are set out below:

(a) Legal obligations are that work carried out to any part of such a building, and here I presume that the Meeting House has a historical listing, must be reported to the relevant authorities such as: Local government conservation officer, English Heritage etc. and only with their approval can any alteration take place to the fabric of the building and any item that is part of it. To disregard this leaves one liable to prosecution.

(b) Original finishes are just that! If the original finish exists as it did here, then that is what must be preserved even if it is frail and needs future maintenance. To obliterate this surface completely using the unfounded argument that "the original designers would probably have approved and might well have done it themselves" is breathtaking in its temerity, and would be amusing if it didn't result in such a total loss. The statement "nothing in the way of historical evidence and quality will be taken away" is untrue and this will be confirmed by reading the surrounding article.

(c) "Future restoration will be straightforward" is correct as there is nothing left to restore except for a 20th century carved dial. Though even this may be misguided as the application of water repellents to stone often engenders greater maintenance requirements than bare stone and may hasten the decaying processes. The reason that the stone had a natural background was that being porous its longevity was secured, a fact that needs to be emphasised with vigour in this age of products that promise to protect the stone, and if any owner or restorer is tempted by glib advertising to chemically treat the surface of a porous material "to strengthen it" please get professional advice first-and not from the suppliers!

(d) It is worrying to note the brief description of the

condition of the surface of the stone and the repair that was affected, what was this "modern weatherproof filling of suitable texture and colour" and is its performance, durability and porosity compatible with stone, which sadly is now the only part of this artefact that has any historical relevance.

(e) In such a case it would have been kinder to remove the original to a safe place for a display and have a new sundial carved rather than creating this irrecoverable version of a palimpsest.

The above points will hopefully emphases the tenet that when confronted with such a valuable and historical artefact we can, and should, only act as caretakers and any works undertaken must respect and protect, wherever possible, the integrity of the original piece and the people who produced it. Imposing modern ideals and methods that remove or irreversibly detract from this is morally and ethically unsound.

December 1997

Chris Daniels
Herbert Read Ltd, St. Sidwell's Art Works
Tiverton Way, Tiverton
Devon EX16 6TG

Alan Smith comments as follows:

My first reaction to the letter by Chris Daniels about the St Helens sundial restoration was "Oh dear, what a storm in a teacup'! My second reaction was to wonder why it had taken so long for the conservation/restoration fraternity to come out shouting! As a long-standing *Fellow of the Museums Association,* and having worked in and with museums and art galleries for some 43 years, I daresay I am as fully aware of the ethics and morality of conservation and restoration as Mr Daniels!

The Hardshaw Meeting House at St Helens is, as Mr Daniels supposed, a listed building (Grade 2). All recent improvements to it such as the modern restoration of the stonework round the windows, including the mullions, and the chisel-hammered finish of the stonework of the facade, were fully approved by the Local Authority. The same is true of the sundial restoration, and in fact Mr David Innes of the Town Planning Section of the St Helens Metropolitan Borough Council was present at the re-installation of the dial on 31 January 1996, and gave his entire approval to the work. Also present was Mr Kenneth Evans, the architect who designed the Meeting House extension and who is Treasurer of the Hardshaw Estate which incorporates the building. The Society of Friends has always been scrupulous in following all building regulations whenever alterations, additions or repairs have been made to the Meeting House, and its members have unanimously agreed that the sundial restoration has been in complete harmony with, and sympathetic to, the building to which it belongs.

Let us consider the St Helens dial after its initial stripping of five layers of later overpainting. We are left with a dull and uninteresting slab of stone, decaying numerals, and a miserable apology for a wrongly placed gnomon, the original having long since been lost. In my view the *integrity* of the dial was in the *accurate calibration and placing of the lines when it was set out, and in the correct position of the gnomon for the declination of the building,* and not in the fact that it was painted. To have repainted these lines in a modern paint medium would have been to have added something just as a alien as to cut them in order to preserve these details for a permanent future. To talk about the 'original finish' (Mr Daniels's words-not mine) is plainly nonsense, for in no way could the surface of stone, as revealed, be described as original! The surface had been exposed to many years of pollution by the chemical, glass and mining industries of St Helens which had consolidated a hard and more or less impervious finish-not even the natural colour of the stone as shown when it was cut. To have restored a 'natural' surface would have meant grinding it down, and I am sure our critic would not have been happy about that! To have followed the suggestion made towards the end of Mr Daniels's letter, to remove the dial to a 'safe place' and have a new dial carved, would have meant storing in a back room at the Meeting House, or in a local museum, an unwieldy artefact of no aesthetic and little intrinsic appeal, completely out of context. The small congregation of the House in any case could not possibly have afforded a new dial at today's prices. As stated in my article a complete photographic record of the work at all stages has been lodged in safe hands, and the procedures undertaken were fully discussed and approved by a representative of the owners, as mentioned above.

It is my opinion that we should not be inordinately 'precious' about conserving artefacts of the past which have little aesthetic value, provided that we can respect the historic and scientific content of the object. Let us rather *add* (where appropriate) new vigour and life to earlier relics, and take a *realistic* view of things as our forebears did, who were not 'hung up' on the so-called ethical standards which prevail today. In my long museum experience I have seen far too many human artefacts ruined and neglected in the so-called cause of conservation, and I do not have much time for people who take a sentimental view of objects just because they are old. In contrast to a dull academic copying of *imagined original finishes*, the

St. Helens Meeting House now has a dial of which its members are justly proud, which quietly and unobtrusively enhances the building's facade and which maintains, *accurately,* the design basics which its original creators intended.

One final word about the treatment of the stone. There is no doubt that most of the damage was caused at the edge by water seepage, wind and frost, and the treatment it received at my hands was fully endorsed by Mr Philip Irvine who has many years of professional experience in architectural restoration and stone treatment. It was he who remounted the dial and completed the job by applying an edging of waterproof cement to help to bond it to the wall and reinforce it against future decay. The work undertaken at St Helens should by no means be regarded as a precedent for all dials needing restoration, for each requires its own solution in terms of local conditions and needs. In the present case, however, we have a dial which is *not* imposing modern ideals and methods, for both are entirely traditional. I am confident that as to the safeguarding of his original work, Mr Alexander Chorley, who was, it transpires, a 17th century man of culture and science (and who probably worked out the original calibration) would be entirely happy with our 20th century solution. I also think that it would be rather good idea for Mr Daniels to come to St Helens to see the work for himself, rather than making critical judgements from a distance of over two hundred miles.

26 December 1997
Alan Smith
21 Parr Fold Avenue
Worsley
Manchester, M28 7HD

REFLECTING SUNDIALS: A CAUTION

In BSS Bulletin 98/1 I published an article describing some reflecting sundials, with constructional details. It has been pointed out to me that conditions may arise in which such a dial might constitute a fire hazard. This is particularly true of the small-segmental dial, in which to accommodate the changing declination of the sun, the screen intercepts only a part of the image at any one time. If the dial is mounted on a window-cill, it is possible that a curtain or other soft furnishing could get into a position close to the screen where it would receive the focused image. Although the image is a bright line and not an intense small image of the sun, there may still be some danger.

Makers of such dials should guard against this possibility. I recommend that any reflecting dial, and particularly a small-segment reflector example, should not be permanently mounted in place on an indoor window-cill or left there unattended for any length of time.

C M Lowne
24 Ditchling Way
Hailsham
East Sussex BN27 3LU

'SUNDIALS IN AN ITALIAN MONASTERY'

Some words and phases of my article, which appeared in BSS Bull.98.1, p 22, were edited out of the article, and I wish to restore them in order to make better sense of the article. The translation from Dante's 'Convivio,' on p.24, top of second column, should have read as follows: 'Concerning the division of the day, we have to know that, as we said in the sixth (chapter) of the third treatise, the Church uses the seasonal hours, that are twelve every day, longer or shorter according to the sun. But the sixth hour that is midday, is the noblest and most virtuous of all day, and the Church puts close to it all the Offices, from every part, that is earlier or later, as far as possible. The office of the first part of the day, that is Terce, they recite at its end; and the Office of the third (Nones) and fourth (Vespers) part, they recite at the beginning. But we use to call Terce before that the bells are struck for that part, and half Nones after that the sound of bells announced Nones; and the same is for half Vespers. But everyone must know that the right Nones must always strike at the beginning of the seventh hour of the day'

M. Arnaldi,
Viale Leonardo 82,
48020 Lido Adriano, Ravenna, Italy.

E-MAIL ADDRESSES OF BSS MEMBERS

Richard Mallett has undertaken to maintain a list of e-mail addresses of all BSS members who possess such an address. If you are on the e-mail network, please send your address to Richard C. Mallett:
100114.573@compuserve.com
His address for snail mail is:

21 Cantilupe Close,
Eaton Bray,
Dunstable,
S. Beds, LU6 2EA
Telephone: 01525 222215

A TEST TABLE FOR HORIZONTAL DIALS

JOHN DAVIS

Have you ever wanted to try out a horizontal dial, but been unable to find a convenient horizontal surface to place it on? Or have you ever made a horizontal dial for friends who live in another part of the country, and had to fiddle around with spacers under one edge of the dial to bring the style height up to your local latitude so that you can check it out before delivery? It was to solve these problems that I made the very simple test table described here.

A photographic tripod gives a very convenient portable base for a horizontal table, and it can be used both outside on grass and on a carpet indoors by south-facing patio windows for comfortable use on cold winters days. The head is normally adjustable for rotation and angle, but usually the adjustment is rather coarse and not easy to set up with the required degree of accuracy.

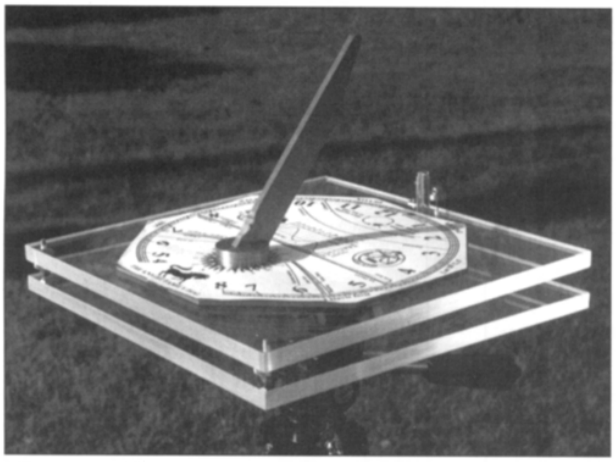


Figure 1. The test table in operation on a camera tripod. It is set for a dial designed for a latitude 1°25′ south of the actual location.

