

The British Sundial Society



BULLETIN

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No. 89.1

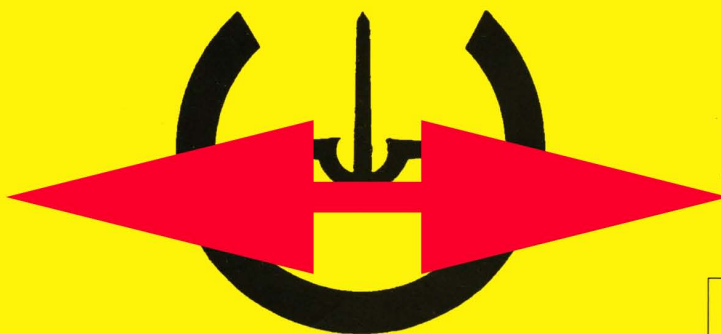
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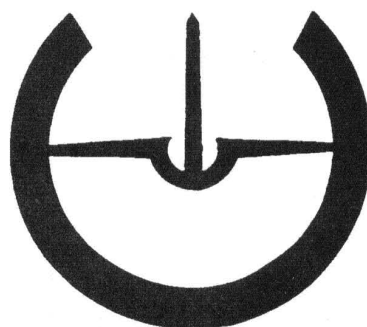
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The British Sundial Society

BULLETIN

No. 90.1

FEBRUARY 1990



ISSN 0958-4315

HONORARY OFFICIALS OF THE BRITISH SUNDIAL SOCIETY

PATRON: THE RT. HON. THE EARL OF PERTH P.C.

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NEWS FROM OTHER SOCIETIES

LA BUSCA DE PAPER

This is the journal of the Catalan Society of Gnomonics and is published in the Catalan language, of which the No 3 issue, the last of 1989, has just been received. It is a well-printed Bulletin of four pages. There is a good long article on the book on Sundials by Pedro Roiz, published in 1576. The copy in the writer's library is the reprint by El Cuadrante 1980, where the date is given as 1575. It is a most pleasant book which would be well worth the effort of translating into English. Under the title of Diallists of the 20th Century is an account of an altitude dial the divisions VIII- XII - IV being delineated on an outline map of Catalonia. It is also at a good altitude of 2 200 metres at Pla de Boavi and was taken there by helicopter! There are two more good articles, in the form of a dialogue about the clock of Vallclara, with a solution to the problem, by D. Camins; the second is on the determination of the width and other dimensions of the lines of a sundial [first part], by Josep Maria Vallhonrat. More cannot be said as the Editor has yet to find his Catalanian dictionary. The Society's address is *Societat Catalana de Gnomonics, Altenes 3, 08006 BARCELONA*. The Director and co-ordinator is Sr. Josep Maria Vallhonrat.

DE ZONNEWIJZERKRING

A total of sixty pages is the offering of *Bulletin* 89.3, the journal of the Netherlands Gnomonics Society. The Editor very kindly inserted details of the British Sundial Society and an application form on page 4, the response to this and other publicity has taken the founders of the British Sundial Society by surprise, the numbers being far greater than anticipated by its founder members. There is a review of the booklet on the "Seven Dials Monument", a very good article on the *Navicula de Venetiis* by J. Kragten, with an extremely well presented analysis plus excerpts from old English and other texts. This is an important article which will be well worth translation into English. Another important article is by C. M. La Grouw which deals with a little known aspect of dialling, that of the retrograde movement of the sun's shadow under certain circumstances, the so-called retrogradation Rg in the tropics. There is the usual book review feature, this includes a review of the first *Bulletin* of the British Sundial Society, and correspondence between Margarida Archinard of the Museum of History and Sciences at Geneva and M. J. Hagen, these being in French, plus sundials in the Netherlands by Mr. Hagen. The last two pages comprise a table of declinations for 1990 by Th J de Vries. The editor would have liked to have said more about the contents but what has been written here has strained his knowledge of the Dutch language to the limits.

The range of contributions in *Bulletin* 89.3 indicates a healthy level of activities and research in the Netherlands Society, it is most encouraging to the newer bodies such as the British Sundial Society that so much can be written on the subject of dialling by members of one of the pioneering gnomonic societies. The erudition of the scientific articles on dialling is remarkable and shows that we are at a new golden age in the science and art of dialling.

EDITORS NOTE: The Editor welcomes news of activities from all groups throughout the world for inclusion in this section. No doubt an international body will ultimately be formed to coordinate the efforts of all those interested in

dialling, this will be expedited if each group is kept informed of the activities of the others.

ALTER UHREN

The German magazine *Alte Uhren* [Old Clocks], Issue No 5 for October 1989 contains an article on the Huelsmann Collection of sundials and other instruments bequeathed to the town of Bielfeld, the collector's birthplace. The fifteen illustrations in the article, some in colour, include an ivory folding dial arranged to tell the time in a number of European towns. Another illustration in colour shows an 18th century dial from Augsburg in a leather case, with the original instructions in Gothic type, a very rare survival.

The article is a condensed version of the introduction to the catalogue of the Collection which is published by Callway, Streitfeldstrasse 35, Postfach 80 04 09, 980000 München 80. 272. There are 204 black and white illustrations and 35 in colour. The price of the catalogue is DM 58.00 [about £21].

A recent exhibition in the castle of Läckö, Sweden, a sundial made of sandstone, dated 1534, was shown. It is calibrated for the hours 3 am to 9 pm, showing what can be achieved with time indication in a country whose latitude stretches from 56°N to 68°N.

Details translated by E.J. Tyler

HORLOGERIE ANCIENNE

The full title of this journal is *Bulletin de l'Association Nationale des Collectionneurs et Amateurs d'Horlogerie Ancienne*, or in more prosaic English, *Bulletin of the National Association of Collectors and Amateurs of Old Clocks* [ANCAHA]. The issue for autumn 1989, N56, is devoted to the bicentenary of the French Revolution. Included in an account of the weekend visit to ANCAHA [16-17th September 1989] to Strasbourg and Mont St-Odile are three illustrations of the magnificent sundial at the Convent of St-Odile. It is in the style of the Scottish monumental sundials. Two of the many dials are shown, the lower east facing dial showing Chaldean hours; the other is the meridional vertical dial showing Alsace hours. Mention of the celebrated sundial at Strasbourg is made but the illustration containing this does not show any detail. In an earlier visit made by the French society to Israel in Spring 1989, the account includes, page 31, an illustration of a large sundial on the front of the immigration office, with the usual feature of two clock dials, one above each end of the semi-circular scale, one giving European Central Time, the other the number of hours before the setting of the sun. This is a belt and braces installation at Jaffa Road, Jerusalem. The illustration is of very poor quality, requiring much imagination to pick out the features, perhaps prepared from a colour print.

With respect to the French Revolution, the adoption of decimal hours by Decree of the Convention Nationale posed many problems for clockmakers, the effect upon sundial designers and makers has hardly been commented upon, although solar time was the legal standard in France, long after it was abandoned elsewhere.

The index included with this issue shows that for Volume VII, No's 48-53, 1987-1988, the only major article on sundials was by the editor A. J. Turner, listing the dialling works printed in French from 1500-1800. If permission can be obtained from the author, an English version of this article will be published in this *Bulletin* at

some future date.

ACCADEMIA DEL SOLE

A copy of the *notiziaria* of the Academy of the Sun and applied Art and Science at Turin was sent by Mr. Hagen of the Netherlands, it is the Spring 1989 issue and much of the eight printed pages is concerned with sundials. Four books in Italian on sundials are reviewed. The address for correspondence is *c/o studio VANEL, c.so Vercelli 87c, TORINO, Italy.*

THE ARBEITSKREIS SONNENUHREN

In the Deutschen Gesellschaft für Chronometrie

The Society Arbeitskries Sonnenuhren is composed of a chequered file of persons who are theoretically or practically occupied with sundials, be it as lovers or experts. They feel themselves dedicated to a good cause, which is suffering today from the vehement aggression of air as well as from human understanding.

The Arbeitskreis has its origin in the union of seven sundial-lovers of the Deutsche Gessellschaft für Chronometrie in 1971. This society, newly constituted at the beginning of the 1950's, is divided into "technical-scientific" and "historical-scientific" branches ("Fachkreise"). This latter is known as the "Freunde alter Uhren" [Friends of Old Clocks], and the Arbeitskreis Sonnenuhren arose within it as a separate operating circle.

This group has established a programme of study and care as follows:

Preservation as well as the new-creating of sundials; systematic filing of sundials in co-operation with our members from Austria and Switzerland; consultation of professional unions; study of the history of sundials and, last but not least, cultivation of personal contacts among the members, and interchange of ideas. The number of active members at present amounts to 46.

Vivacious contacts are cherished also with the guest-participants at our annual congress. The *Mitteilungen de Deutschen Gesellschaft für Cronometrie* is published twice a year to inform members of interesting news, and a book is

published annually, the *Schriften der Freunde alter Uhren*; which complements this with articles about clocks and sundials of all kinds; the last edition was Volume XXVIII, 1989.

An annual congress lasting two or three days takes place following Ascension Day at varying places in Germany and neighbouring countries. These reunions with their communications and events, stimulate all our sundials activities and fill them with life.

HEINZ SCHUMACHER 23.12.1989

Professor Schumacher is the Honorary President of the Arbeitskreis Sonnenuhren and was for many years Head of the School of Sculpture and Stonemasonry at Freiberg-im-Breisgau. He has made many stone sundials and trained young masons in the art, besides writing, in conjunction with Adolf Peitz, a three-volume manual on sundial design and construction (*Sonnenuhren*, Volume I, 1973, revised and reprinted 1984; Volume II, 1978, reprinted 1982; Volume III, 1981). Although the text is German, the books are so profusely illustrated that much can be learnt without any knowledge of the language. These books are still available.

The present Chairman of Arbeitskreis Sonnenuhren is Dr. Ing. Hugo Philipp, Dusseldorfer Str. 73, D4010 Hilden, West Germany.

* * * * *

As can be seen from the preceeding notes, the subject of dialling is being vigorously pursued on the Continent. It is equally clear that there is a large reserve of talent in the British Isles waiting to make contributions to the art, if the number of members who have joined to date is any indication. Because of the constraints of space available, many items have had to be left out of this issue of the *Bulletin*, so apologies from the Editor to those who have sent material and have not had it included here. It may be that the issues per year will have to be increased to four, the decision will be made shortly.

OBITUARY NOTICE - DR. F. A. B. WARD C.B.E.

It is with deep regret that we have to report the death of the first President of the British Sundial Society, Dr. F. A. B. Ward on Tuesday morning, 30 January 1990 at the age of 85 years. Although taken ill in 1989 and fitted with a pace-maker for a heart condition, he was looking forward to being at the first meeting of the British Sundial Society at Oxford, meeting members and delivering the President's address at its first conference.

Dr. Ward was acknowledged as the foremost expert on dialling in Britian, in addition to his great knowledge of mechanical horology. From 1945 he was the Keeper of the Department of Physics, including the Time Measurement Section at the Science Museum, London, until his retirement in 1970. He prepared the many editions of the Science Museum handbooks on Time Measurement, and after his nominal retirement catalogued a number of important collections, including the Scientific Instruments of the British Museum and the Clock Collection of Waddesdon Manor. He published many papers and articles, plus giving many lectures on horology and dialling. Until his recent illness he was a constant attender of meetings, retaining his enthusiasm until the last, always happy to

discuss with or listen to people talking about horology and dialling.

It is typical of Dr. Ward that when asked if he would be the first President of our then infant society, he accepted with enthusiasm although he regretted that he was getting a little too old to do a great deal himself. But at a meeting in the British Museum on 1st November 1989, he was talking about how much he was looking forward to the meeting of the Sundial Society at Oxford and meeting old colleagues again. Sadly it was not to be and his many friends will be deeply sorry at his passing. The horological world in general, and our society in particular, are the poorer for his passing.

The Committee members of the Society, on behalf of all the members, express their deep sympathy and condolences to Dr. Ward's widow, Mrs. M. Ward.

The British Sundial Society was represented at the funeral service held at the Church of St. Mary the Virgin, Monken Hadley, on 6th February 1990, by Mssrs. David Young and Charles Aked.

A. R. SOMERVILLE,
Chairman British Sundial Society

A MEDIEVAL SCRATCH DIAL ON THE GOTHIC CHURCH AT RUDABÁNYA (HUNGARY)

In the area now covered by Hungary there exist only two medieval sundials; one on the Gothic church in Szentendre (Danube-elbow), and another on the Reformed Church in the old miners' village *Rudabánya* (North-East Hungary, Borsod-Abaúj county, near the great industrial city of Miskolc). A third example known is of doubtful authenticity.

The scratch dial in Rudabánya was unknown for a long time since it was covered by plaster until renovation of the church in 1927. But it was only after the systematic restoration of the church in the 1970's that a detailed description was made by Mr. Z. Balázás Eng (for the first catalogue of fixed sundials in Hungary, edited by Mr. S. Keszthelyi, in 1983). In the spring and summer of 1988, Ms Adrienne Buka, a member of the Group for the History of Astronomy, and later myself, investigated the dial with the friendly assistance of Mr. Gy Viktor, the Curator of the Mining Museum, and Mr. Hadobás, the leader of Rudabánya Council.

The dial is discernible on the south face of a half pillar on the SW corner of the church, approximately 2.5 metres (8 1/3ft) above the present ground level. The dial has a diameter of about 24cm (10 inches) and contains 13 engraved lines: with two on the east and west above the horizontal E-W line, and seven actual 'hour lines' under the horizontal ('sunrise-sunset') line. The angular distance between these lines is between 22°-23°, averaging 22.5°.

The outer circular frame of the dial is fine stone-cutter's work, and possibly scribed with a compass-tool, it is just over 60cm (24in) diameter and is partially cut into the block of stone above the single block of stone on which the actual dial is cut. We think that the outer circle was engraved after erection of the half-pillar. The division lines are cut more roughly than the circular lines, and not all these meet accurately at the centre of the circles. The hole for the gnomon is very precisely placed at the centre and is

orientated perpendicular to the surface of the stone block.

The most problematic question is the age of the dial. The oldest part of the church in Rudabánya was erected in the XIIIth century, it covered a small area only and did not extend to the site of the half-pillar. In the early and late XVth century, the church was widened; and in the first half of the XVIth century it was appropriated from the Reformed Church and again enlarged.

In our opinion, the dial was cut at the same time the half-pillar was built in the early XVth century, and the similarity with the Norman or Anglo-Saxon type of dials indicates our dial to be early. In the second half of the XVth century, the scientific activity of many learned men (Johannes Regiomontanus, Hans Dorn, and others) was disseminating knowledge of the modern kinds of sundials having polar gnomons and equal-hour indications. Archeologists consider that the half-pillar was erected in the first half of the XVth century.

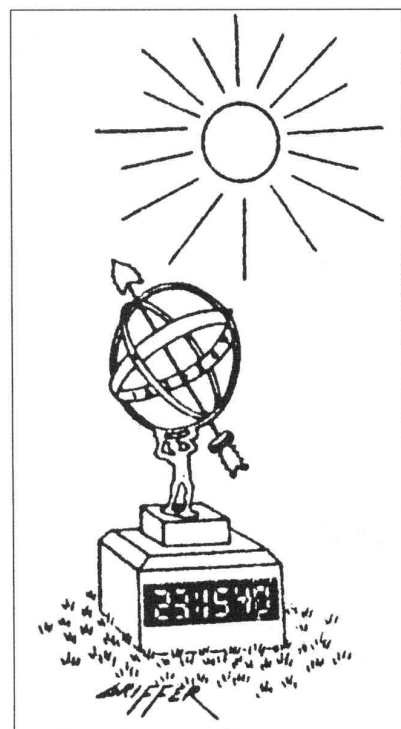
The surface of the dial is turned 15° to the West from the South. Therefore from autumn to spring the dial is in shadow until the sun's rays fall on it in the early forenoon. In our opinion the dial as originally cut contained only four lines, the horizontal, the vertical and two at 45°. Past the equinoctial, the gnomon shadow in the spring season fell halfway between these lines and so new lines bisecting the angles were cut, and these have the inaccuracies in angular direction noted earlier, hence do not meet the centre hole correctly.

We consider that the scratch dial on the church in Rudabánya is one of the last ecclesiastical dials on the Continent, the 'old-style' dial has survived by the protection of plaster work over the centuries preserving the engraved lines.

Ms ADRIENNE BUKA
& LAJOS BARTHA
(Hungary)

A MODERN SUNDIAL?

The Editor of *Antiquarian Horology*, Mr. David Penney, has kindly forwarded the illustration shown here, which in turn was sent to him by Gunnar Pipping, Senior Curator, Sveriges Tekniska Museum [National Museum of Science and Technology]. This cartoon was published in *Metallarbetaren* 43/82 ['The Metal Worker'], a Swedish trade union weekly. It shows a modern sundial of Netherlands manufacture, of which there are many in England; with the added convenience of digital time presentation in the base below. There is no correlation between the two, which is not surprising since the sundial itself appears to be south of the equator by the sun's position, and yet is set for a northern latitude. From which we must deduce it is summer in the area where the sun never sets, and the digital clock is running two or three hours slow. No doubt a British design will be on the market before too long, with a similar performance. Technical details are not yet available from the marketers.



A METHOD OF FINDING WITH INCREASED ACCURACY THE POSITION OF SHADOWS CAST BY THE SUN

As the Sun is not a point source but has an apparent diameter of approximately $0^{\circ}5'$, shadows of distant objects appear ill-defined, due to the surrounding half-shadows. The *width* of the penumbra varies directly as the length of the shadow. At a distance of 100ft from an object, for instance, the penumbra is 1ft wide, and as a rule it is very difficult to determine to the nearest inch the position of the shadow of a house or similar object at this distance. The method described below has been found useful for increasing the accuracy of observation considerably.

Suppose the shadow of the smooth edge of a building is being observed on a white screen. If a piece of cardboard is moved from inside the shadow towards the half-shadow, then a shadow of this piece of cardboard becomes discernible on the screen at that moment when the cardboard passes the boundary between the shadow and the half-shadow of the building. It is advisable to hold the cardboard an inch or two above the screen, and to allow the edge of the cardboard to enter the half-shadow slightly, so that a certain degree of contrast between the shadow of the cardboard and the half-shadow of the building is produced. Without much practice it is possible to determine with accuracy that position of the cardboard which gives the required contrast.

When applying the above method, one will notice the change of position of the shadow which is caused by the diurnal motion of the Sun. It is actually possible to demonstrate this effect of the rotation of the Earth, in as little as one or two seconds.

Another application of the method is concerned with the annual variation of the Sun's altitude at culmination. Where a smooth horizontal edge which runs exactly east-west is available, the position of its noontide shadow can be found with such accuracy that a very small change in the Sun's altitude can be detected. By combining observations made about the time of the equinoxes in two consecutive years, it

should be possible to determine the length of the tropical year with an accuracy which is surprising in view of the simple means applied.

The question arises whether a method similar to that described above was known to observers in pre-telescope times. The Great Pyramid in Egypt, for instance, with its precise astronomical orientation, could have lent itself to observations of this kind.

Yours faithfully,
G.H. ARCENHOLD,
Queen Elizabeth's Grammar School,
Wakefield.

[The above letter has been extracted from *The Observatory, A Review of Astronomy*, Volume 66, No 832, June 1946, pages 299-300.]

* * * * *

SPECIALIST PANEL

As mentioned elsewhere in the *Bulletin*, the Provisional Committee of the British Sundial Society are considering the setting-up of a Panel to deal with the dialling problems sent in by members. Whilst these have been dealt with by the present Committee members to date, each already has a significant amount of work to carry out for the Society, in addition to that through being involved in other activities.

The Committee would be pleased to hear from any member who would like to volunteer to serve on such a panel, the queries and solutions would be printed in the *Bulletin* as is done in other similar journals. Please write to any of the Committee members, whose addresses are given on the inside of the front cover, stating the area in which advice can be given; or alternatively with any suggestions on how such a service to members could, or should be, conducted.

ADDRESSES FOR CORRESPONDENCE

CHAIRMAN:

Dr. Andrew R. Somerville, 'Mendota', Middlewood Road, Higher Poynton, Cheshire, SK12 1TX.

[For general correspondence connected with the administration of the British Sundial Society, Conference Matters such as submission to details of proposed lectures and/or demonstrations for lecture programmes, meetings and tours.]

TREASURER:

Mr. David Young, Brook Cottage, 112 Whitehall Road, Chingford, London, E4 6DW.

[Membership enquiries/subscriptions, dial recording and pads of recording forms, further copies of the *Bulletin*, and all financial queries.]

EDITOR:

Mr. Charles K. Aked, 54 Swan Road, West Drayton, Middlesex, UB7 7JZ.

INSCRIPTIONS FOR SUNDIALS

My attention is often drawn to Gnostic remains, whether of Inscriptions or of Sundials.

Built into the present (? 18th century) walls of Noke Manor House are several large fragments of a cubical Sundial with four vertical facets, each 22½ inches (half of an Old English E11) square. Enough remains to make this absolutely certain. The Dial had incised lines and hour numbers, with rows of three dots marking the half-hours on the two meridional facets, but the portions containing the Mottoes (if such existed) are not apparent.

More recently a more substantial fragment of a smaller, single faceted Dial (a South decliner) has been built into the wall of 'Quaker Cottage' at Broad Campden. Only the 'right hand' border of this Dial is missing; leaving us with half of a date (16??), some anonymous initials, and the greater part of a Mottoe: "TEMPVS VMBR[A]", meaning (if one assumes a long A) "The Time from a Shadow"; superficially trite, but capable (as most things are!) of a 'deeper' metaphysical interpretation. Substitution of Æ for the final A would give the meaning "The Time of (or to) a Shadow". Assumption of a short A would give: "Time is a Shadow" or: "(Behold) the Time, O Shadow"; which last brings us close to another popular Sundial Mottoe: "VMBRA VIDET VMBRAM"; "One Shadow gazeth at Another".

The urge to inscribe Sententiæ (as opposed to technical data or the occasional Dedication) upon Sundials does not appear to go back (upon the wealth or archæological evidence available) to classical antiquity; but made a tentative beginning on the tentative Dials of the middle ages, and only began to be extensively indulged in with the introduction of 'modern' scientific Sundials in the 15th century.

One can rarely be quite sure of the ultimate origin of a Mottoe. Those who first introduced such things were fluent in Latin and could easily compose their own. They were more likely, however, to display their learning by the use of well chosen quotations from the Scriptures or the Classics.

The first printed collection of such Mottoes, embarked for use on Sundials, occurs as an appendix to the *Confomatio Horologiorum Sciotericorum* (1576) of Herman Witekind, a Schoolmaster of Heidelberg. Before giving a spate of German 'mortality' rhymes (with which readers of my own *Art of Sundial Construction* should be thoroughly familiar!) he presents his readers with three extensive quotations from the Vulgate Bible, three relatively short Greek phrases (including "GNŌTHI KAIRON" = "Know the Hour"), and fourteen Latin sentences (the last in rhyme), each carefully ascribed to its originating author (where such is known). These include the famous "TEMPORA MVTANTVR: ET NOS MVTAMVR IN ILLIS"; "Times change, and we change with them"; which Witekind confidently ascribes to Ovid, although modern researchers have professed not to be able to find it in the Works of that poet: perhaps they should look again!

Some Mottoes have an extensive, and controversial, history. The famous "SIC TRANSIT GLORIA MVNDI"; "So passeth the Glory of the World", is usually sourced confidently to a slightly different phrase occurring in *The Imitation of Christ* of St. Thomas à Kempis; but this proves to be a mere reference to an apparent ultimate source in the

Vulgate text of I John 2: 17: "And the World passeth away, and the Lust thereof". One is troubled, however, by the lack of precision in the phraseology; and more so when one reads that the 'familiar' version is said to have been in use as early as the days of the Roman Republic, long before the days of St. Thomas, or even those of St. John. As used it begs an Emblem for comparison. In mediæval times, when the phrase was quoted at the institution of a new Pope, this was supplied by the presence of an hank of flax, which was set on fire and burned away to nothing. This idea develops into the full blown 'Bonfire of the Vanities' which illustrates this Mottoe in the 17th century Emblem Books: "Ev'n as the Smoke doth passe away; So, shall all worldly-pompe decay". When used as a Sundial Mottoe (it is very common) the Dial itself (rather its shadow) provides the Emblem; provoking the surprizing (if understandable) 'translation' of "So marches the god of day". "That's the way the cookie crumbles" has also been offered!

There are many other Mottoes to which the Sundial itself supplies the Emblem. I was recently shewn a photograph of an Hungarian(?) Sundial of two facets; one facing East and the other South. The stone of the East-facing facet is skillfully carved into the figure of Death (as a skeleton) in high relief; so contrived that an iron Arrow (or Dart), uplifted to strike, forms the bar gnomon of the East-facing facet; whilst the iron blade of a Scythe, which Death also carries, forms the angled gnomon of the South-facing facet (rather of the half of a South-facing facet which this technically inefficient arrangement compels: the shadow passes from both facets at noon!). Prominently inscribed on the Dial is its Mottoe: "EXTREMAN REPVTA QVAMLIBET ESSE TIBI", which suggested the interpretation of "Consider the last at pleasure, it is for thee", or "However you regard the ultimate it will still come to you"; but a more subtle Latin Scholar of my acquaintance insisted that the presence of the inscribed Hours upon the *Dial* demanded the 'understanding' of the word "HORAM" within the *Inscription*; giving the meaning: "Consider whichever (hour it is) to be, for you, the last".