My table simply consists of two plates, one above the other, which allow fine adjustments to be made. The bottom one is secured to the tripod's camera-table by means of its captive bolt screwed into a tapped hole in the centre of the plate. The standard hole in the bottom of a camera is threaded $^1/_4$ BSW. The upper plate stands on the lower one, having three legs which can be adjusted for height. The legs have domed brass feet which locate lightly in countersunk depressions appropriately drilled in the top surface of the lower plate, and hence they stop the top plate sliding around, yet allow it to be tilted or lifted off. Any triangular position of the legs would allow the plate to be levelled in the x- and y-axes. However, choosing an isosceles arrangement as has several advantages. If the base of the triangle is formed by legs near the corners of the south-facing edge, and the apex is in the centre of the north-facing one, the adjustments for E-W and N-S levelling are independent. Furthermore, once a satisfactory level has been achieved, a controlled slope in the N-S direction (for checking out dials with the "wrong" gnomon angle) can simply be achieved by screwing the apex leg up or down by the requisite amount.

The table could be of virtually any material and any size. I chose to make mine out of 12mm perspex sheet as it is a favourite material of mine - it works easily with hand tools and yet can be machined if required, it has a flat and stable surface, it looks good, and it comes with removable protective plastic surfaces with allow the dimensions to be drawn on. If you get your supplier to pre-cut it to the required size, the edges only need a light filing and polishing to give a high level of finish. I opted for a size of around 300mm square as this meets the needs of most of the horizontal dials I make.

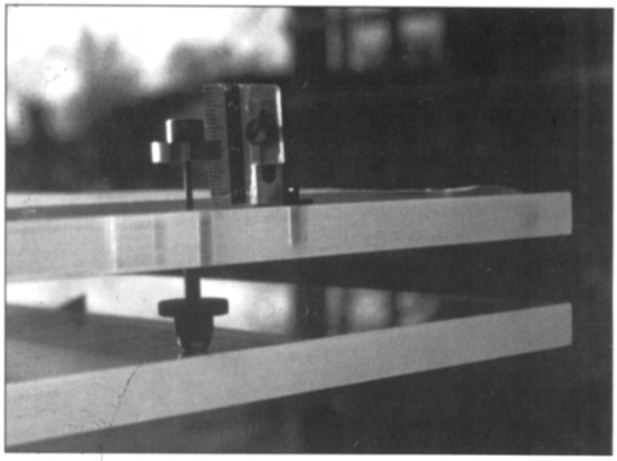


Figure 2. Close-up of the adjustable leg on the north edge of the table, together with the adjustable height gauge.

The spacing of the two south-edge legs is immaterial. However, if the height of the triangle between them and the single north leg is chosen to be 286.5 mm, then simple trigonometry shows that the slope of the top plate changes by 0.2° for every 1mm that the leg height is adjusted. This makes for a very convenient calibration. I made the legs from M4 brass bolts, which have a thread spacing of 2 turns per mm. Thus one revolution tilts the table by exactly 0.1° (6 arcminutes). Naturally, this linear calibration only holds for small angles, but if you are confining yourself to the range of British latitudes, this constraint is met naturally. In order to make reading the angle easy, I extended the north leg above the top plate and attached a disk to it which moves against a scale attached to a bracket.

This scale is a short piece of a normal plastic metric ruler which can be slid up and down so that it can be zeroed after the plate is set level. The periphery of the disk is divided up into ten segments, with one segment equivalent to a tilt of 0.01°. For the traditionalist, dividing the disk into six segments would give 1 arcminute per segment. In either case, this is far more accurate that you are likely to be able to resolve when setting the plate level in the first place.

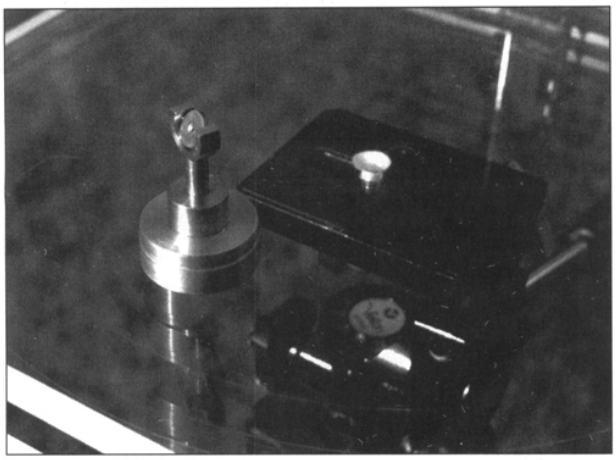


Figure 3. The altitude gnomon in position on the table. In action, a sheet of polar co-ordinate graph paper would be fixed to the table.

In operation, the baseplate is first set approximately level using the tripod tilting head, with the south edge rotated to face south. There are several ways of achieving this, one of which is with an accurate local sundial and knowledge of the local solar time. The upper plate is then placed in position and finely levelled in the E-W direction by adjusting the south legs. For this stage, a high quality spirit level is needed, and the average of two readings is required with the spirit level rotated 180° in between. Next, N-S level is achieved by adjusting the north leg in a similar manner. Finally, after zeroing the scale, the required tilt can be added.

Having made the table, I thought that a vertical gnomon would be a useful accessory. Initially, I produced a plain vertical brass post let into a hole drilled in the top plate. However, not only was it difficult to get it truly vertical, it was extremely difficult to locate to top of the shadow. This is a very well-known problem[1] resulting from the extended source, of course, but I was surprised just how big the effect was on a winter's day with the sun struggling up to 16°. An aperture made from a brass disk with a 1 mm central hole produced a much clearer spot of light. The disk had a thickness of 1.5 mm, so the aperture had to be countersunk from both sides to allow for any slight misalignment to the sun's rays. It was also necessary to allow the aperture to rotate in two axes, and to support it at an accurately known height (I chose 40 mm to ensure that the winter sun could be used) on a secure vertical post. Thus a simple idea turned into a relatively complex bit of construction! With an appropriate scale laid on the table, this removable vertical gnomon is a good way of finding the meridian if you have a set of tables or a pocket computer[2] which will give the sun's azimuth for your location. It is important that this scale lies very flat on the top plate, especially in the winter or when the sun is very low. Also, if the paper has significant thickness, it needs to extend under the base of the gnomon maintain its correct height.

I'm sure that others will have improvements to these ideas, but I have found it useful to be able to test a dial at a comfortable height and without kneeling on the ground.

REFERENCES

1. A. A. Mills, 'Aperture gnomons, meridian lines, and accurate determination of earth's orbit' *Bull. BSS* 1997 No.4 30-31.

2. J. R. Davis, 'The Psion Organiser - the dialist's friend' *NASS Compendium* 1997 **4**(3) 10-12.

Dr J R Davis
Orchard View, Tye Lane
Flowton, Ipswich, IP8 4LD
e-mail: John.Davis@btinternet.com

RECLINING AND DECLINING DIALS

JOHN SINGLETON

The object of this exercise is to assemble a set of simple equations for the design of dials which both decline from the south and recline from the vertical.

First it is useful to reiterate the formulae for a vertical dial declining δ degrees west of south (see Fig. 1). The gnomon of such a dial will run parallel to the N-S axis of the earth as usual, but is more appropriately described by the angle α it makes with the substyle (its projection on the dial), and the angle β at which the substyle lies, relative to the noon line. At latitude ϕ, these angles are given by:

$$\sin\alpha = \cos\delta . \cos\phi \qquad (1)$$

$$\tan\beta = \sin\delta/\tan\phi \qquad (2)$$

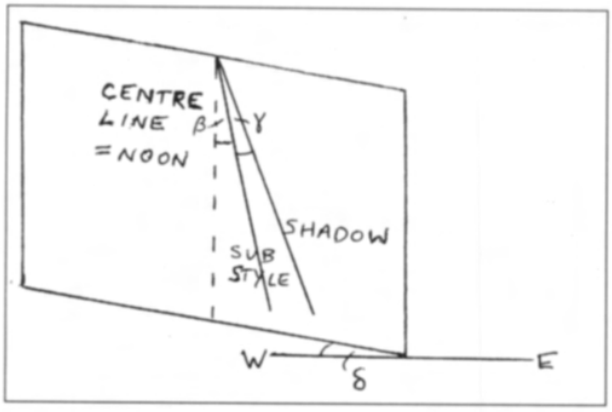


Fig. 1 Vertical dial declining west

The shadow lines for the hours lie at angles γ to the substyle, given by:

$$\tan\gamma = \sin\alpha . \tan(H-h) \qquad (3)$$

where H is the sun's hour angle and h is given by:

$$\tan h = \tan\delta/\sin\Ø \qquad (4)$$

As shown by Fig. 1, the shadow angles relative to noon have values (β+γ).

Turning to cases where the dial declines (west) at angle δ and also reclines at angle R (see Fig. 2), the two tilts combine to produce effective values δ and R, given by:

$$\sin\delta = \cos R . \sin\delta \qquad (5)$$

$$\sin R' = \sin R/\cos\delta' \qquad (6)$$

Hence the reclining dial at latitude Ø will be equivalent to a vertical dial with declination δ' at latitude Ø', where

$$\Ø' = \Ø + R' \qquad (7)$$

Finally a rotation must be applied by increasing all hour angles by n degrees, where

$$\cos n = \cos R'/\cos R \qquad (8)$$

(n is negative if R and δ have opposite signs)

To design the Ø' dial we can use Equations 1 to 4, but it is convenient to add primes to all the symbols therein (calling them Equations 1' to 4'). On the reclining dial, the total hour angle is then given by (β'+γ' + n). The substyle is at angle β' from the noon line, or (n+β') from the centre line, and the gnomon projects at angle α'.

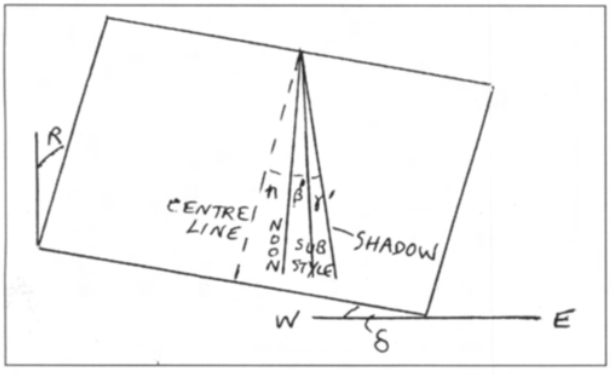


Fig. 2 Dial reclining and declining

A numerical example follows. Fortunately one's results can readily be confirmed by setting up a model of the dial on top of a 'horizontal' drawn for the same latitude, in the manner of a diptych. The hour lines should then be continuous.