Because of the universality of its application, the theme of "MEMENTO MORI" (naïvely rendered "Remember to Die") has well proved its usefulness, both to the Diallist and to the inscriber of Tombstones; and variations upon it are the property of both disciplines.

The Diallist, however, should remember that the Mottoes which he/she chooses ought, ideally, to speak to any and every potential mood which a reader may carry. The use of Latin is ideal for this purpose; allowing for every ambiguity in 'translation'. Thus the 'pessimistic' text "HODIE MIHI CRAS TIBI", adapted from a phrase in the Vulgate text of Ecclesiasticus 38: 22, and meaning: "Today for me, tomorrow for thee" (with the implication "Today's my lot, tomorrow thine may fall" or "Today my number's up, it's your turn tomorrow"), has also been 'read' as "Today is mine, tomorrow may be thine"; a decidedly more optimistic message!

Such deliberate 'miss-taking' is a noted feature of the first major collection of specific Sundial Mottoes to be published for the use of the English reader. It is appended the Charles Leadbetter's *Mechanick Dialling* (Dialling for the rude mechanicals!); of which there are many 18th

century Editions, although the book is otherwise an audacious plagiarization of a 17th century work, with the same title, by Joseph Moxon. Leadbetter gives us a collection of some 301 Mottoes; mostly in bilingual versions of Latin and English. Some of the English 'translations' seem but tentatively linked to their Latin 'originals'. "AVT CÆSAR AVT NIHIL" ("Either Cæsar or nothing") becomes "I shine or shroud": hardly a self-evident interpretation!

The two complementary Mottoes "EN SVpra VITA FVGAX" and "EN INFRA CERTA MORS" are taken together to mean "A Life on Flight's soon out of Sight"; whilst "ECCE HORA" ("Behold the Hour") becomes "Now or Never". For the well-known "FESTINA LENTE" ("Make haste slowly") we are offered the alternatives of "Observe my Motion" and "Do nothing hastily"; less paradoxical but more prosaic! "POST VOLVPTATEM MISERICORDIA" (a Mottoe from a Sundial on "the *Lock*, or Hospital for those that have the *foul Disease*") is both relatively closely rendered as "Pleasure is the Parent of Pain" and, more freely, as "Night treads upon the Heels of Day".

Leadbetter is aware of the need to fit the Mottoe to the situation of the Dial. He gives Mottoes from Sundials set up on Chimneys: "FVMVS ET VMBRA SVMVS" ("We are Smoke and a Shadow") and "TANQVAM FVMVS" ("Like Smoke"). A Dial incorporating a Windvane is to be inscribe "VENTVS QVO VVLT SPIRAT" ("The Wind bloweth where it listeth", from John 3:8), whilst the inscription on a Dial at Billingsgate, "MENTIRI NON EST MEVM" ("Lying does not belong to me"), would seem not to lack a wider application.

A few of Leadbetter's Mottoes have no 'original' Latin; and yet the English quite manages the required equivocal tone: "ABOUT YOUR BUSINESS" ("On the General *Post-Office*"), "LOOK FORWARD", "MAN'S BUT A SHADOW", "REMEMBER", "TIME AND TIDE STAY FOR NO MAN" ("At the *Steel Yard*, facing the *Thames*."), and "WORK TODAY, AND PLAY TOMORROW". Rhyme frequently inclines to the maudlin: "PEACE, LOVE and UNITY, THRO' TIME TO ETERNITY".

Appart from some knowledge of German, I have but little experience of the Continental Vernaculars in this medium. A friend has given me a photograph of a Sundial (now dated 1839, but probably older, as it has a Nodus such as would have been used to tell the old 'Italian' Hours counted from Sunset, although it now tells the modern 'ordinary' Hours) at Selva di Progni, a village near Verona in Italy, which bears two Distichs in Italian; one at the top of the Dial and the other near the bottom, parallel to the Æquinoctial:

IN BREVE A DIO RAGION RENDERE DOVRAI
 DI TUTTE L'ORE CHE PERDUTE AVRAI.
 IL TEMPO FUGGE, E NON 'S'ARRESTA UN'ORA
 E TU SCHERZI, E RIDI, E PECCHI ANCORA.

One imitates in English:

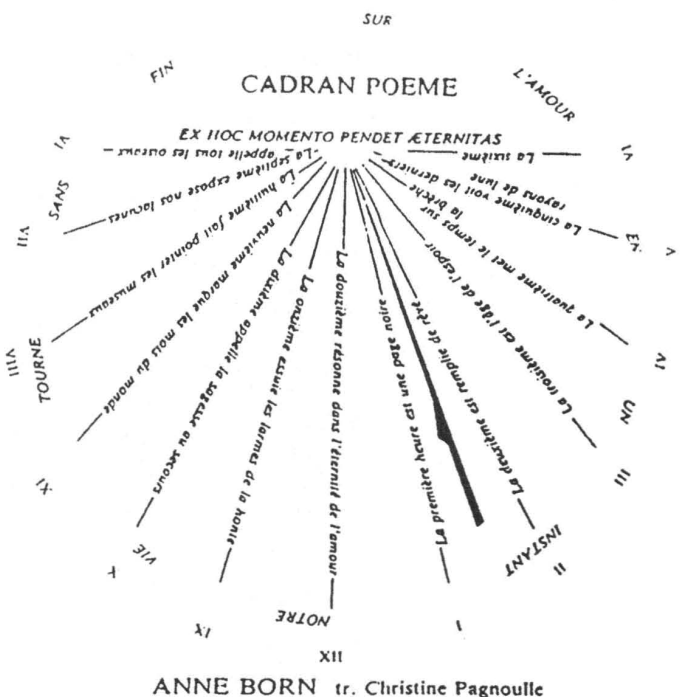
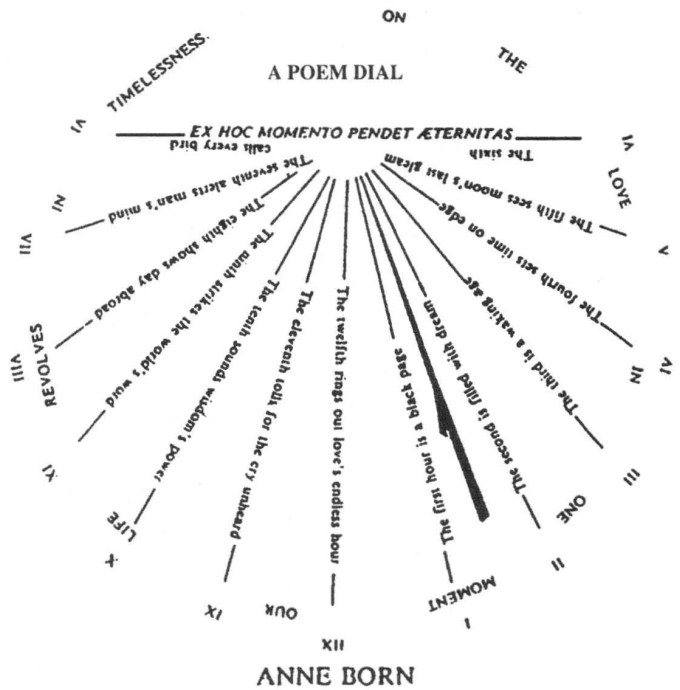
Soon thou, before thy God, must shew the cost
 Of all the hours which thou thyself hast lost.
 Time flies; and doth not, for one hour, refrain:
 And thou dost joke, and laugh, and sin again.

Surely a very Italian sentiment.

The Common Market opens this field of study to wider interest.

Anne Born, an American Poetess and Translator living and working in England, has produced a deeply optimistic

poem in English, which has since been translated into French and published in both languages. Starting with the Latin Mottoe "EX HOC MOMENTO PENDET ÆTERNITAS", usually translated as "Upon this Moment depends Eternity" or "Thine action now may weigh down the scales of fate", it develops the theme quite differently:

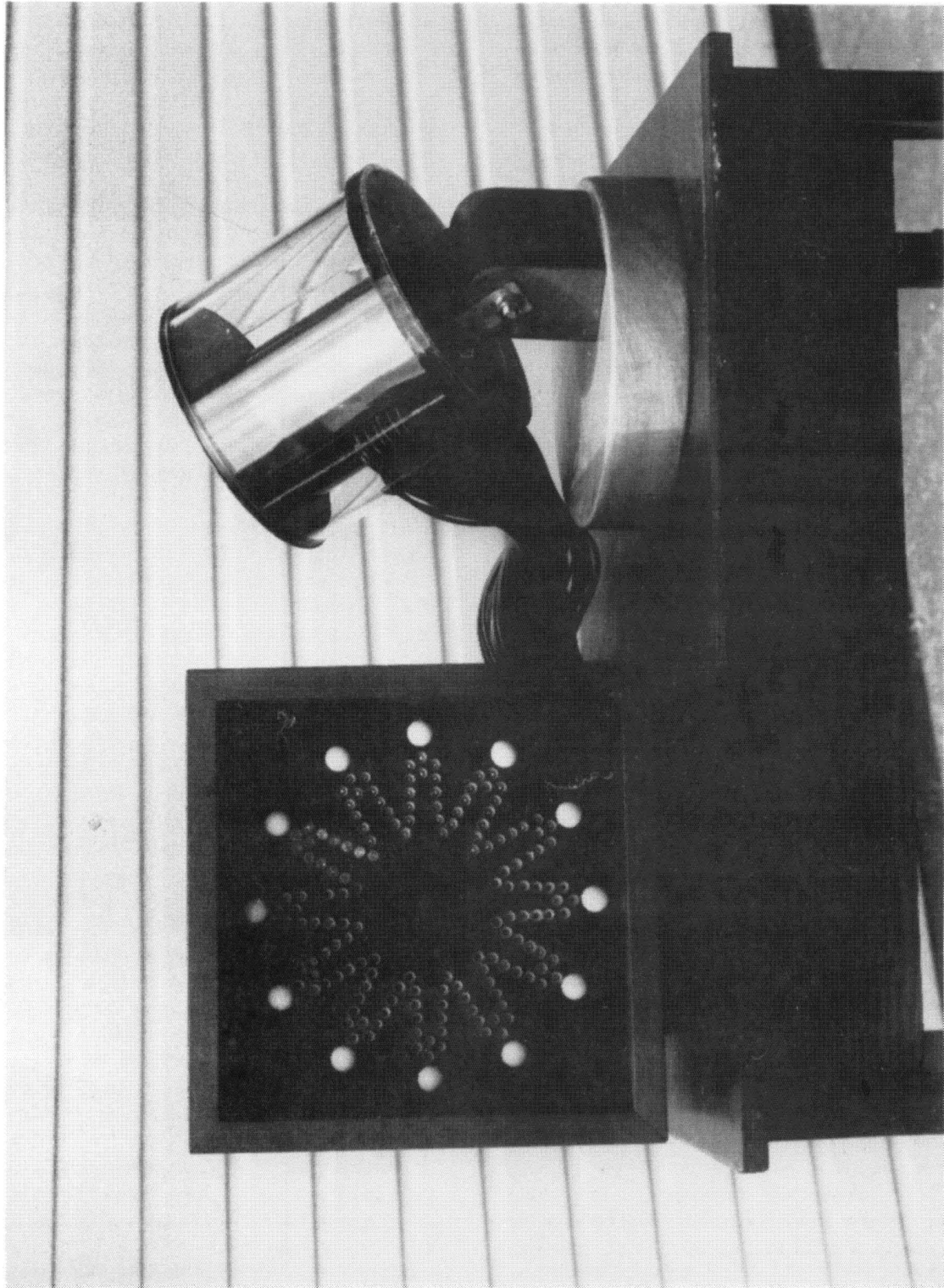


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We are here a long way from the old pessimistic concept of the passing Hours: "OMNES VVLERANT, VLTIMA NECAT" ("All wound, the last kills") or "PEREVNT ET IMPVTANTVR" ("They perish and are laid to our charge").

Meaning, like Beauty, is altogether in the eye (or mind) of the beholder.

PETER I. DRINKWATER



**A REMOTE READING SUNDIAL DESIGNED
BY MR. W.G. BENOY
SENSOR AND DISPLAY UNITS**

(See *Bulletin* 89.2, pages 16-18)

THE SUNDIALS OF THE KAPPELTURM GALLERY AT OBERNAI

BY RÉNE R.-J. ROHR

In the 16th century Obernai was a fortified town in which the Kappelturm, bell tower of the vanished church Notre-Dame, served as the belfry. Subject to a strict statute, a perfectly organized watch was kept there day and night, making a tour of the gallery and guarding the surrounding area. Many times by day, and night, at each relief of this guard over the centuries, the band of watchmen mounted and descended the stairs of this tower.¹

Their duties were multiple. By agreed signals, strokes of the bell or trumpet sounds, the town was informed of people or groups of people approaching from afar, whether suspected of being armed or not, and of all danger, also warning those tending cattle in the external pasturages, or again should a danger appear to threaten the vines. It also included surveillance of the town itself for signalling outbreaks of fire and public disorders. Finally, and this appeared to be of some importance, they had to mark, by blows on the bell, the hours indicated by their somewhat primitive mechanical clock, the presence of which was noted for the first time in 1474 in the town archives.

It does not mean, and we shall return to this later, that the indications of this clock always gave satisfaction, for it ceased functioning periodically for more or less long periods, which for clocks of that time, was a normal performance. Perhaps it was during such a period that the idea was initiated in certain of the watchmen to search for other means of marking the passing hours. And of the alternative means, the only one which could offer hope to them, was the Sun and the ancient sundial.

Concerning the age of the tower, this cannot be earlier than the XVIth century. It is more remarkable however to think that the research, in which the history is given by the stones of the tower would be unfolded in the first quarter of the following century, since one of the improvised dials on the East face of the gallery carries the date of 1619 nearby, the only indication of the year left by the guard. In contrast the remains of their gnomonic activities are abundant, for in making a tour of the gallery, one finds oneself in the presence of two sundials scratched into the face of the East wall, nine others in the South face and finally a single one in the West face, now bereft of their styles. It is true to say that none truly merit this title, for they are, in effect, mere caricatures of true dials.

At this time, the old canonical dials of the Middle Ages had become more numerous on walls of churches and country convents, perhaps the church of Notre-Dame itself had a example, which the watchmen had examined at their leisure. Their role [the dials] was essentially for religious services. They were normally composed of a semi-circle traced on the stones of walls (Figure 1). A joint between the layers of stones served as the horizontal diameter containing at its centre the hole for the style which was inserted perpendicular to the wall. This diameter and a number of lines provided the necessary division into the required parts, in which the shadow of the style indicated the times of the prescribed services, that is to say prime, sexte, none, etc. The ancient Roman edifices of Alsace carry more than a score of these dials. It hardly needs pointing out that it is impossible to obtain equal intervals of time or any other indication having agreement with those intervals that we now understand. About the end of the XVth century however there appeared, in Eastern countries,

dials with an inclined style allowing the division of the day into 24 equal hours. Orientated parallel to the axis of rotation of the earth, this style was an invention of the Arabs, with whom the science of sundials had attained a very high degree of perfection from the XIIIth century onwards. It is likely that the watchmen of Kappelture had often seen dials of both kinds, but it appears to be common knowledge that they were totally ignorant of the basic principles of dialling. To make up for the deficiencies in performance of their mechanical clock, they traced the semi-circle of a canonical dial and placed the style at right angles to the wall. Following the indications of the clock, they marked the entire hour figures by the shadow of the style. In these conditions they could have had at least one exact instant of the day, which is the hour of noon, when the shadow is vertical, if only the walls of the tower had been orientated in the cardinal directions. Nothing of the kind, for they declined in regard to these directions in the sense of the hands of a watch at an angle of 20.5° (Figure 2). When at true midday, the sun being on the meridian and true South, the shadow of a style on the South face cannot fall vertically, but is found to the left, whereas when on the East wall it falls to the right (Figures 3 and 4).

The watchmen did not desist any the less to furnish the hours of their dials, without doubt setting in train an error committed a thousand times before by other investigators. Their procedure, alas, could not give lasting results. For a few days, after such a tracing, the indications of the dial had satisfied its authors; but later, progressively as the sun changed its declination, they became more and more aberrant, which evidently the watchman had not counted upon. But they were not discouraged for long. Intrigued by what they had found by this curious problem, they resumed their experiment on another stone. The only attempt to have also been made on the East face of the tower was a curiosity and a new hope for one finds there is a semi-circle of 50cm diameter (Figure 5). The disappointment this time, was that the figures from the 2nd to the 7th hour of the afternoon were contained in a sector of barely 50°, and towards the moment of the setting of the sun, the style gave a shadow of only a few centimetres in length. Taking the conclusions of this augmented dimension, they returned to the South wall to attempt the tracing of a dial of 1.50m radius but of which only a sector of 70° was executed. This time examination of the figures gives evidence that the style was placed above the centre of the arcs (no 7 in Figure 6). This was another failure.

It seems clear, in this connection, that for certain dials (6, 7 and 8 of Figure 7) the attempts had been made with the help of inclined styles. If the roughness of execution of these dials does not permit the recovery of the angle of this inclination, examination of the numerals shows, however, that to be placed in the plane of the meridian the style must be in a plane perpendicular to the wall. After a dozen tentative attempts to find a solution to this problem, it was abandoned.

But it was not lost from view, for one day, and perhaps only a little later, an experienced gnomonist ascended the gallery. From a strong vertical trace, which crosses the top and bottom of two of the watchmen's dials (4 and 5 of Figure 6), he traced a meridian² on the south wall of which the hour of midday was indicated daily by the shadow of a

style of which the plug hole in the wall is still visible (Figure 7). Henceforth, at Obernai, life unfolded to the precise rhythm of the true local time.

In two cases only (2 of Figure 6 and upper East dial) the hour lines have been traced, it is observed that the watchmen's dials have the strange peculiarity that the hours are inscribed there in a curious mixture of Roman and Arabic numerals. A synoptic glance at the ensemble of figures is given later.

It is clearly established that hours after 9, that is to say those of which the writing necessitated a pair of two Arabic numerals, are always inscribed in Roman numerals. The explanation could be that in this epoch, the watchmen did not know how to write such numbers.

As for the clock, the orientation of the walls of the tower and the orthogonal installation of the styles permit after striking, a rough adjustment of indication. These styles, in effect, evidently indicate the azimuth of the sun at the moment where their shadows are vertical, marking then a certain time on the dials. This time was that which the clock had given on the day that the watchmen had traced the dial. By taking the latitude of Obernai (48°28' N), of the azimuth of the styles and this hour, a simple calculation would determine the declination of the sun on this same day. If the clock had been well regulated to true local time, this calculation would also allow the date and dial was traced to be known.

But results obtained on the large majority of the dials bordering on these declinations always point, to be sure, to the work having been performed in summer, but above those which the sun could never reach. The clock had thus marked these moments of the diversion of real time which varied with the season up to two entire hours, a state of things which no doubt lasted up to the day of installation of the meridian.

The origin of the sundial goes back into the dim past. It was the first measuring instrument invented by man. And this was against all the odds, the desire to measure time, an abstract thing impossible to see, to weigh, or to touch. The story of this measurement constitutes one of the most curious branches, even less known than the activities of our ancestors. The episode inscribed in the stones of the Kappelturm is not that of an example among thousands in the ancient past, the examination of which permits disclosure of details. But this episode is one of the most

moving and the most profoundly human stories because its actors were simple folk.

FOOTNOTES:

1. The present study is due to the initiative of Mlle Christine Muller whose research work in the domain of the local history of our region merits attention. I would particularly like to thank her for her great help with enquiries on the Kappelturm gallery and the illustrations of which she is the author and which she has kindly placed at my disposal.

2. It appears from an estimate submitted by Schwilgué dated 15 October 1840 in respect of the actual clock installed in the tower, conserved in the Municipal Archives of Obernai, that the ensemble supplied included a meridian. It concerns, without any doubt, one of those then fabricated by the firm of Schwilgué, which are still in place today on numerous churches in the district (Ottrott, Saint-Nabor, Umatt, Muhlbach, etc) where the meridional trace is carried out on a narrow cast plate. From about fifty years ago these installations were often lost during restorations to the walls of churches, which is the case at Obernai. The above-mentioned meridian serves well to recall the precise and meticulous work incorporated in all those items which came from the Schwilgué workshop, and must therefore be better than those earlier ones.

DIAL FIGURES

East Face

Upper Dial	7-8-9-X-XI-XIII-1	Horary lines
Lower Dial	6-7-8-9-X-XI	Dated 1619

South Face (See Figure 6)

No 1	Without figures	
No 2	9-X-XI-XII-I-II-III-III	Horary lines
No 3	X-XI-XII-I-II-III-III	
No 4	2-3-4	
No 5	9-X-XI-XII-1-2-3-4-5	
No 6	IX-X-XI-XII-1-2-3-4-5	
No 7	VI-VII-VII-VIII-X-XI-I-II-III-III-V-VI (no XII)	
No 8	9-X-XI-XII-1-2-3	
No 9	9-X-XI-XII-1-2-3-4	

West Wall 2-3-4-5-6-7

* * * * *

CAPTIONS FOR FIGURES OVERLEAF

FIGURE 1: Canonical dials served in the Middle Ages to mark the hours of the conventional Offices. Over twenty can be found on old Roman buildings in Alsace.

FIGURE 2: The orientation of the faces of Kappelturm with respect to the North. The entrance door is found in the West face.

FIGURE 3: Dial number 8 in the South face. The site of the style is found located in the horizontal fissure which passes through the centre of the two semi-circles.

FIGURE 4: Accompanied by the date of 1619, the lower dial on the East face could constitute one of the first tentative attempts of the watch-keeper to fix the hours.

FIGURE 5: The only dial of the West face is particularly deceptive.

FIGURE 6: The vertical trace of the meridian crosses the dials no's 4 and 5 on the South face. Here is the no 5 dial of figure 7.

FIGURE 7: Disposition of the dials 1 to 9, and the meridian M on the South wall. The circle T indicates the fixing point of the end of the style of the latter.