Example

Given: Ø = 51° 30'N, δ = 20°W, R = 25°.

From Eqn 5, δ' = 18° 4'

From Eqn 6, R' = 26° 25'

From Eqn 7, Ø' = 77° 55'

From Eqn 8, n = 8° 48'

From Eqn 1', α' = 11° 29'

From Eqn 2', β' = 3° 48'

From Eqn 4', h' = 18° 27'

From Eqn 3', for 4pm (H' = 60°) we find γ' = 10° 0'. Hence the 4pm-line angle is (n+β')+γ' = 22° 36'. Likewise other hours.

The dial is shown in Fig. 3. 10am is virtually on the centre line (0°) and noon is at n = 8° 48'. The substyle is at angle (n+β') = 12° 36', and the angle between gnomon and dial is α' =11° 29'.

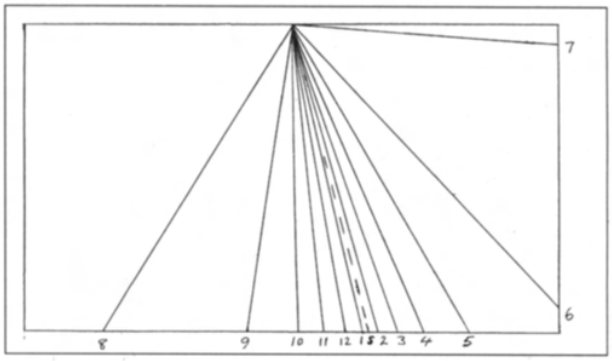


Fig. 3 Dial reclining 25°, declining 20°W (Lat. 51.5°N). S is substyle.

ACKNOWLEDGMENTS

This item was initiated by reading 'The Chatham Sundial' by Robert Mills (Bulletin 96.2) and 'Marking Time' by Peter Lamont (Bulletin 97.4).

John Singleton,
The Old Coach House, Salcombe Road,
Newbury, Berks RG14 6ED.

THE HEMISPHERIUM OR DIAL OF BEROSUS IN ANNA LIFFEY GARDEN, LUCAN, CO.DUBLIN

DICK SHACKLETON

When members of the British Sundial Society came to see sundials in Ireland a few years ago, they visited my home at Anna Liffey House. In the garden beside the River Liffey there are five different kinds of sundials.

I was having some difficulty in finding out how to delineate the summer and winter solstice lines and the equinox on the hemispherium dial. Christopher Daniel took a look at the problem, and on his return to England he sent me a detailed drawing of a template showing the position of the solstices. The engineer at the Shackleton Flour Mill, Alexander Birnie, made from the drawing a very accurate template in galvanised sheet steel, (as shown in the photo, Fig. 1) This template fitted perfectly into the hemispherium.

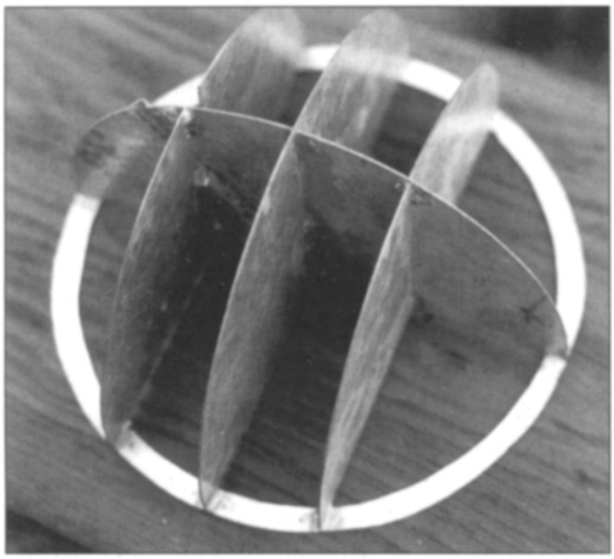


Fig. 1 Template for hemispheriun lines

During the following months, at the summer solstice, equinox and winter solstice, the shadow was absolutely correct in all cases. It was unusual and very fortunate that the sun shone on all three days, as can be seen in these photos. Benedict Byrne, a local sculptor, made the pillar from Kilkenny limestone, which was part of a discarded building at Clonsilla railway station. He made the top from Portland stone.

It is said that the hemispherium was invented by the Chaldean astronomer Berosus who lived about 300 BC. It consists of a hollow hemisphere placed with its rim perfectly horizontal, and having a style of which the *point* is exactly at the centre. The path of the shadow of the point would be approximately a circular arc; the arc divided into twelve equal lengths would determine twelve equal

Fig. 2 The Hemispherium

intervals of time for that day. Supposing this were done at the time of the solstices and equinoxes and on as many intermediate days as might be considered sufficient, and curved lines were drawn through the corresponding points of division of the different arcs, the shadow of the style-tip falling on one of these curved lines would mark a division of time for that day. Thus we would have a sundial which would divide each period of daylight into twelve equal parts. These equal parts were called temporary hours, and since the duration of daylight varies from day to day, these

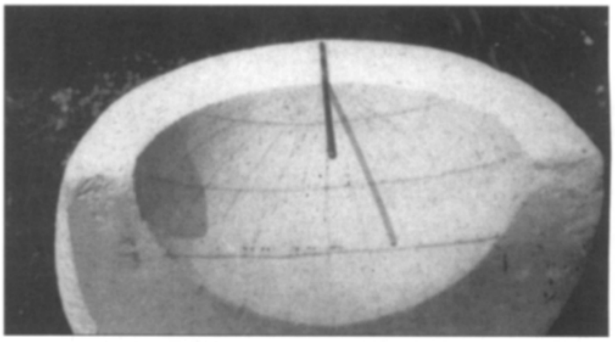


Fig. 3a Shadow at summer solstice

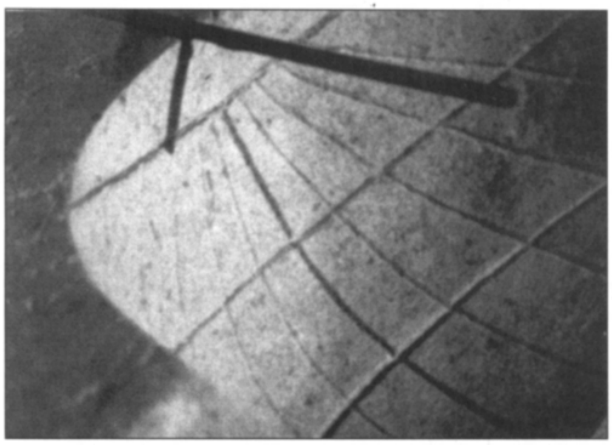


Fig. 3b Shadow at winter solstice

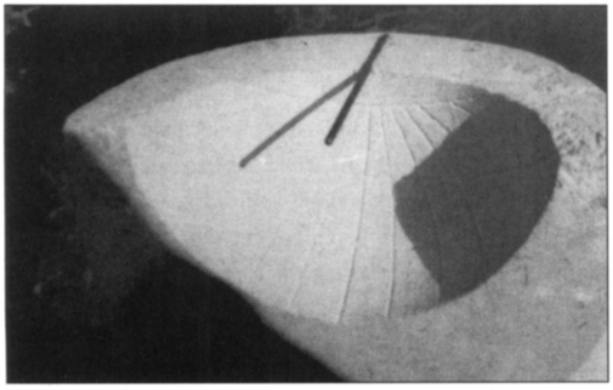


Fig. 4a Shadow at spring equinox

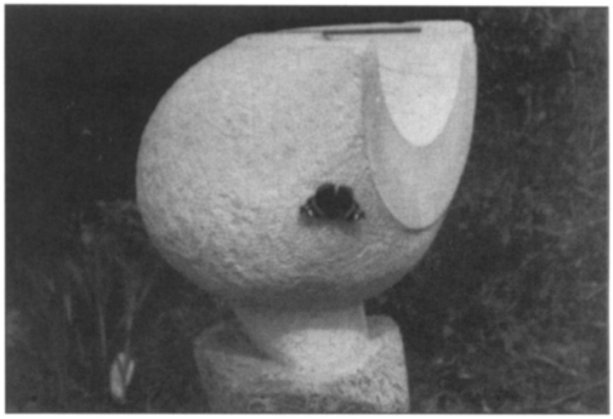


Fig. 4b Sundial with Red Admiral butterfly

temporary hours of one day would differ from those of another. This inequality would probably be disregarded in times gone by, and especially in countries where the variation between the longest summer day and the shortest winter day is much less that at our latitude.

Dick Shackleton,
Anna Liffey Stable House,
Lucan,
Co.Dublin,
Ireland

TWO SCRATCH DIALS AND TWO MODERN DIALS IN HUNGARY

LAJOS BARTHA

In 1997, two medieval vertical scratched dials were 'discovered' by Mr. and Mrs. Keszthelyi of Pecs, Hungary, on two churches near the west border of Hungary. Mr. Sandor Keszhelyi wrote a short description of these in the Hungarian Astronomical Bulletin 'Meteor'. In this article he surmises that the sundials have the same age as the churches: 13th and 14th centuries.

The first is the sundial on the church at Narda, near the large town of Szombathely in the Transdanubian area. The small church was built in the 13th century. On the south wall, 2.4 m above ground level, we find a medieval scratch dial. It is a double circle, the circles of diameter 58 and 53 cms. In the centre of the circles we find the hole of a horizontal gnomon (the original is lost) and radiating from the hole we find 15 (?) hour lines. Mr. Keszthelyi believed that the angles of the hour lines are unequal.

During the autumn, Mr. Ernö Vèrtes (the leader of the Gothard Astronomical Club in Szombathely) and I visited the church and examined the sundial. I confirmed that the angles of the hour lines are *equal*, but the stone cutter made a coarse work. Of the 15 hour lines, (2 above the horizontal east-west line, and 11 below it) today we can see only 8, and a small part of 3 others. The others are lost from the stone surface over the centuries. The whole sundial is very similar to the Pillerton Hersey (Warwickshire) dial, a picture of which was published in the B.S.S. Bulletin 92.3, p.6, Fig.4. It is similar to the sundial at Szentendre in Hungary. It is a characteristic medieval sundial for ecclesiastical use. It was made, with the church, around 1250 A.D.

On St. Michael's Church in Sopron, (West Hungary) between two half-pillars on the south wall, there came to light during the restoration in 1992 an interesting scratch dial below the plaster. The church was erected around 1250 A.D. and completed in 1276, and Mr. Keszthelyi thinks that the sundial was made at the time. Now Mr. Miklos Rakosi, (an elderly amateur astronomer) studied the sundial again, and I surveyed the archives; our date confirmed Mr. Keszthelyi's view.

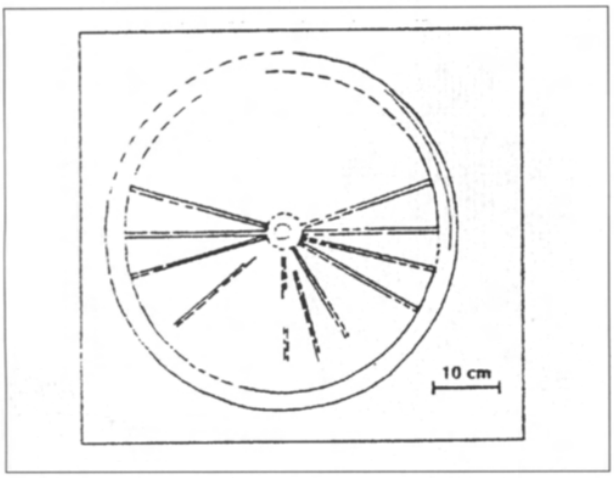


Fig. 1a Scratch Dial on Church at Narda

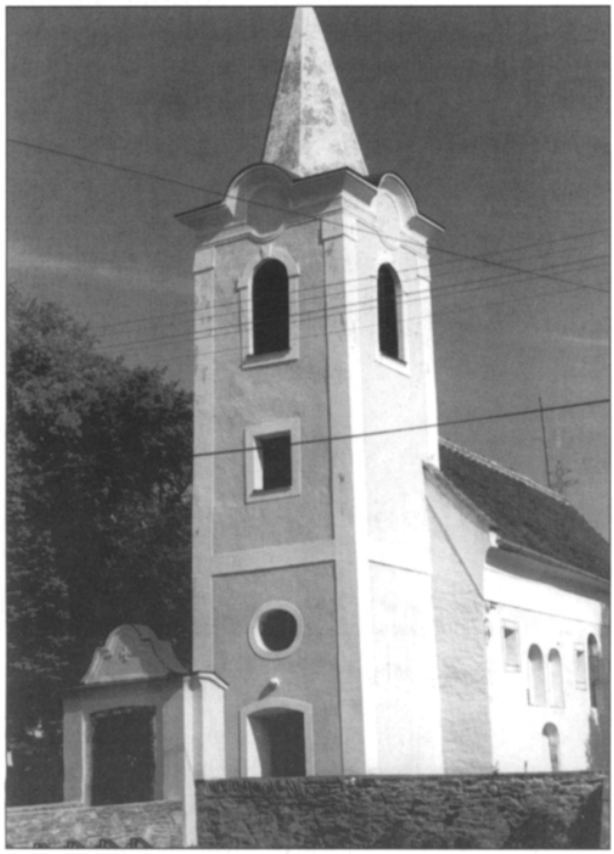


Fig.1b Photograph of Church at Narda

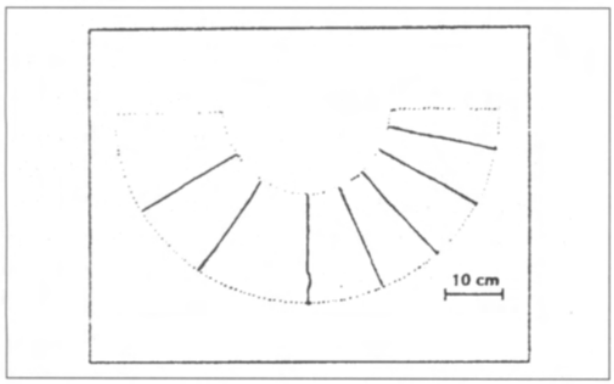


Fig. 2a Scratch Dial on Church at Sopron

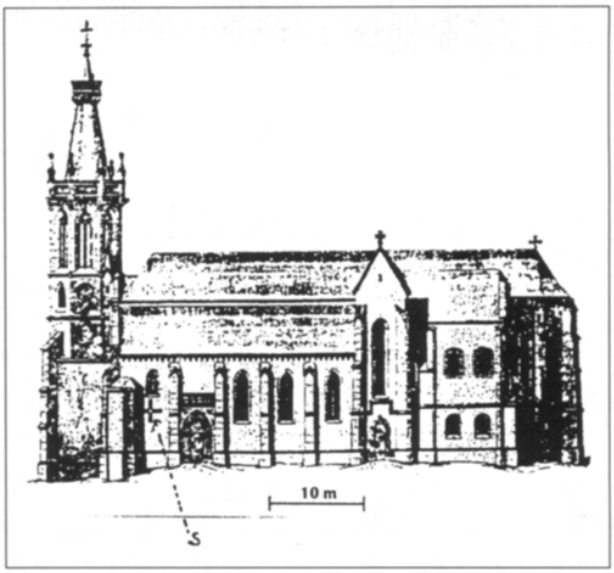


Fig. 2b Sketch of Church at Sopron

The sundial was constructed in two half-circles with diameters of 32 and 72 cms. The hour lines are contained in the inner half-circle and today we see 7 lines, apart from the horizontal. But in my opinion the dial plate contained originally 13 lines, including the east-west horizontal. But a number of these have been obliterated. Originally the two churches were not plastered, but during the rebuilding and 'modernisation' the walls were covered with a plaster layer, and the medieval sundials were covered up. But in the Baroque period, on the small church of Narda and the large St. Michael's Church new sundials with polar gnomons were constructed. Now, after restorations, the old sundials come to light.

I send drawings of the sundials. I send also a recent photograph (taken by Miklós Ràkos) of the dial on St. Michael's Church, Sopron. It shows that when the church

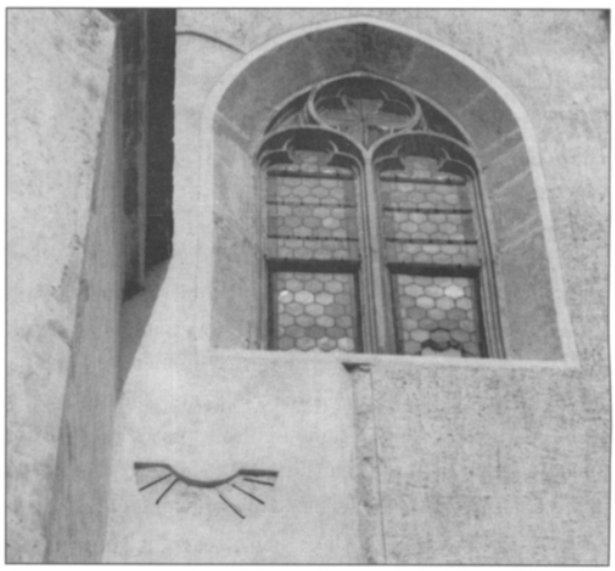


Fig. 2c Photo of Sopron Chuch wall: a new layer of plaster surrounds the original hour lines of the Scratch Dial

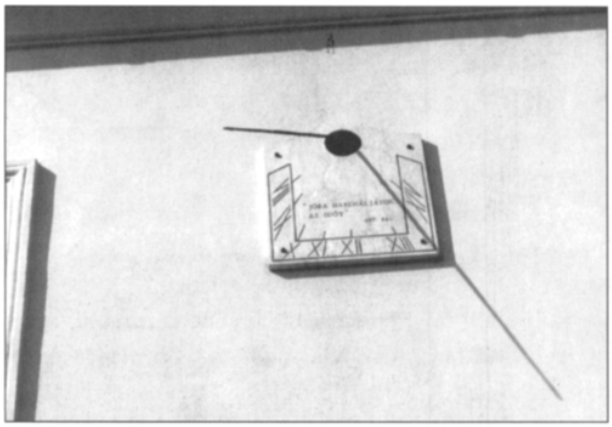


Fig. 3 New Sundial on Premontres building in Szombathely

wall was newly re-plastered, on the site of the sundial - plate the semi-circle remained free, so we see the stone surface with the hour lines.

A new sundial had been made on the old church in Szombathely, W. Hungary. On the 200-year-old building of the Premontres Monks the original old sundial was destoyed. Now a new dial (Fig.3) has been constructed and built on marble plate by Ernö Vèrtes, head of Gothard Amateur Astronomical Club, in 1996

Fig. 4 shows the sundial on the wall of the inner court of the Benedictine Monastery of Pannonhalma, near Györ, Hungary. The original sudial was constructed around the end of the 15th century. About 1730, the ruined buildings were restored and the dial was newly painted on the plaster. Between 1880 -1885, S.Storno, an amateur archeologist, 'modernised' the dial, and this dial was restored in the1960's

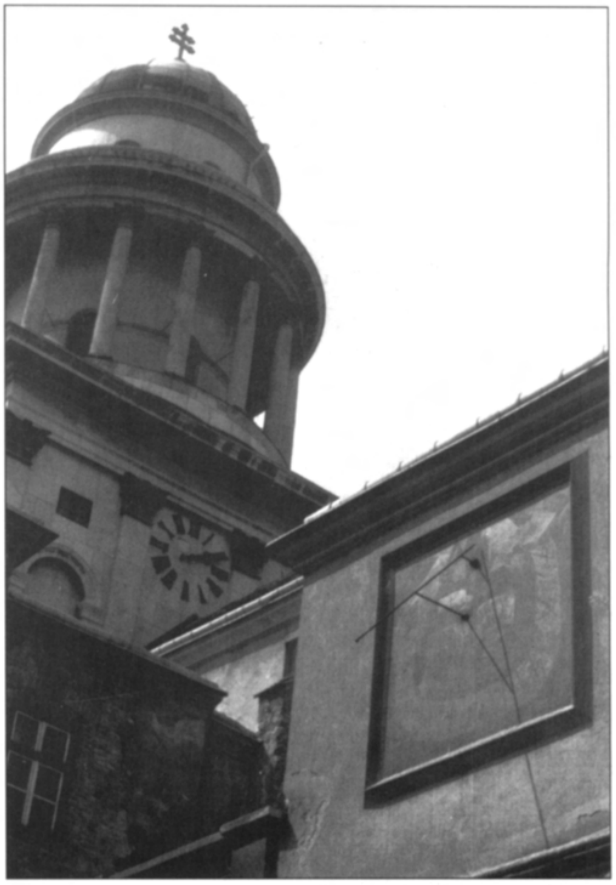


Fig. 4 Restored Dial, Bendictine Monastery, Pannonhalma

Lajos Bartha
H-1023 BUDAPEST II
Frankel Leo Str. 36
Hungary

EDITOR'S NOTES

1. The Editor proposes to alter the numbering system for issues of the Bulletin, from the beginning of 1999. There will be 'Volumes', numbered yearly, each (as now) consisting of three issues. Volume 11 will comprise the three issues of 1999, this being the 11th year of publication of the Bulletin. The change is being made partly to simplify the entries of the Bulletin in reference lists; the present system requires numerous digits, and also the duplication of information. Furthermore, if the present system is maintained for another two years, the first issue of the year 2000 would carry on its cover '00.1', a somewhat surprising appearance for a journal then in its 12th year of publication.