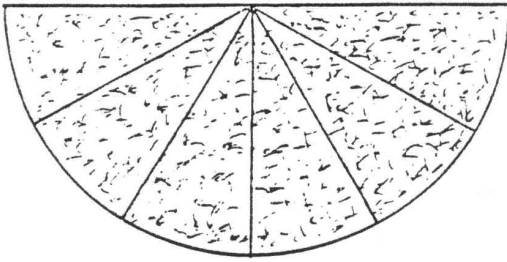


FIGURE 1

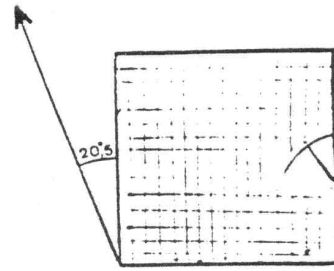


FIGURE 2

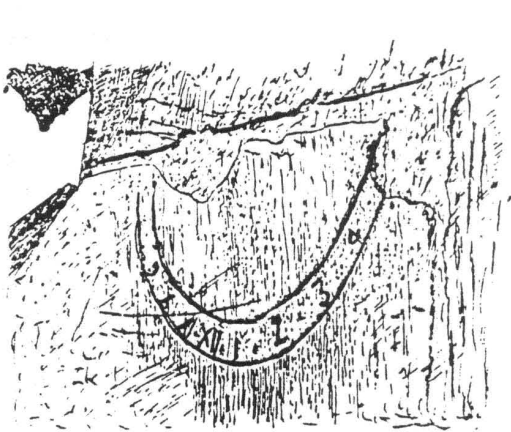


FIGURE 3

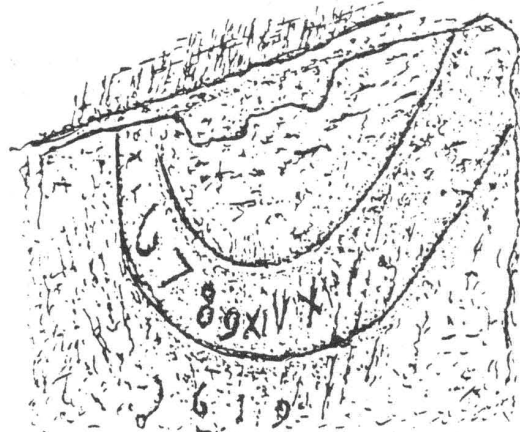


FIGURE 4

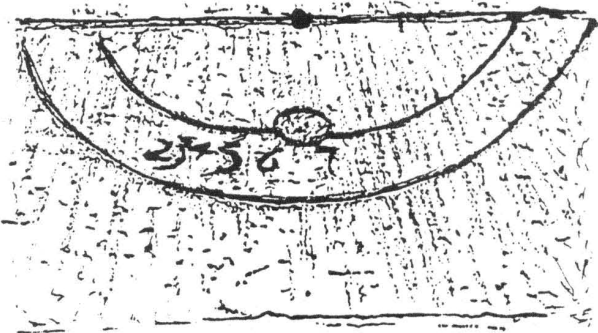


FIGURE 5

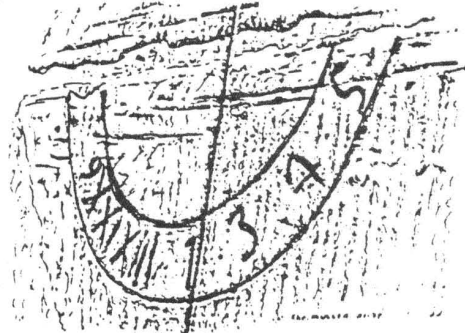


FIGURE 6

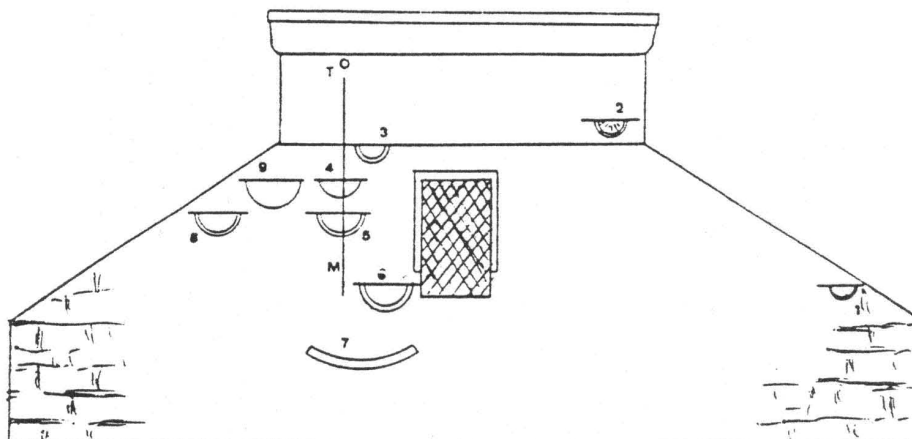


FIGURE 7:

SUNDIALS OF THE KAPPELTURM AT OBERNAI

LAMBERT'S CIRCLES

This most interesting article by M. René R.-J. Rohr was published in *Bulletin* No 98.1. The list of references quoted in the article was unfortunately left out, nor was there space left to include it in *Bulletin* No 2. For the benefit of members it is given here, together with an illustration of the sun compass depending upon Lambert's proposal [see next page].

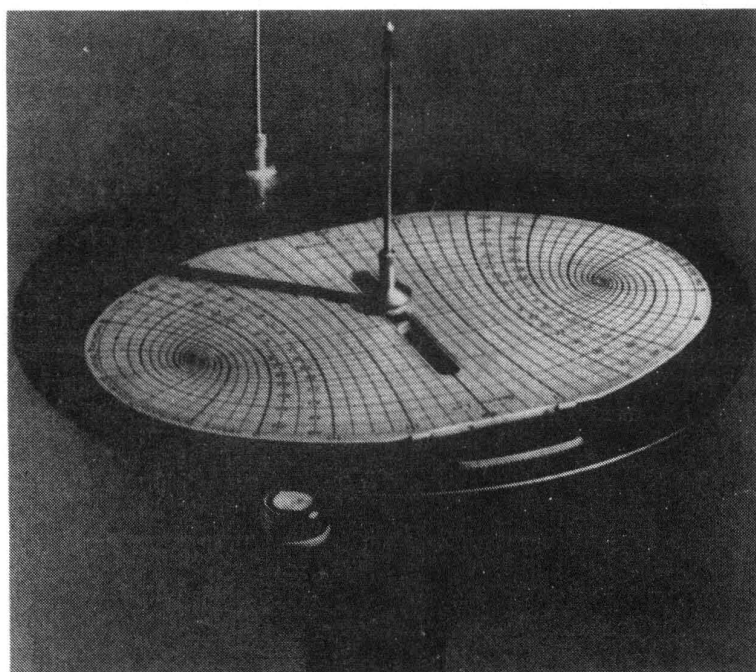
NOTES

1. Another analemmatic sundial ascribed to Parent. It is the projection of the equatorial dial in the plane of the meridian; see *Les Cadrans Solaires*, René R.-J. Rohr, 1986, page 123.
2. "Der SonnenKompass", René R.-J. Rohr, in *De Zonnewijzerkring*, Bulletin XVIII, 1983, page 850.
3. At the points of intersections of the curves, their tangents are the bisectors of the interior and exterior angles formed by the lines going to the focii.
4. *Les Cadrans Solaires*, René R.-J. Rohr, page 118.
5. In a later consultation of the text of (6), I have gained the impression that Lambert must have had no knowledge of the Parent's universal dial.
6. *Beyträge zum Gebrauch der Mathematik und Deren Anwendung*, J. H. Lambert, 1770, 2nd part, page 314.
7. *Astronmische Instrumente*, Zinner, 1956, page 422; Rohr *op.cit.* page 124.
8. I had not met the expression *Lambert's Circle* apart from that in the letters of my friend (J. Emonet, Saint-Martin-le-Vinouse, Isère). Lambert himself does not mention the circle except in an off-hand fashion in a geometric explanation, "It is useless", he says, "to remark here that the points L, F, G, F' and K are all on the circumference of a circle, because this results from the fact that GL and GK are perpendiculars".
9. Figures 2 and 5 are due to M. J. F. de Vries of

Eindhoven in the Netherlands who has used a computer programme to produce these designs from this equation and together with equations (I) and (II). I am, moreover grateful to him inasmuch the impossibility for me to execute the drawings to the required accuracy delayed this present study for some years.

10. Rohr, *op. cit.*, page 120: Remark.
11. The arcs of the circles for these declinations have been carried out in the computer design by the author and have no pretensions to the same accuracy.
12. There is a most excellent illustration of the "Sun Compass" manufactured by the Adams Instrument Company of Michigan, USA, shown on page 29 of *De Zon Als Klok - Zonnewijzers* by J. A. F. de Rijk, Utrecht, 1983, reproduced below by kind permission of the author.

Quite a number of members have commented that they found difficulty in understanding the mathematical treatment in the explanation of Lambert's design. This is understandable since the level of mathematical understanding required is rather higher than most of us older members have been able to retain from our student days, whereas younger members with the required level of mathematical expertise experience no difficulty whatsoever. Therefore there are two possibilities, either back to mathematical studies for a time, or accept the results as found. Alternatively if some members would like to submit a simplified approach which would allow the less learned of us to proceed to an understanding of Lambert's proposal in smaller and simpler steps, the editor will be pleased to publish it at a later date or send a copy to those who have expressed an interest in M. Rohr's article.



The Sun Compass developed by P. A. Koning of the United States to allow the tanks of World War 2 to be able to navigate in the Sahara Desert.

A BOULBY SUNDIAL AT WALTON HALL NEAR WAKEFIELD BY ROBERT B. SYLVESTER

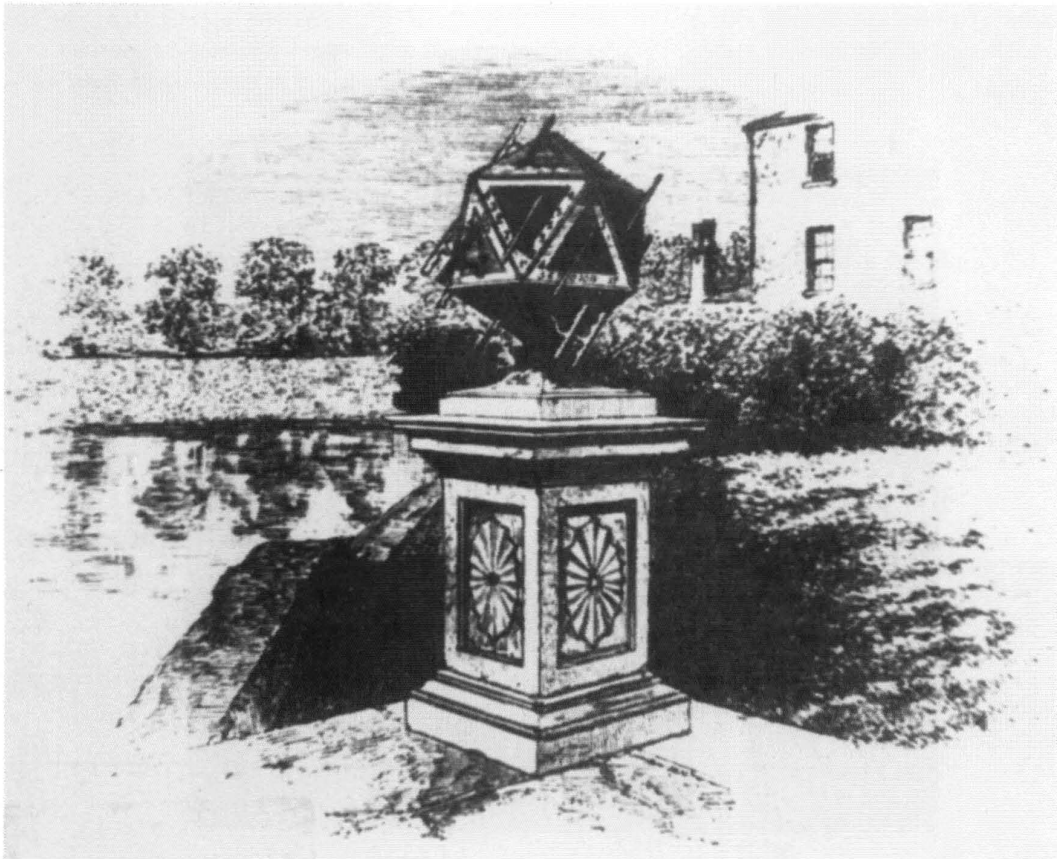
Walton Hall is a country house situated a few miles to the south-west of Wakefield in West Yorkshire. Its setting is unusual in that it is built on an island in a small lake, access being gained over a small wrought iron bridge. The current dwelling dates from 1770 and was built by Thomas Waterton to replace an earlier house. Its claim to fame today is the fact that its most celebrated occupant was Sir Charles Waterton, son of the builder, who was a traveller and naturalist of considerable standing. As a young man, Charles Waterton journeyed to South America and Antigua as well as remote parts of Canada; and his enquiring mind contributed to the growth of natural history as we know it today. The Waterton National Park in South West Alberta is named after him as a lasting monument.

Back at Walton Hall, Charles Waterton set about recording his discoveries and in true Victorian fashion, practiced the art of taxidermy on the creatures brought back from his travels. As a taxidermist he was acclaimed, although many criticised him for misapplication of his talents for dabbling in assembling contrived animal parodies on occasion, as savage illustrations of the political issues of the day. He was rebuked by fellow naturalists who considered the popularistic style of his books as unscientific, but he pointed out that his science was sound and, unlike many of his contemporaries, he had experience in the field.

Charles Waterton was, in many ways, a man ahead of his time. He was a conservationist, who encouraged wildlife by creating a nature reserve in the parkland surrounding Walton Hall, in the unlikely setting of the

industrialized West Riding of Yorkshire. In his later years he was both revered and misunderstood. He tended towards eccentricity, whilst his manner and shabby mode of dressing excited comment which deeply hurt him. In this conservation conscious age, such is the current interest in his work that in 1989 another biography was published on his life and work, as well as a display in Wakefield Museum. His presence in the latter was illustrated by an enduring image based on a painting of him as a young man sat astride a cayman in the swamps of Guyana, his native helpers muzzling and restraining the great beast.

Waterton's association with sundials stems from a chance meeting with the stonemason George Boulby. Dr Richard Hobson, in his book *Charles Waterton, his Home, Habits and Handiwork*, (1966), recounts the meeting between these two men. Waterton had been out hunting (an arguably questionable pursuit for someone dedicated to conservation!), when on his way home he passed through the village of Crofton and noticed the sundial outside Boulby's house. It transpired that Boulby was untutored, having taught himself his craft, but as a young man he had an insatiable desire for self-improvement, and having saved a little money, he bought himself some of Plato's works. From these he was intrigued to learn that any solid could be reduced to a shape consisting of twenty equilateral triangles, whereupon he obtained a globular stone and reduced it to such a form. He then proceeded to carve a dial on each face to tell the time in as many parts of the world, with up to ten dials functioning at any one time. Boulby only asked a meagre sum of his handiwork, but so



BOULBY'S SUNDIAL IN THE GROUNDS OF WALTON HALL

delighted was Waterton with the manner of its execution that he gave Boulby twenty guineas.