2. N. Severino, of Roccasecca, Italy, wrote (February 1998) that the work 'Bibliografia della Gnomonica' reviewed in B.S.S. Bull. 98-1, 16-17 was not 'a book' but 'the draft of a book'. Signior Severino subsequently wrote (March 1998) giving the information that 'International Bibliography of Gnomonics', by C.K. Aked & N. Severino, is now available, on disk only, (2 disks, Word for Windows) price £25, from N. Severino, Via Lazio 6, 03030 Roccasecca Stazione FR, Italy. Payment by international money order. This work contains about 11,500 titles of books, articles and manuscripts.

JOURNAL REVIEW

MARGARET STANIER

COMPENDIUM: JOURNAL OF N.A.S.S.

Volume 4 No.4 issue for December 1997 opens with a description by Ross McCluney, one of the founders of NASS, of a large sundial contructed as the centrepiece of a new 4-storey office block in Orlando, Florida, commissioned by the Disney Corporation. The architect, Isozaki '...desiring to capture the sunny essence of Florida, the Sunshine State..' designed a large hollow truncated cone, 120 feet high, standing between two slightly lower brick-shaped blocks of office rooms. The photo on the front cover of this issue shows the whole complex. The centre of the top circle of the cone is offset about 7 feet to the north of the centre of the bottom circle. This means that the north wall of the cone slopes at just the right angle to line up with the sun's rays at noon on the summer solstice. The hour lines are marked on the inner wall of the cone, and the gnomon is a 2-foot-diameter sphere placed at the tip of a horizontal arm projecting over the space within the cone from its upper edge. It is an ingenious and spectacular design, according to the custom in Disney World.

Another article in Compendium describes an archeological find made in 1952 at Qumram in Israel: a stone disc engraved with concentric circles and with a central hole, suggesting the insertion of a vertical stick gnomon. The circles are deeply engraved, and somewhat shallower radial graduation marks are also present.. The author, Avraham Avitzour, suggests a way in which the radial graduation marks along the circles could have been used to mark seasonal hours, those of the inner, middle and outer ring being used respectively in summer, equinoxes and winter. The article includes a set of clear photographs of the disc, with 'gnomon' inserted, at morning, noon and evening, at solstices and equinoxes; and the author modestly suggests that other people's views on the 'instructions for use' of the disc may be expected.

The issue includes another ingenious Quiz from Fred Sawyer, and the solution of the previous one. There is also an interesting and well-illustrated account of the Annual Meeting of NASS in Chicago in September 1997 (We wish we had been there). Among the short items are (a) the news of the issue of a new edition of the Gotteland/Camus 'Cadrans Solaires de Paris' which has been out of print for some time (b) 'Gatty's Cache'--the news of the viewing and proposed cataloging by Peter and Jane Walker of the collection of Mrs. Gatty's Sundial Books at Downside Abbey (c) a review of a book 'Making a clock-accurate Sundial' a booklet for primary school children.

Volume 5 No.1 dated March 1998 starts with an account, with photographs, of an exhibition of Sundials and Sundial Designs by a sculptor and NASS member, Robert Adzema, held at the Bergen Museum of Art and Science in Paramus, N.J The photographs show some quite interesting items of sculpture and it is clear from the text that the sculptor (unlike many who make sundials) is sufficiently knowledgeable in gnomonics to carry out his own delineations.

There is an entertaining article about an equatorial dial 'Sun Wheel' set up in 'Founders' Park' near Chicago, celebrating the pioneer settlers of this region of Illinois. There is a delightful description of a 'terrella' or 'Little Earth', and how to make one as an alternative astronomical toy for your garden. There is a Quiz, set by Allan Pratt, based on A.P.Herbert's 'Sundials Old & New'

There is also a note about 'Sciatheric Notes', a collection of Fred Sawyer's articles which appeared in the BSS Bulletin between 1992 and 1997, and are now published by the author in book form, price £20, or £23 overseas.

BOOK REVIEW

JOHN MOIR & DAVID YOUNG

Making a clock-accurate Sundial customized to your location (for the Northern Hemisphere) Sam Muller, Naturegraph Publishers, P.O. Box 1075 Happy Camp, CA 96039 USA; price S8.95

This well-illustrated 58 page booklet came to us for review complete with a glowing and on the whole well-deserved testimonial from the University of Toledo, Ohio, USA. It is aimed at 'teachers, students, amateur scientists, gardeners and hobbiests'

It begins with instructions to make and set up a simple cardboard sundial, to get to grips with how a dial functions. By placing it in a windowsill the student can prove that at

any given clock time the gnomon's shadow stays in the same place (almost) from one day to the next. Unfortunately the drawing shows it placed by a west facing window: not the best position for this experiment

Apart from this small criticism, we found the book to be well written, with clear explanations. It goes on to describe how to make a wooden sundial which is delineated empirically, using clock time and equation-of-time tables. There is a short chapter on moondials, followed by one on basic concepts, explaining how to use a globe, cardboard dial and torch to model the relation of the sun and earth's rotation to the time of day and time-zones.

While this is altogether a good little book the only regret is that there is no theoretical content. A student who is old enough to be let loose with a saw and superglue is presumably old enough to understand at least some geometry or trigonometry. At least there should have been a bibliography, to direct the reader to other more theoretical treatments of the subject.

OBITUARY:

PROFESSOR PHILIP ADAMS

One of our most esteemed friends and fellow members, Philip Adams, died following a debilitating illness, borne with great fortitude, on November 1st 1997.

Many of us will remember Philip for his considerable contribution to the intellectual and social development of our Society since its foundation in 1989. His lectures and demonstrations, often enhanced by his own meticulously contructed models depicting various elements of the solar system, were a pleasure to attend. He had a natural gift for rendering complicated theory into very understandable language, and accompanied this with an infectious display of wit and charm that must have been a joy to his students when he lectured at the University of Liverpool and Queens University, Belfast.

On the social side, which of us who watched Philip "shake a leg", as he called it, at an hotel disco in Cork in September 1994 will easily forget his sheer delight in music, dance and the company of friends?

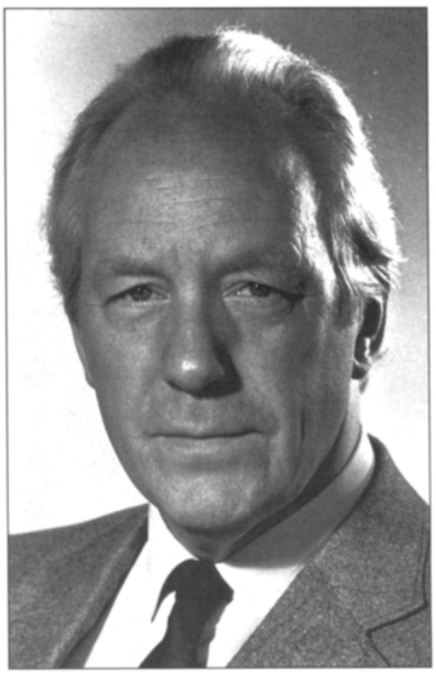
Philip was a very talented but unpretentious Ulsterman who, after a distinguished career in dental prosthetics and orthodontists was appointed professor of orthodontics in the Queens University of Belfast, in 1974, and was the president of the British Society for the Study of Orthodontics in 1974-75.

After his retirement in 1984 he was appointed Professor Emeritus in Queens University, and it was from this College that he hosted a memorable week-long sundial tour of Northern Ireland for our members in the Autumn of 1996.

I attended the Service of Thanksgiving for Philip, on behalf of our Society, in Belfast, on 5th November 1997, and extended our members' condolences and sympathy to his wife, Audrey, and their children, Caroline, William, Lucy and Rachel.

We were truly privileged to have Philip as a vibrant member during those formative years of our Society.

Owen Deignan



BSS CONFERENCE, DUNCHURCH LODGE

1-3 MAY, 1998

Dunchurch Lodge near Rugby is a convenient locaton and a popular conference centre. One hundred and ten members were resident at the centre, and several others were able to attend on a daily basis. The facilities were excellent: comfortable rooms, spacious and well-equipped lecture halls, delicious meals and a beautiful setting. The gardens are a most attractive feature of Dunchurch Lodge and they were at their best, with formal beds of spring flowers, landscaped parkland and a small lake. There is a heliochronometer (see G.Aldred, BSS Bull. 98.1) and several modern sculptures, one of which has a noon-sunrise-sunset marker. (Fig.1)

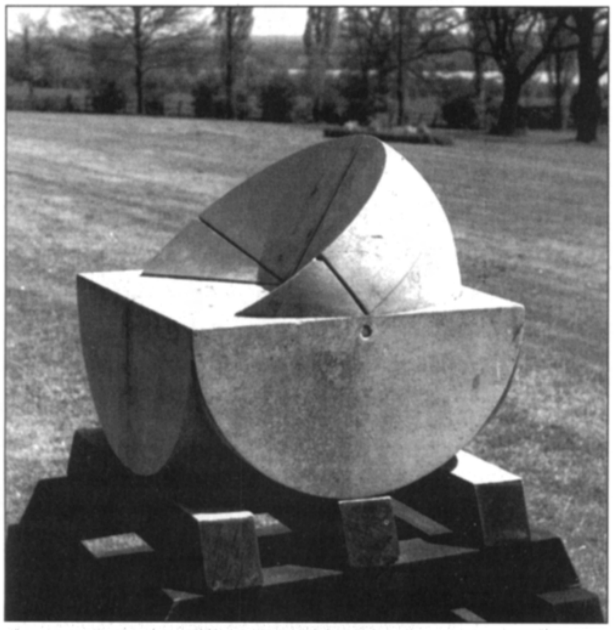


Fig.1 Noonmark sculpture, Dunchurch Lodge garden

This was our ninth conference and events soon fell into their usual pattern, meeting and greeting old friends and introductions to new ones, while exhibits were being set up and tea passed round in the conference rooms. Sadly this was also the day of Charles Aked's funeral, and we stood in remembrance of Charles and of Philip Adams, who died during the year, with a minute's silence before the evening meal.

The conference got under way after dinner with an introduction from the Chairman, followed by three short talks. Our Treasurer, Nick Nicholls, led with a talk entitled *North of Watford*, in which he explained the workings of the flight of ten locks and the restoration of the inclined plane on the Grand Union Canal at Foxton, just north of the Watford Gap, with which he had been involved some years ago. The sundial connection seemed somewhat tenuous until we were shown a slide of two dials at Foxton which were to form part of Saturday's *Sundial Safari.*

Christopher Daniel then gave a talk on *The Double Horizontal Sundial,* invented by William Oughtred in the 17th century. The position of the sun in the sky, and hence altitude, azimuth, declination and the effects of the zodiac, can be deduced from the intersecting shadows of two gnomons. This talk was also in preparation for the *Sundial Safari.*

The third talk, entitled *An 18th Century Dial,* was given by Walter Wells, who shared with us a detective story on the origins of two dials in manor house gardens. Clues involved the introduction of the Gregorian Calendar and its effect on the equation of time.

On Saturday morning we were treated to another of Allan Mills' always enjoyable lectures. His subject this year was *Altitude Dials.* Allan always starts simply, this time with a Victorian tellurian to demonstrate the movements of the earth around the sun. The lecture progressed to co-ordinate systems and spherical trigonometry used in various types of altitude dial, leaving us with the feeling that we had been agreeably stretched as well as entertained

We then saw David Young's slides of the 1997 German tour, with an amusing commentary by Frank Evans. There was also a large display of photographs (by Doug Bateman) at the back of the hall. For those of us who were unable to go on the tour it was a pleasure to enjoy it at second hand.

Our members' interests are nothing if not varied; we come at dialling from all sides, and the conference programme has to be arranged with this in mind. Fred Sawyer's talk, *Ptolemaic Co-ordinates,* catered for those with a mathematical interest. He has invented three new sundials using vertical, meridian, hectemorous and horarious angles, and demonstarted how these could be measured using a simple protractor drawn on an oblong sheet. Fred has an entertaining style and even those who couldn't follow the maths could appreciate the diagrams. And the words *hectemorous and horarious,* which refer to great circles of the earth, might come up in crosswords!

To avoid over-crowding around the sundials, the two coaches left in opposite directions for the *Sundial Safari* on

Saturday afternoon; a wise precaution as the photographers among us find it impossible to get a clear shot with other members' heads obscuring part of the dial.

Fig.2 Cawston Hall Sundial

The coach I was on went first to Cawston Hall where a polyhedral dial, a memorial to Lord John Scott, stands at the edge of a large pond.The dial was erected by his wife before 1878 and its design was copied from the royal sundial at Holyrood in Edinburgh. The dial has no maker's name but has eleven panels with inscriptions pertaining to the Scott family.As well as the names, family crests and mottoes of Lord and Lady Scott, there is 'United in time, parted in time, to be united when time shall be no more', and 'Best riding by moonlight'. Two of the photographs were taken by Fred Fernden who lives locally and was able to visit Cawston and Stanford Halls on a quiet day. The sun shone out of a clear blue sky and we were able to verify that those dials which were lit by the sun were in working order.

Stanford Hall was our next port of call where, remembering the Chairman's talk of the previous night, we attempted to read the information given by a very fine 17th century double horizontal dial made by David Delander. Our group was unsuccessful in this although the shadows were very clear, but the dial prompted considerable discussion. Stanford Hall has also the Pilcher Museum which tells the

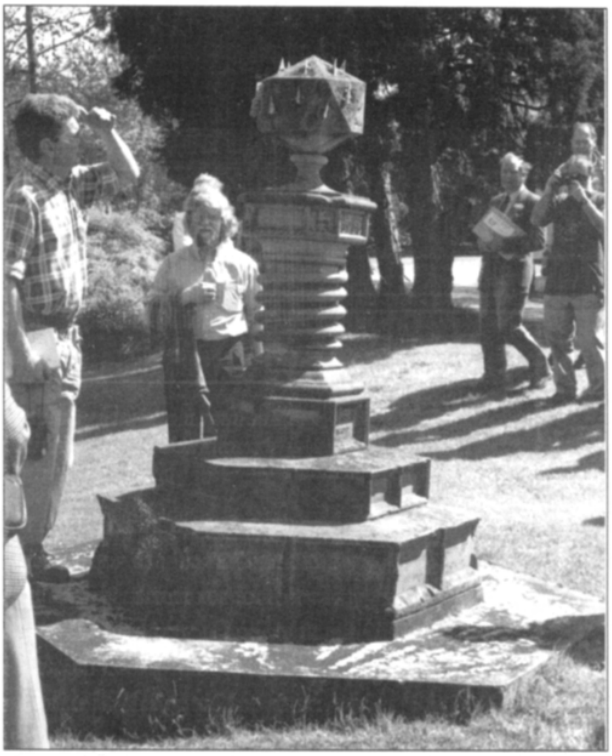


Fig.3 BSS members at Cawston Hall

Fig.4 BSS members studying the dial at Stanford Hall

story of an early air accident when a young man in a flying machine crashed and was killed in the grounds.At Foxton we were given a guided tour by the curator, David Goodwin. The award-winning little museum is well worth a visit for anyone interested in the canal system. The two recently constructed vertical dials declining approximtely N E and S W are on the wall of the museum. The flight of locks is in constant use and the inclined plane is being restored by a group of enthusiasts.

Returning to Dunchurch we had barely time to change before meeting again in the bar for pre-dinner drinks. The Conference Dinner on Saturday evening is always a high spot of the weekend and this year's came well up to standard, with a delicious meal beautifully served.

The Chairman's speech was brief and to the point, and we raised our glasses to Charles and Philip whose company we had enjoyed at previous conferences.

Traditionally the Conference Dinner is followed by an auction of books, pamphlets, dials, and artifacts of a dialling nature which members wish to dispose of. With three years' practice in the profession, Chris Daniel could certainly make a living as an auctioneer, should sundials ever pall. All of the papers which pass through his hands are 'rare' and all of the artifacts 'valuable'. Prices ranged from £1 to almost £100, some items being entered on a 50/50 basis and others donated wholly to Society funds. The amount raised on this occasion was £463.

On Sunday morning Roger Bowling came to the rostrum with a talk entitled *Rossetti's Sundials.* Here was something for those members whose interest is artistic rather than scientific. Roger discussed the significance, or otherwise, of the sundials shown in the illustrations to the *Divine Comedy* in which Dante and Beatrice live and die mostly at nine o'clock - or thereabouts. This time the illiterate rather than the innumerate among us tagged along while the better informed were able to nod wisely and laugh at all the jokes.

David Brown managed to down tools for long enough to come and take us through the planning stages and progress so far on his award-winning dial for Christ Church, Oxford. His design is based on a multi-faceted dial by Nicholas Kratzer, and will be a worthy and exciting addition to Christ Church when it is presented later in the year.

The Andrew Somerville Memorial Lecture was given this year by Sarah Symons whose subject was *Ancient Egyptian Shadow Clocks and Sundials.* Sarah is a Ph.D. student at Leicester University; she hopes to publish her work later this year. Her study of surviving examples of shadow clocks (or early dials) from the middle Egyptian period and of hieroglyphic records led to arguments for and against the use of a cross-piece on ancient Egyptian dials. Her delivery was clear and professional. It was fascinating to sit in a very modern lecture hall at the end of the 20th century and listen to instructions for making and using dials as written in 1500 B.C.

Alongside and in between the programme of talks and lectures there were demonstrations of various computer programmes, and as always a wonderful exhibition of members' work, completed dials and ideas for future projects. I have been attending conferences since 1990, and the variety, ingenuity and skill, from a collection of photographs to a piece of precision engineering which are exhibited never ceases to amaze me.

Fig.5 The double horizontal dial, Stanford Hall

In fact I hadn't nearly as much time as I would have liked to spend in the exhibition this year as I was involved in the rag trade. Yes! we now have a Society sweatshirt, which will be available at future conferences in several sizes, qualities and colours.

The AGM, which was well-attended, was on Sunday afternoon, and then it was back to the real world and the bank-holiday traffic. The organisation of a conference on this scale is no mean task and our thanks go to David Young, Nick Nicholls and the staff at Dunchurch and everyone who worked to make the weekend a resounding success.

Jane Walker
1 Old School Lane, West Lydford
Somerton, Somerset, TA11 7JP

THE SUNDIAL PAGES OF HUTTON'S 'RECREATIONS'

PETER RANSOM

My interest in sundials started when four of us, Peter and Ruth Wallis, John Fauvel and myself began preparing an exhibition and catalogue *Mathematical Tradition in the North of England* for The Mathematical Association's 1991 conference at Newcastle upon Tyne. One of the philomaths featured was William Emerson (1701-1782). When visiting the town where he had lived (Hurworth, Co. Durham) I noticed a number of sundials, one of which allegedly had been constructed by him (above the Bay Horse Inn). (Fig.1a & b) The dial, shown here, is estimated at 60 centimetres square. It declines slightly to the south west, is dated 1739, and shows what appears to be construction lines.