Miss Kate Taylor wrote an acclaimed series of articles on local history for the *Wakefield Express* in the mid-1970's and they were subsequently published in book form for the European Architectural Year. One of these articles deals with Walton Hall, with remarks about this distinctive sundial, describing it as 'unique'. Whether this is indeed the case, I cannot say, as I have seen illustrations of several multi-faceted sundials, but there being another sundial consisting of as many as twenty individual dials on a solid made in accordance with a theræom of Plato's seems most unlikely.

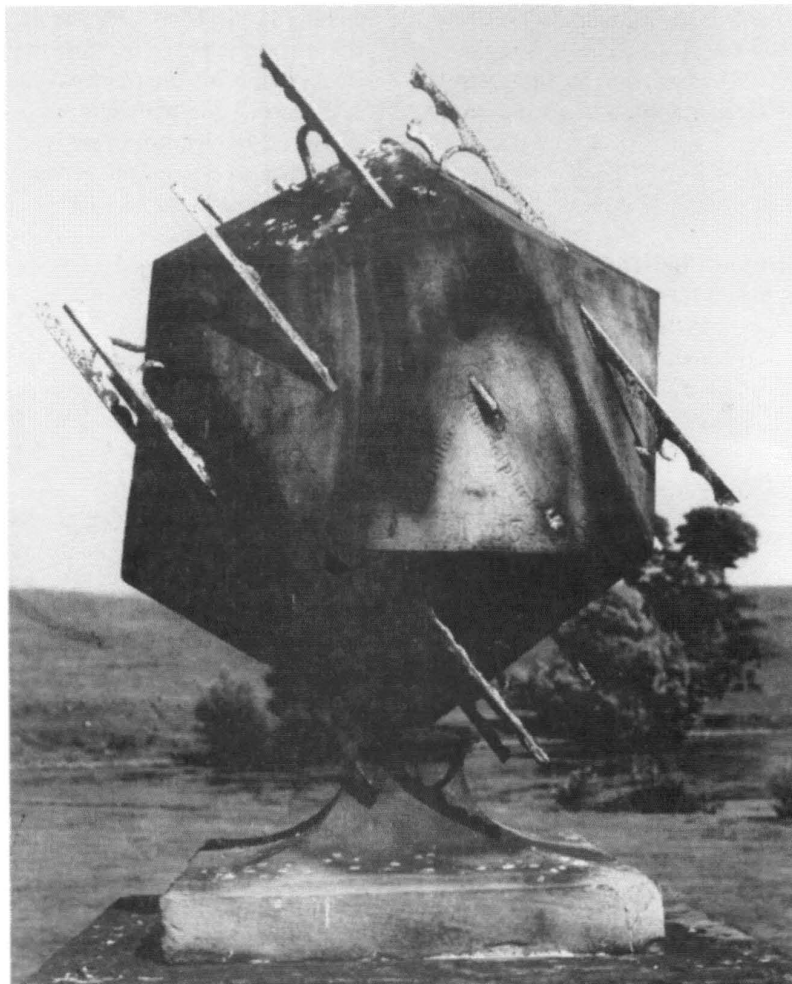
I visited Walton Hall recently with the express intention of examining this sundial. It is situated close to the house on a low grassy hillock, and as one approaches it, particularly if it is backlit, it takes on an eerie appearance as it bristles with its multitude of gnomons. The sundial dates from 1813 and is of sandstone, mounted on a carved pedestal of the same material. The instrument is fitted with a polar axis which doubles as a pair of gnomons, and about sixteen of the original gnomons survive; the missing ones are presumably the victims of vandalism. The dial faces are still readable but the carving is none too deep. Each face, apart from the one designating the dial's location, is marked for the part of the world to which it is specific. The location-specific dial also carries curves delineating the sun's passage through the zodiacal constellations.

The sundial seems to sit precariously on its pedestal although close inspection reveals there is a reinforcing rod

to hold it firm, made visible by slight cracking in the stonework. The design on the pedestal has suffered marked erosion, although the dial itself is in a fairly good condition for its age.

Shortly after my visit to Walton Hall, I spoke about sundials to the astronomical society in Lancaster and featured the Boulby sundial in the talk. I was very surprised when a member of the audience introduced himself as a teacher at Stonyhurst College in Lancashire and pointed out that Charles Waterton was one of their most famous old boys. [In fact, at the exhibition in Wakefield previously mentioned, much of the Waterton memorabilia displayed was on loan from the college]. Could Waterton's interest in sundials have dated from an early age? There is also another intriguing connection. For many years, until the better-sited American observatories took over, Stonyhurst College occupied a very prominent place in solar work and astronomers still refer to Stonyhurst Disks; an aid to recording solar observations. Perhaps Waterton's interest in sundials was fostered at Stonyhurst, a college which was to achieve an enviable reputation for solar studies later.

Walton Hall passed out of the hands of the Waterton family many years ago and has been used since for such varied applications as a maternity hospital and a water-skiing centre. It is currently used as an exhibition and conference centre. Judging by the care lavished upon the house itself and adjacent leisure facilities, should any restoration work on the sundial be contemplated by anyone, I am sure it would be greeted favourably by the present owners.



THE PRESENT CONDITION OF THE BOULBY SUNDIAL

BOOK REVIEW

Easy to Make Wooden Sundials - Instructions and Plans for 5 projects. Milton Stoneman, 38 pages, 24 figures in the text plus five plates for cutting out, cover illustrations in colour. This was first published in 1982 by Dover Publications but has resurfaced in several book stores. ISBN 0-486-24141-6.

There is no doubt that the construction of the various types of dial is as good an introduction to the art of gnomonics as any for those who have little experience. This booklet is a painless method of entry into the world of dialling, the major drawback being that it is written for those in the United States and some parts of North America.

Step by step instructions are given for making actual examples of horizontal, direct south vertical, folding equatorial, bowstring equatorial and diptych sundials. Templates for marking out the various parts are provided, intended to be used by transferring the lines by means of carbon paper so that they may be used again and again. An outline of how to design and make your own pocket dial is included. Generally the material used for the dial is wood, but there is an ingenious conversion of a metal shelf bracket to form an attractive gnomon.

A small amount of history is given, with sections later for dial correction, equation of time, longitude, magnetic variation and hour angles, rounded off with a bibliography and a list of sundial mottoes. What more could one ask for a price of only 2.95 dollars in the States and £2.80 in England? Those who visit the Science Museum in London will find copies by passing through the Science Museum shop to the right of the internal entrance, into Dillon's book store. No museum entrance fee is required to go into the sales areas.

* * * * *

Clockmaking in Oxfordshire 1400-1850, Dr. C.F.C. Beeson. Third edition published by the Museum of the History of Science, Oxford, 1989. This has a new introduction and index by A. V. Simcock. 8vo, viii + 193 pages + 19 page index, 37 plates and folding map, card covers. ISBN 0-903364-06-9. Price £20.

This is not a book on dialling as such, rather, as A. V.

Simcock states, it is one of the first attempts by an horologist to put meaning into the scattered hotch potch of the remaining horological items in a county. Amongst the wealth of mechanical clocks described is a small section, pages 76-80, which details the sundials in Oxfordshire. Many of these have, alas, now vanished for ever and would, but for Dr Beeson's patient research, probably have remained undescribed also. Some of those listed are hanging on by the skin of their teeth, as those who attend the Oxford symposium will discover. For example the dial on the tower of Exeter College, the venue of the meeting, is very faint and not immediately apparent to the casual observer. Other dials, such as the Pelican dial of Corpus Christi College, have been described since in much better detail than that given by Beeson. Dr Philip Pattenden's research into this dial and his two booklets are regarded by the writer as masterpieces of collation of data, logic and deduction.

The work has been greatly improved, without altering Beeson's text, by Mr Simcock's new introduction which gives an outline of the life and career of the author; and more particularly by a greatly expanded index which enables the information to be retrieved rather more easily than the original meagre listing. Although the pages are sewn in, the use of card covers restricts the opening of the pages. Good bindings add too much to the price to be viable for horological works to this nature.

As Oxford was the Mecca of those interested in dialling in the 16th, 17th and 18th centuries, the book is worth acquiring even by those not interested in mechanical clocks, but it is worth remembering that it is only in recent decades that the partnership of sundial and mechanical clock was brought to an end with the advent of electrical communications allowing accurate time signals to all parts of the country.

Further details of the book will be found in the pamphlet included in the last *Bulletin*, the book may be ordered from Rogers Turner Books Ltd, 22 Nelson Road, Greenwich SE10 9JB. An invoice will be included with the book on delivery. Those living near Oxford will be able to collect a copy from the Museum of the History of Science, Broad Street, Oxford OX1 3AZ. Those who patronise other booksellers will be able to order through them in the usual way.

NATIONAL SURVEY

I have a growing collection of records sent in by many of our members but as yet not really enough to make a reasonable list for any one county - with one or two exceptions. I was hoping to publish some county lists with this *Bulletin* but I'm afraid that it will be another month or two before the lists are ready.

I know that there are members dotted about the country who have, over the year, made up their own lists. Even if these only give the location of dials we would like to incorporate these into the survey as they could be used as a basis on which to build. It would be much appreciated if

those concerned send me a copy of their records. I will see that they are acknowledged.

I would like to thank all those who have returned forms, whether just one or two or a whole batch, but particularly three members, Neville Rodber, Robert Sylvester and Graham Ferris who have been specially prolific. Several members have sent in constructive criticism and we shall be discussing the way forward at the AGM at Oxford.

DAVID YOUNG

A PROGNOSTICATION BY LEONARD DYGGES

The first published issue of *A Prognostication* ... was in 1553, of which no copy is known to exist. The second edition was in 1555, of which the full title is:

A PROGNOSTICATION of right good effects, fruitfully augmented contayninge playne, briefe, pleasant, chosen rules, to judge the wether for euer, by the Sunne, Moone, Sterres, Cometes, Raynbowe, Thunder, Cloudes, with other Extraordinarie tokens, not omitting the Aspectes of Planetes, with a brefe Iudgment for euer, of Plentie, Lacke, Sickenes, Death, VVarres &c. Openinge also many naturall causes, woorthy to be knowen, to these and others, now at the last are adjoynd, diuers generall pleasaunte Tables: for euer manyfolde wayes profitable, to maner al men of any vnderstanding: therefore agayne published by Leonard Dygges Gentylman, in the yeare of oure Lorde. 1555

The little book was printed in London within Blackfriars by Thomas Gemini, see *Bulletin* 89/2, November 1989 page 15 for other details.

There are a number of references in the work of interest to diallists, but items no's 19 and 20 in the list of contents are dealt with here:

19. The houre of the daye doeth playnly appeare by right shadow: that is, by anything directly standing vp, and also by shadow Geometrical, whiche is squyre shadow ... page 64.

20. The exact houre of the nighte is pleasantly searched by Sterres and Tables calculated with an instrument appointed for that practice. The instrument is a perfect Dial for the day of al other the gronde, whose makeing, reringe, placinge, and use is playnlye opned. ... page 65.

However, in order to gain some idea of the conditions under which Leonard Digges published his work, his Dedication and Foreword, in which he hints at his late difficulties, are reproduced here.

DEDICATION

To the right honorable, Sir Edward Fines, of the noble order of the Garter Knight, Lord Clinton and Saye &c. Leonard Digges wissheth continuance of health and daily increase of honor. (.:) [The significance of this sign is not known].

Sithe my late troubles (right honorable, and singular good lord) my dutye hath made me careful to procure, that some frute of my studies might declare me thankfully mynded, towarde youre lordshippe, emonge other honorable, to whome I owe my self, with all my fredome of study, and frutes of endeour. For the performance whereof, not onely your Lordshippes late talke of a Prognostication, seemed to make that argument fittest: but also the manifest imperfections, and manifold errors yearly committed, did craue the ayde of some that were both willinge and able to performe the truth in like maters. I thought it therefore worthy the labor, truly and brefely to collect many thinges, both necessarie and pleasant, as well for Nobilitie as for others; and to adioyne them to my general Prognostication, imprinted the yeare 1553, augmentinge diuerse wayes the same; and more orderly placing such as were befor set forth. Your honor shal here receaue, in this little boke, by

infallible rules taught, for euer, a truthe of all such thynges as heretofore haue put forth of other for one yeares profit onely, compelled thereby of necessitie to make a yearly renewinge of them; wherupon errors many increased. You shall haue diuerse other conclusions generall, of none before attempted. These (right honorable lord) according vnto my dutie, I do present, and besech you in good worth to receaue; and haue willed them to passe under protection of your Lordshippes name: that yf to any, any commoditie ensue thereby, such as receaue it may have cause to further me, in yeldinge thanks to youre honor.