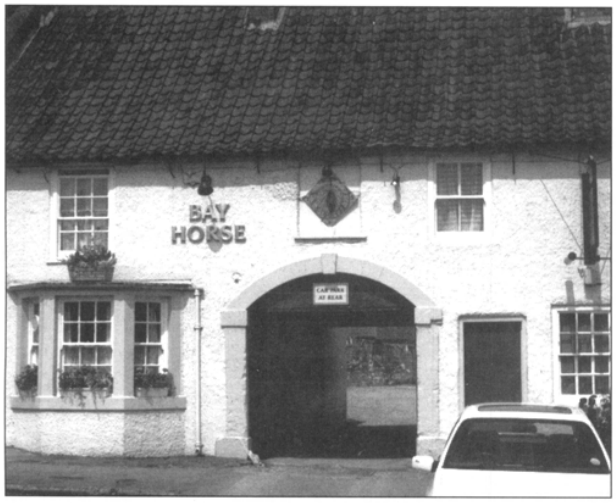


Fig. 1a Bay Horse Inn, Hurworth, Co. Durham

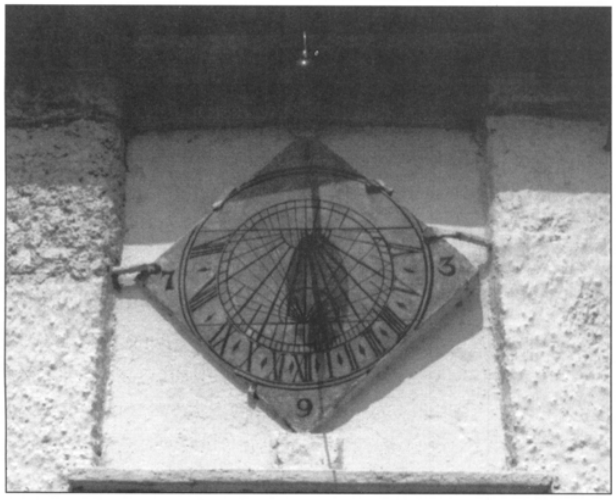


Fig. 1b Sundial on Bay Horse Inn

Following this diversion I became intrigued by many connections between mathematics and sundials. It is gratifying to note that another pub in the town is called the Emerson Arms, and features William Emerson on the inn sign. Are there any other hostelries in the UK named after mathematicians or diallers?

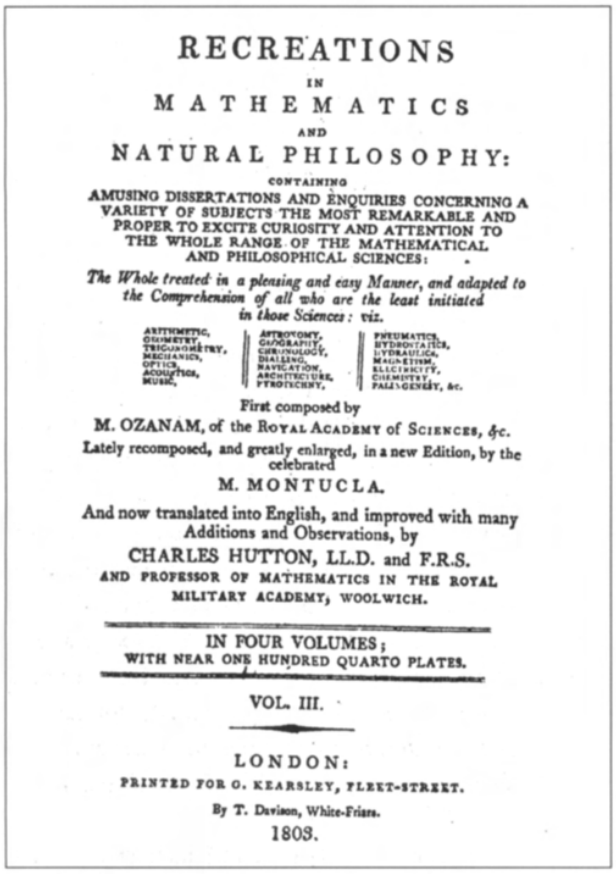
Another person mentioned in *Mathematical Tradition in the North of England* is Charles Hutton (1737-1823). He is the most important mathematician to emanate from Newcastle upon Tyne. The bust featured here (Fig.2) was presented to him by a group of admirers and now resides in the library of the Newcastle Literary and Philosophical Society.

Fig. 2 Bust of Charles Hutton

Hutton suffered a physical disability in childhood (an elbow injury in a childish quarrel at the age of seven) which saved him from a life down the pit like the rest of his family. (His name appears at the bottom of the pay sheets of Benton Colliery in 1755 and 1756.) Instead he became a teacher and opened a mathematical school in Newcastle upon Tyne. His first book, *The Schoolmaster's Guide* (1764) established his reputation locally with his national recognition coming with his *Treatise on Mensuration* (published in parts between 1768 - 1770).

He wrote many more mathematically valuable texts, part of one of which came my way over a year ago. This was volume 3 of *Recreations in Mathematics and Natural Philosophy*. (Fig.3) The basis of this four volume work was *Récréations mathématiques et physiques* composed by

Jacques Ozanam (1640-1717) in 1694. This ran to many editions and the one of 1750 is said to have been corrected by Jean Etiénne Montucla (born 1725 and a friend of Diderot and D'Alembert), but this remains unacknowledged until the 1790 edition. Montucla's revision of 1790 was translated and improved by Hutton, and editions of this were issued in 1803, 1814 and (as a single volume) in 1840.



RECREATIONS

IN

MATHEMATICS

AND

NATURAL PHILOSOPHY:

CONTAINING

AMUSING DISSERTATIONS AND ENQUIRIES CONCERNING A VARIETY OF SUBJECTS THE MOST REMARKABLE AND PROPER TO EXCITE CURIOSITY AND ATTENTION TO THE WHOLE RANGE OF THE MATHEMATICAL AND PHILOSOPHICAL SCIENCES:

The Whole treated in a pleasing and easy Manner, and adapted to the Comprehension of all who are the least initiated in those Sciences: viz.

ARITHMETIC, GEOMETRY, TRIGONOMETRY, MECHANICS, OPTICS, ACOUSTICS, MUSIC, | ASTRONOMY, GEOGRAPHY, CHRONOLOGY, DIALLING, NAVIGATION, ARCHITECTURE, PYROTECHNY, | PNEUMATICS, HYDROSTATICS, HYDRAULICS, MAGNETISM, ELECTRICITY, CHEMISTRY, PALINGENESY, &c.

First composed by

M. OZANAM, of the ROYAL ACADEMY of SCIENCES, &c.

Lately recomposed, and greatly enlarged, in a new Edition, by the celebrated

M. MONTUCLA.

And now translated into English, and improved with many Additions and Observations, by

CHARLES HUTTON, LL.D. and F.R.S.

AND PROFESSOR OF MATHEMATICS IN THE ROYAL MILITARY ACADEMY, WOOLWICH.

IN FOUR VOLUMES;

WITH NEAR ONE HUNDRED QUARTO PLATES.

VOL. III.

LONDON:

PRINTED FOR G. KEARSLEY, FLEET-STREET.

By T. Davison, White-Friars.

1803.

Fig. 3 Title Page of 'Recreations in Mathematics'

The contents of volume 3 are described as

Part VI	Containing the easiest and most curious problems, as well as the most interesting truths, in astronomy and geography, both mathematical and physical.
Part VII	Containing the most useful and interesting problems in Gnomonics or Dialling.
Part VIII	Containing some of the most curious problems in navigation.
Part IX	Some curious particulars in regard to architecture.
Part X	Containing the most curious and amusing operations in pyrotechny.

To me it is part VII that holds most interest, and running from page 255 to 351 followed by 22 plates it is clearly quite a substantial work! The section is set out as the following 41 separate problems, two of which are described later. Whether they can be described as recreations in the sense that might be thought of today is debatable, but you may find some of them interesting to carry out.

I	To find the meridian line on a horizontal plane
II	To find the meridian by the observation of three unequal shadows
III	To find the meridian on a plane, or the substylar line
IV	To describe an equinoctial dial
V	To find the divisions of the hour-lines on a horizontal dial, with only two extents of the compasses
VI	To construct the same dial with one opening of the compasses
VII	Construction of the most important of the other dials Of the south vertical dial Of the north vertical dial Of polar dials
VIII	Of vertical east and west dials
IX	To describe a horizontal or a vertical south dial, without having occasion to find the horary points on the equinoctial
X	To trace out a dial on any plane whatever, either vertical or inclined, declining or not, on any surface whatever, and even without the sun shining
XI	To describe a horizontal dial in a parterre, by means of plants
XII	To describe a vertical dial on a pane of glass, which will shew the hours without a style, by means of the solar rays
XIII	To describe three and even four dials on as many different planes, on which the hours may be known by the shadow of only one axis Another method
XIV	In any latitude to find the meridian by one observation of the sun, and at any hour of the day
XV	To cut a stone into several faces, on which all the regular dials can be described
XVI	To construct a dial on the convex surface of a globe
XVII	Another kind of dial in an armillary sphere
XVIII	To construct a solar dial, by means of which a blind man might know the hours
XIX	Method of arranging a horizontal dial, constructed for any particular latitude, in such

a manner as to make it shew the hours in any place of the earth

XX Method of constructing some tables necessary in the following problems

Table of the angles which the hour-lines form with the meridian, on a horizontal dial, for every half degree of latitude, from 50° to 59°30'

Table of the sun's azimuth from the south, at his entrance into each of the twelve signs, at each hour of the day, for the latitude of London 51° 31'

Table of the sun's altitude, at his entrance into each of the twelve signs, at each hour of the day, for the latitude of London 51° 31'

XXI Another method of constructing an universal horizontal sun-dial

XXII The sun's altitude, the day of the month and the elevation of the pole being given, to find the hour by geometrical construction

XXIII To construct a horizontal dial, to shew the hours by means of a vertical immoveable style in the centre

XXIV To construct a moveable horizontal dial, to shew the hours merely by the sun's altitude

XXV To construct a horizontal dial, to shew the hours by means of the sun, without the shadow of any style

XXVI To construct a dial to shew the hours by reflection

GNOMONICAL PARADOX.

Every sun-dial, however accurately constructed, is false, and even sensibly so, in regard to the hours near sun-set

XXVII To construct a sun-dial which, not withstanding the effect of refraction, shall indicate the hour exactly

XXVIII To describe a dial on the convex surface of a fixed cylinder, perpendicular to the horizon

XXIX To describe a portable dial on a quadrant

XXX To describe a portable dial on a card

XXXI Method of constructing a ring dial

XXXII How the shadow of a style on a sun-dial might go backwards, without a miracle

XXXIII To construct a dial for any latitude, on which the shadow shall retrograde, or move backwards

XXXIV To determine the line traced out on the plane of a dial by the summit of the style

XXXV To know the hours on a sun-dial, by the moon shining on it

XXXVI To construct a dial to shew the hour by the moon

XXXVII To describe the arcs of the signs on a sun-dial Another method

Of the different kinds of hours

XXXVIII To trace out on a dial the Italian hours

XXXIX To trace out on a dial the lines of the natural or Jewish hours

XL To find the hour by means of some of the circumpolar stars

XLI To tell the hour of day by means of the left hand

APPENDIX containing a general method of describing sun-dials, whatever be the declination or inclination of the plane

PROBLEM II

To find the Meridian by the Observation of three unequal Shadows

The meridian line on a horizontal plane is found generally by means of two equal shadows of a perpendicular style; the one observed in the forenoon and the other in the afternoon. For this purpose, several concentric circles are described from the bottom of the style; but notwithstanding this precaution, it may happen that it will be impossible to have two shadows equal to each other. This inconvenience however may be remedied by three observations instead of two. For this ingenious method, we are indebted to a very old author on Gnomonics, named *Muzio oddi da Urbino*, who published it in a treatise entitled *Gli Orologi solari nelle superficie piane*. This author was exceedingly devout; for he piously thanks Our Lady of Loretto for having communicated to him, by inspiration, the precepts he has taught in his work. The operation is as follows. (Fig.4)

Let P be the bottom of the style, and PS its height; and let three shadows projected by it be PA, PB and PC; which suppose to be unequal, and let PC be the shortest of them. From the point P draw PD, PE and PF perpendiculars to PA, PB and PC, and all equal to each other, as well as to PS. Draw also the lines DA, EB and FC, on the two largest of which, viz, DA and EB, assume DG and EH equal to FC; then from G and H draw GI and HK perpendiculars to PA and PB, and join the points I and K by an indefinite line:

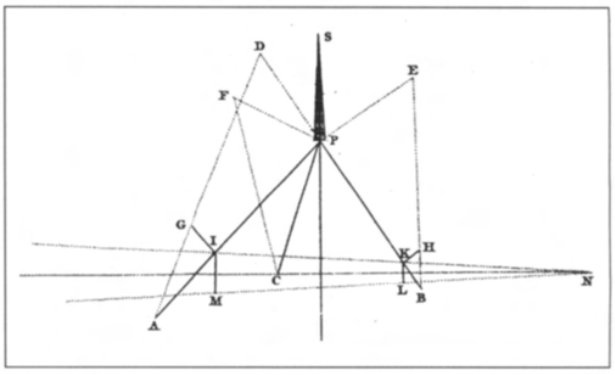


Fig. 4 Finding the meridian by three unequal shadows

make IM and KL perpendicular to IK, and equal to GI and KH; and draw ML, which will meet IK in the point N: if through N and C the line CN be drawn, it will be perpendicular to the meridian; consequently by drawing, from P, the line PO, perpendicular to CN, it will be the meridian required.

As the demonstration of this problem would be too long, we must refer the reader to the fifth book of a work by Schotten, entitled *Exercitationes Mathematicæ.*

PROBLEM XLI

To tell the hour of the day by means of the left hand.

It may be easily conceived that there can be very little precision in a method of this kind; and therefore we attach no more value to it than it deserves. (Fig.5)

Extend the left hand in a horizontal position, so that the inside of it shall be turned towards the heavens; then take a bit of straw or wood, and place it at right angles, at the joint, between the thumb and the fore finger: it must be equal in length to the distance from that joint to the end of the fore finger, and must be held upright, as represented in the figure, at A: this piece of stick or straw supplies the place of a style.

Turning the bottom of the thumb towards the sun, the hand being still extended, till the shadow of the muscle which is below the thumb terminate at the line of life, marked C. If the wrist or bottom of the hand be then turned towards the sun, the fingers being kept equally extended, the shadow of the bit of straw or stick will indicate the hour. When the shadow falls at the tip of the fore finger, it denotes 5 in the morning or 7 in the evening; at the end of the middle finger, it denotes 6 in the morning and evening; at the end of the next finger, 7 in the morning and 5 in the evening; at the end of the little finger 8 in the morning and 4 in the afternoon; at the nearest joint of the little finger, 9 in the morning and 3 in the afternoon; at the next joint of the little finger, 10 in the morning and 2 in the afternoon; at the root of the little finger, 11 in the morning and 1 in the afternoon; in the last place, where the shadow falls on that line of the hand marked D, which is called the table line, it will indicate 12 o'clock or noon.

The section finishes by mentioning some treatises on gnomonics from the eighteenth century that Hutton recommends. Most of these are French, but he adds the following English works: *Emerson's Dialling*, published along with his Mathematical principles of Geography; also *Martin's Principles of Dialling*; and, for those who wish to describe dials merely by the rule and compasses, *Leadbetter's Mechanic Dialling*.

Hutton was editor of the Lady's Diary from 1774 to 1817 encouraging many mathematicians of both sexes. In 1785 his *Mathematical Tables* were published, which start with 180 pages on an extensive history of trigonometric and logarithmic discoveries. His most ambitious work was the *Historical and philosophical dictionary* of 1795-1796.

It is worthwhile examining old mathematical texts for dialling sections as the two subjects are closely linked. The illustration of the tree of mathematics from John Draper's *The young student's pocket companion* (Whitehaven 1773), and used on the front cover of *Mathematical Tradition in the North of England,* shows the Dialling fruit on the trigonometry branch. Dialling must have been considered an essential part of one's education in the 18/19th century as it crops up in such self-educators as *The instructor: or, Young Man's Best Companion* by George Fisher, [London, 1809] (11 pages out of 347) and *The Young Man's Best Companion* by Dr. Parkins of Little Grimsby, [London, 1811] (8 pages out of 322). When will we see dialling form part of the current national curriculum for mathematics?

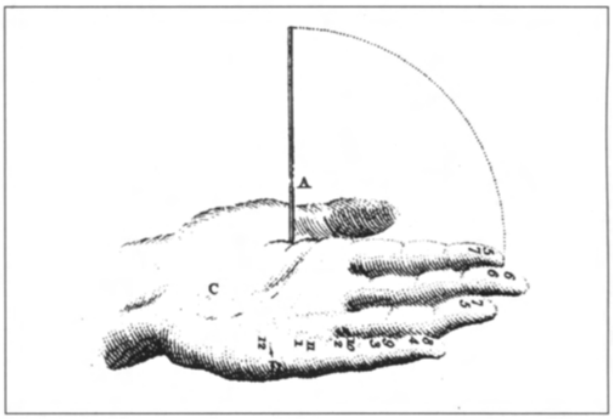


Fig. 5 The left hand as a dial

BIBLIOGRAPHY

Wallis, Wallis, Ransom and Fauvel *Mathematical Tradition in the North of England* (Available for £5 from the address below) NEBMA 1991

Rouse Ball,W.W. *Mathematical Recreations and Essays* Macmillan 1931

Hutton,C. *Recreations in Mathematics and Natural Philosophy vol. 3* Kearsley 1803

Wells,D *The Penguin book of Curious and Interesting Puzzles* 1992

Peter Ransom,
29 Rufus Close, Rownhams,
Southampton SO16 8LR

Honorary Officials of the British Sundial Society

Patron: The Rt. Hon. The Earl of Perth P.C.
President: Sir Francis Graham-Smith F.R.S.
Vice-President: M. René R.-J. Rohr (France)
Vice-President: Mr. C.K. Aked

Chairman: Mr. Christopher St.J.H. Daniel
General Secretary: Mr. David Young
Finance: Mr. R.A. Nicholls
Membership: Mr. Robert B. Sylvester
Bulletin Editor: Dr. M.W. Stanier

Council Members

Mr. Graham Aldred (Restoration)
4 Sheardhall Avenue Tel: 01663 762415
Disley, STOCKPORT
Cheshire SK12 2DE

Mr. John Churchill (Advertising)
55 Rushington Avenue Tel: 01628 627382
MAIDENHEAD
Berkshire
SL6 1BY

Mr. C.St.J.H. Daniel (Chairman)
8 The Maltings, Abbey Street Tel: 01795 531804
FAVERSHAM
Kent, ME13 7DU

Mr. R.A. Nicholls (Treasurer)
45 Hound Street Tel: 01935 812544
SHERBORNE
Dorset DT9 3AB

Mr. P. Nicholson (Internet)
9 Lynwood Avenue Tel: 01372 725742
EPSOM
Surrey KT17 4LQ

Mr. P. Powers (Registrar)
16 Moreton Avenue Tel: 01582 713721
HARPENDEN
Herts AL5 2ET

Mr. Peter Ransom
29 Rufus Close
Rownhams
SOUTHAMPTON
Hants. SO16 8LR

Mr. Alan Smith (Northern Liaison)
21 Parr Fold Avenue Tel: 0161 7903391
WORSLEY
Manchester M28 7HD

Mrs. Anne Somerville (Library, Archival
Mendota Records & Sales)
Middlewood Road Tel: 01625 872943
HIGHER POYNTON
Cheshire SK12 1TX

Dr. M.W. Stanier (Editor)
70 High Street Tel: 01638 741328
Swaffham Prior
CAMBRIDGE
CB5 0LD

Mr. Robert B. Sylvester (Membership)
Barncroft, Grizebeck Tel: 01229 889716
KIRKBY-IN-FURNESS
Cumbria LA17 7XJ

Mrs. Jane Walker (Education)
1 Old School Lane Tel: 01963 240421
West Lydford
SOMERTON
Somerset TA11 7JP

Miss R.J. Wilson (Sundial Makers)
Hart Croft Tel: 01386 841007
14 Pear Tree Close
CHIPPING CAMPDEN
Gloucestershire GL55 6DB

Mr. A. O. Wood (Mass Dials)
5 Leacey Court Tel: 01452 712953
CHURCHDOWN
Gloucestershire GL3 1LA

Dr. I.D.P Wootton (Vice Chairman)
Cariad Cottage Tel: 01491 873050
Cleeve Road
GORING-ON-THAMES
Oxon RG8 9BD

Mr. D.A. Young (Secretary)
Brook Cottage Tel: 0181 5294880
112 Whitehall Road
CHINGFORD
London E4 6DW


LENTE HORA CELERITER ANNI
1997