TO THE READER

To auoyde (Gentle reader) the yearly care, trauailes and peines of other, with the confusions, repugnances, and manifold errors, partly by negligence, & ofte through ignorance, committed: I haue agayn breefly set forth a Prognostication general, for euer to take effect: adioining thereto diuers profitable collections & many pleasant conclusions, easy of all willing ingenious to be perceyued. Here note (Reder) wher as the eleuate Pole, & Meridian should be considered: in this work it is performed for London: because I wisse this Meridian, Situation, or Clime the exact truth of thinges. If any yearly practises in lyke maters, agree not with my calculations: be assured, they are false, or at the least for other Eleuations, or Meridians supputated, and therefore little seruing thy purpose. And that the late rude inuentions, and grosse deuises of some (this yere, and two yeares past, published) might be of them perceued, then filed, and so serve to some profit: I haue purposed even now to put forth a boke named Panauges, well serving their turne, and so generally, and most exatly all Europe, pleasant, profitable to the learned and no small delight to all maner men. An other boke is also redy to come to thy handes, titled Tectonicon, a treasure unto the Masons, Carpenters, and Landmeaters: correcting their olde errors, wrongfully rekened of them as infallible groundes: teaching faythfully, sufficiently, and vey brefely, the true mensuration of all maner land, tymbre, stone, bourde, glasse, &c: and at the ende conteining an Instrument Geometrical, appointed to their use. Take in good worth these labors (Louing reader) and loke shortly for the pleasant frutes Mathematical, euen such as haue ben promysed by my frendes, and partly by me. Neither shall my desire to profit here stay: but extendeth farther to procede, yf these seme accepted. As the good wil of Printers not had, hath kept the foresayd from you: so I trust that willing minde and excellencie of Thomas Gemini, shal bring them shortly vnto you. Certes my hope is, while life remaineth, not to be unfruteful to this commune wealth, with study, and practice.

PROFITABLE RULES AND TABLES

Howe the houre of the day, by right shadow, that is by any thyng standing up, is knowen: and by Squyre shadow also.

First it behoueth you to haue a staff, or any other thyng, diuided in twelve equal partes: and eche portion in 6. other: so are those last partes 10. minutes a pece. When ye list to haue the hour, set vp directly youre diuided staff, on a playne leuell gronde, bourde &c. Note the iust length of that shadowe, what partes and minutes it containeth. With those, enter your moneth in the peculiar *Kalendar*

folowynge: beholdinge diligentlye vnder the name fo that moneth, the small enclosed Tables: consideringe well, whiche of those smal Tables are nerest vnto youre day: and that iudge by the signe, or daye there noted. That table serueth youre purpose: where you must loke oute the parts and minutes of the shadowe afore founde, or nere vnto it, under or ouer the which the hour is set, before, or after noone. Note that two pryckes there signifie half a part more than is noted: one prick, half a parte lesse. Here it is also to be noted, that euery Table hath within twoo rowes of figures: the upper is for the staf: the other is for the squyre shadow. And whatsoever is before sayd of the one, that same is ment here of the other, sauing of the *composition*. For the squyre must be diuided from the inward angle, to the ende of one side, in 12. equall partes: even so from that angle, the other side into 24. lyke parts, as this figure sheweth. These to the wytty suffice.

The above passage modernised:

First it is necessary for you to have a staff, or similar, divided into twelve equal parts, and each part sub-divided into 6 more, each of which is 10 minutes. When you wish to know the time, set your divided staff vertically on plain level ground, a board, etc. Note the exact length of the cast shadow, and what whole divisions and minutes it contains. With these, select the month from the following calendar, and select the nearest value in the small table to that you have measured, before or after noon. Two dots after the value denotes + 1/2, one dot - 1/2. Each small table has two rows of figures, the upper for the shadow of the staff, the lower for the shadow of the square. The instructions for each are the same except for the markings. The square must be divided from the internal angle to the end of the smaller side into 12 equal parts, the other limb divided into 24 equal parts as shown in the figure. These instructions suffice for the intelligent.

The Peculiar Kalendar

	5	6	7	8	9	10	11	12	
1	108	123	142	165	190	214	60	71	From evening to midnight.
5	112	128	148	172	198	220	61	75	
10	117	135	157	182	207	228	67	78	
15	123	142	165	192	214	234	71	81	
20	129	150	175	200	222	240	75	86	
25	136	158	183	208	229	244	79	90	
30	142	166	192	215	234	249	82	94	
January hath XXXI dayes									
From midnight vnto day.	82	94	106	121	142	168	198	—	1
	86	97	111	127	149	177	206	—	5
	89	101	116	134	157	187	214	—	10
	93	105	122	141	168	198	223	—	15
	98	111	128	150	179	207	231	—	20
	102	117	135	159	189	216	237	—	25
	106	122	143	169	200	223	243	—	30
	1	2	3	4	5	6	7	8	

		12	11	10	9	8	7	H	
Day	10	Staffe	36:	39	49:	83	550	0	Shadow 0
		Squire	4	32	3.	2.	0	0	Shadow 0
		H	0	1	2	3	4	5	
	19	Staffe	32.	34	42	65:	109	0	Shadow 10
		Squire	4:	4	3	2	1.	9	Shadow 10
		H	0	1	2	3	4	5	
	29	Staffe	27:	29:	35:	52	119	0	Shadow 20
		Squire	5	5.	4	3.	1	0	Shadow 20
		H	0	1	2	3	4	5	

[NOTE: The Table presented here is sufficient for the month of January only, another eleven similar tables are necessary for the rest of the year - February to December,

inclusive. It seems a very cumbersome system of determination, and the author does not cite a single example of its use in elucidation.]

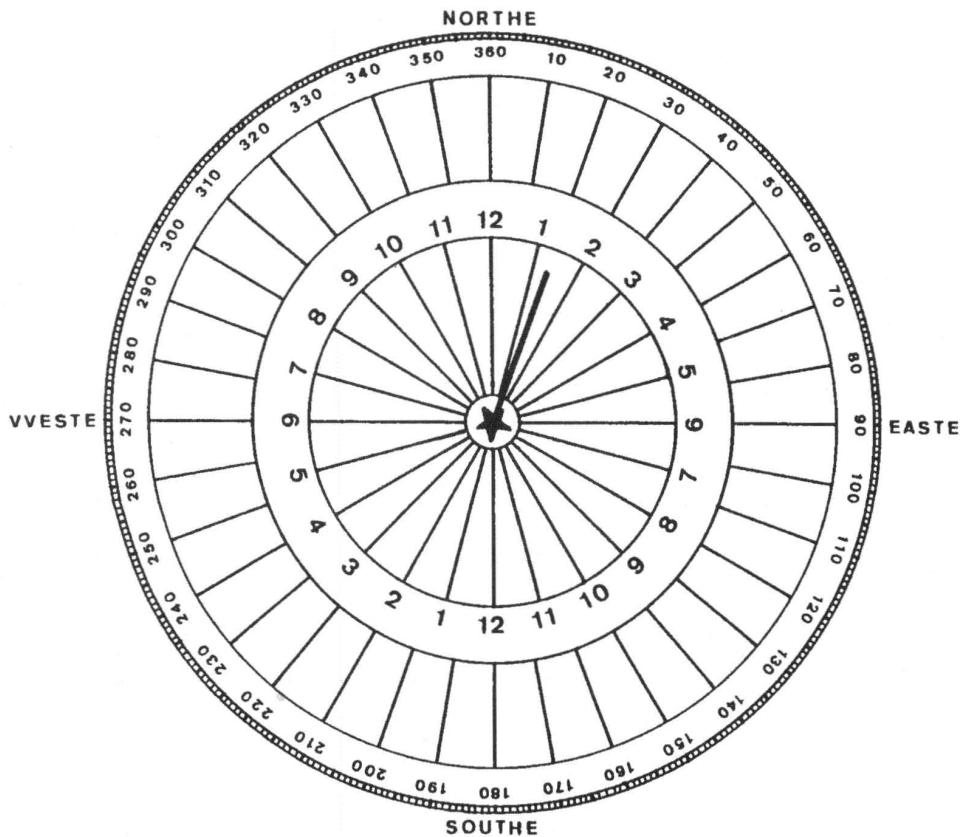
The composition of an instrument, for the houre of the night: which is also a perfect Dial for the day.

The takinge of an *Altitude* supposed, I coulde exactly in fewe (and that without an instrument) satisfie. And for want of that knowledge, make vpon a playn bourde, or rather fine plate, a circle: the bygger the better: part it into 360. portions, thus:

The circle made, divide it in 6. not moving the compasse: then every of them in 6.: and eche of those last in 10: so haue you 360. partes. Then *Character* it, begynning at the North thus 10. 20. 30. &c. (as in the figure) towards the East, ending with 360. Nowe laye a ruler on the centre, even with some diuisions, drawing thorowe to the extremes of the circle, a lyne. Then crosse

that with an other. These two must diuide your circle in 4. equal partes; which lynes shewe the very *Easte*, *VVest*, *Northe*, and *Southe*, when by a *Meridian* or *Square Diall*, with a nedel rectified, they are placed. Now to ende, set a small streyghte wyre a foote or more long plumme upright in the centre: and there fasten it. Thus this *instrumente* is finished, to be fixed about your house, *equidistant* or leuil with the *Horizon*: hauinge a nedell, yf ye lift, in it, trewlye to plage it, when and where you will. That it may be also a *Dial*, you muste pull streyghte lynes from the centre, to euery fyftenth part: decking them with *Characters* in the inwarde margent, conueniently as ye see the figure. Thus when the *Sunne* shyneth, the shadow of the wyre, sheweth the trew houre &c. beynge trewlye plageg, wel placed, and rered, as foloweth.

A perfecte instrument for the day, and the night



The right reryng, and placing of the Dial tofore mentioned.

Lift vp hansomely, youre instrumente or *Diall*, towarde the Northe, in some meete place, the side of a sqyre lyenge on it, vntill the plummet and lyne, centred in the extreme vpper part of the other side of your sqyre side lyke long, cut all that square side whiche lyeth on your instrument, the

fifte part onely except. The moue your instrument, hither and thither, this or that way, vuntill the shadow of the wyre falleth upon the houre of the day, kepyng diligently you heyth before. Your *Dial* thus fixed declareth, all the yeare longe, the exacte houre and partes thereof. No *Dial* in truthe excelleth this. Haue in remembrance, that this instrument must lye level, nothing at al rered for the houre of the night by sterre.

The above passage modernised:

Well incline your instrument or dial towards the North, in a suitable place, until the plumb line on a square placed on the dial cuts four-fifths along the side of the square placed on the dial. [This causes the central wire to point at the Celestial North Pole in the latitude of London.] Next rotate the dial until the shadow of the wire indicates the correct time, keeping the angle of inclination constant. The dial being fixed in this position will indicate true time at all times of the year. [The dial would have to be marked on both sides for this purpose.] No other dial is better for the purpose, but remember that for finding time at night by the stars, the dial has to be set level, and not inclined.

To get the exact heure by two sterres of the fyrst light, with an instrument or circle, before diuided, first of me inuented, calculated and practised.

The instrument, equidistantly set and plaged, as is declared in the composition, ye ought to laie the edge of a ruler vnto the wyre, the other nether ende touching the instrument, mouyng here and there, styll touching the wyre, vntyll either *Sterre dothe offer it self* with that edge, and that by the iudgement of the eye. Then put down discretely your ruler (euer touching the wyre) the hynder ende not moued, obseruing how many partes are cut from the *North*, to the edge of the ruler. Entre with them the peculiar *Kalendar* folowyng: sekyng oute your *moneth* placed in the middes of euery Table: then the daye of that moneth must be there founde.

Note that, euerye table hath on the sides, the days thus ordered, 1. 5. 10. 20. 25. 30. Knowe, that order or rowe of figures, which is ryght agaynst, or nerest your day, serveth the turn. The nombre of partes before cut by the *Ruler*, and now found in that row of your table, sheweth the precise hour. If it be to littel, that heure ouer the head or vnder is not yet come: if contrary it is past.

The above passage modernised:

A straight edge is placed with one end adjacent to the wire of the instrument, levelled and orientated as indicated before, the other end is pointed at one of the two bright stars of the first magnitude, looking along the edge of the ruler until one of the stars is found, the ruler is lowered to the dial without altering the direction, and the degrees between the point and North noted. Select the month and day in the 'peculiar Kalendar' and find the nearest value in the table to the observed value, which will give the nearest hour. If the value in the table is too small, the precise hour is yet to come; if too large, the hour is past.

How these two bright sterres, beyng of the fyrst light are found: the one called Aldebaran: the other Airamech.

The best waye is thus: The *moneth* and *daye* knowen, with the *trew heure* of the *nighte*, entre youre Table, consideringe that *moneth* and *daye*: obserue what partes belonge there to that *Sterre* and *houre*. Then resort to your instrument, layeng the edge of your ruler, as many partes belonge there to that *Sterre* and *houre*. Then resort to your instrument, layeng the edge of your ruler, as many partes from the *Northe*, *East-ward*, circumspectlye lifting up that edge, close by the wyre: so the *fayr Sterre* shyneth euen with that edge.

Or thus grossely.

Aldebaran is euer a meate rodde, and more to the eye vnder the 7. *Sterres*, and some what to the *North* of them, in the rysing. *Alramech* is contrarie to him plaged, accompanied with a little dimme *Sterre*, an ell from hym, by the iudgement of the sighte.

The above passage modernised:

Aldebaran is always a meat red and appears to be under the seven stars [of the constellation Ursa Minor which has the Polar Star]. Alramech is situated opposite to Aldebaran, and has a companion dim star, about 45 inches away as judged by eye. [One ell = 45 inches approximately].

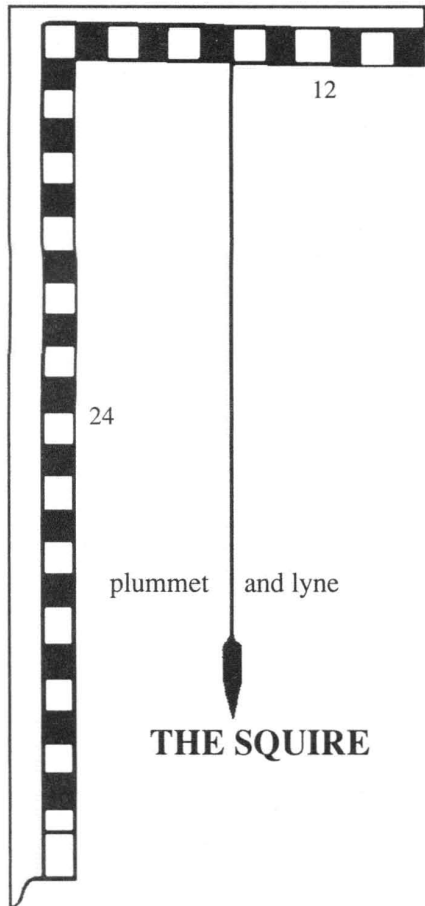
[These two stars are always above the horizon and appear to turn around the Pole Star, forming a heavenly clock which turns with uniform angular rotation. Strictly speaking this gives sidereal time but the values are tabulated for each day of the year to give civil time.]

COMMENTS:

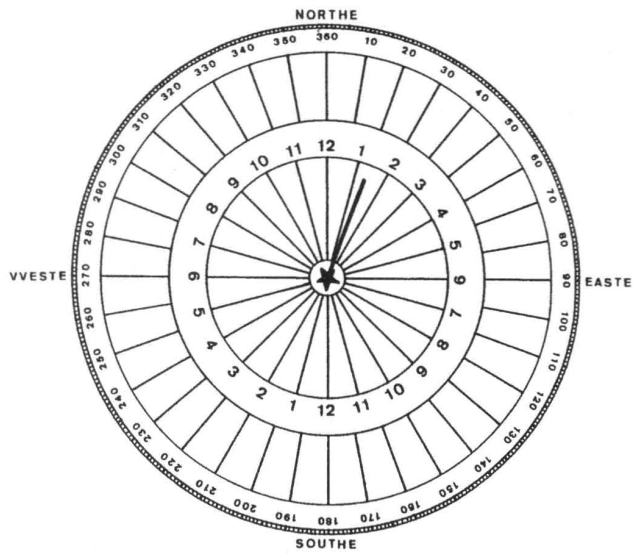
Leonard Digges' instrument is basically a form of equatorial dial with a polar gnomon, hence the uniform hour scale. This form of dial indicates on its upper surface once the Sun has entered the Northern Tropics, and on the under surface when in the Southern Tropics. Digges makes no mention of this, nor does he give more than the basic information on how to set the dial on a true North-South line, ie. to make certain the gnomon is pointing to the Celestial Pole, upon which the accuracy of the indications is completely dependent. At the time the use of a magnetic needle was commonly employed to 'plage' the dial, ie. set it in line with the compass directions; the annual variation in the direction of the magnetic North pole being unknown at the time. Later the bisection of the angle between two equal shadows cast by the sun was preferred to obtain true celestial North, or alternatively direct observation of the Polar Star. The small angular error resulting from the Polar Star not being truly at the Celestial pole can be ignored for a small sundial which can only give an indication to the nearest five or ten minutes; but not for a precision instrument reading to minutes. Digges does mention that the larger the dial, the better.

The use of the dial for taking altitudes of chosen stars is much more crude, and no one having once set the dial for solar readings would want to undo the work merely to ascertain time by the stars. He recommends setting the dial high up, which whilst this is more convenient for sighting stars, is quite inconvenient when in use as a sundial. The error is lowering the rule to the scale to ascertain the angular direction of the star would not be of any great significance since the reading would only give the nearest hour and, of course, the star could not be sighted without the dial being lowered. The scale of degrees would have to be projected from the equatorial to the meridional plane to give true angular displacement values, for which the 'peculiar calendar' gives correction in converting the observed values to actual approximate times.

The two functions would obviously be better separated than combined. In none of these old outlines of how to obtain time by night is there any hint of how illumination of the instrument scale is provided. It is not advisable to carry out such procedures today, your neighbours would regard these with suspicion.



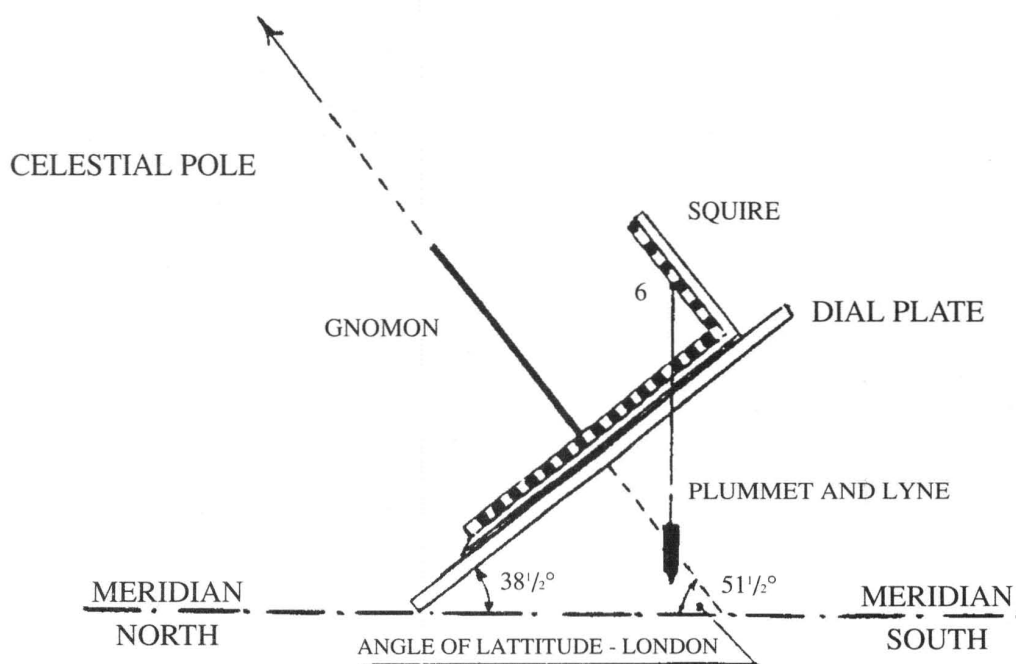
and perfect instrument for the day, and the night.



THE DIAL

Necessary instruments to find exactly the houre of the day and night, diuerse wayes, with the help of the peculiar Kalendar.

SETTING-UP THE INSTRUMENT AS A SUNDIAL



LOOK AT IT THIS WAY

This paper is about the first step in the choosing, designing and assessing the performance of the commonest dials, those having a style parallel to the earth's axis and a flat dial surface; and approaching this in a way which may be new to some diallers at least. Such dials may differ from each other in one essential respect only, the magnitude of the "regime angle", ie. the angle between the style and dial surface, (see figure 1).

A shadow regime is, in general terms, a record of the daily sun-shadow paths traced on a fixed flat surface in the course of a year by a fixed small object, in particular by the tip of the style on the surface of the dial. The distance of the shadow-forming object from the surface is immaterial as it only affects the magnitude and not the form of the regime.

As the styles of all such dials are parallel and remain fixed in direction, all that the designer can do to change the regime angle is by tilting the dial plane, nevertheless by doing this he can achieve all shadow regimes possible.

Now for the *soi-disant* novel perception: the earth itself is a perfect show case in which all possible shadow regimes are arranged in an intelligent order. This is true in the sense of sun shadows generally and that is why the arrangement is so intelligible, since we are already well aware of how daylight and the length of shadows vary seasonally in different parts of the world. From this it is easy to see how this knowledge can enlighten us about the performance of sundials with differing regime angles.

Commencing at the North pole (figure 2), the dial surface is horizontal and the regime angle 90° , moving down any longitude line the dial surface must be tilted to remain parallel with the tangent to the earth's surface at that point, ie. horizontal. At the equator the dial surface is

at right angles to that at the North pole and as the direction of the style has remained unchanged, the regime angle becomes zero. Moving towards the South pole causes the regime angle to increase once more until it reaches 90° at the pole. The indications on each of these horizontal dial surfaces correspond to the daylight regimes at different latitudes, (see figure 3).

Imagine a level surface of snow at the North pole and the shadow cast by a thin vertical rod. This shadow will rotate at uniform speed in an almost perfect circle; on days following the Summer solstice, the shadow length will increase and become fainter, to disappear at the equinox; reappearing in Spring from an invisible infinity to strengthen to a well marked out circle once more. This is the performance for a dial regime of 90° .

As the dial surface moves south, the regime changes its conic section, first ellipses, hesitating with a parabola at the Arctic circle, on to hyperbolas, steep at higher latitudes and flattening out towards the equator; with the same transformations in reverse order in southern latitudes, thus providing a fully comprehensive display of shadow regimes for the sun-earth relationship where each regime angle is equal to that of the latitude of the dial position.

But wait. There is the question of aspect; how about a dial surface declining east or west? Whilst this makes a difference, it does not effect the regime, for if we take the dial surface round on a line of latitude, the regime would remain the same. The shadow curves would simply be traced earlier or later in Universal Time. Thus it follows that any possible dial can be identified by two numbers: Latitude for regime, Longitude for declination (rotation about the earth's axis).

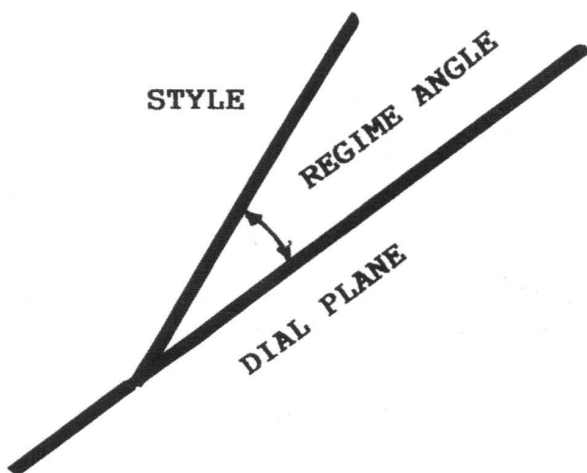


FIGURE 1: REGIME ANGLE

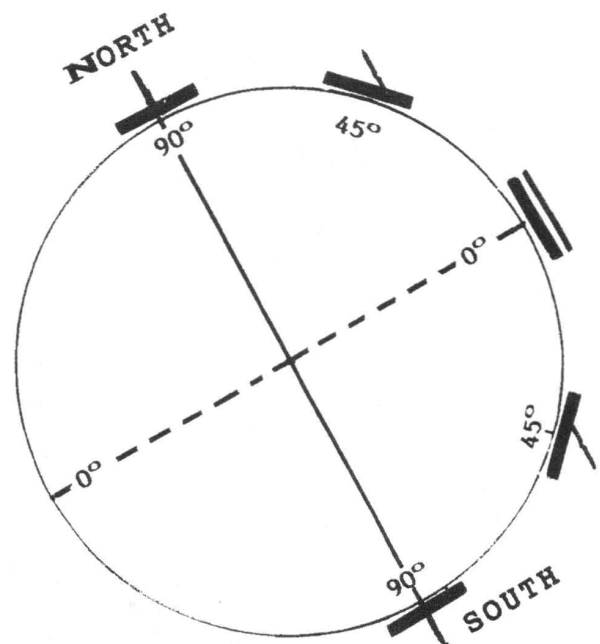


FIGURE 2: REGIME ANGLE/LATITUDE

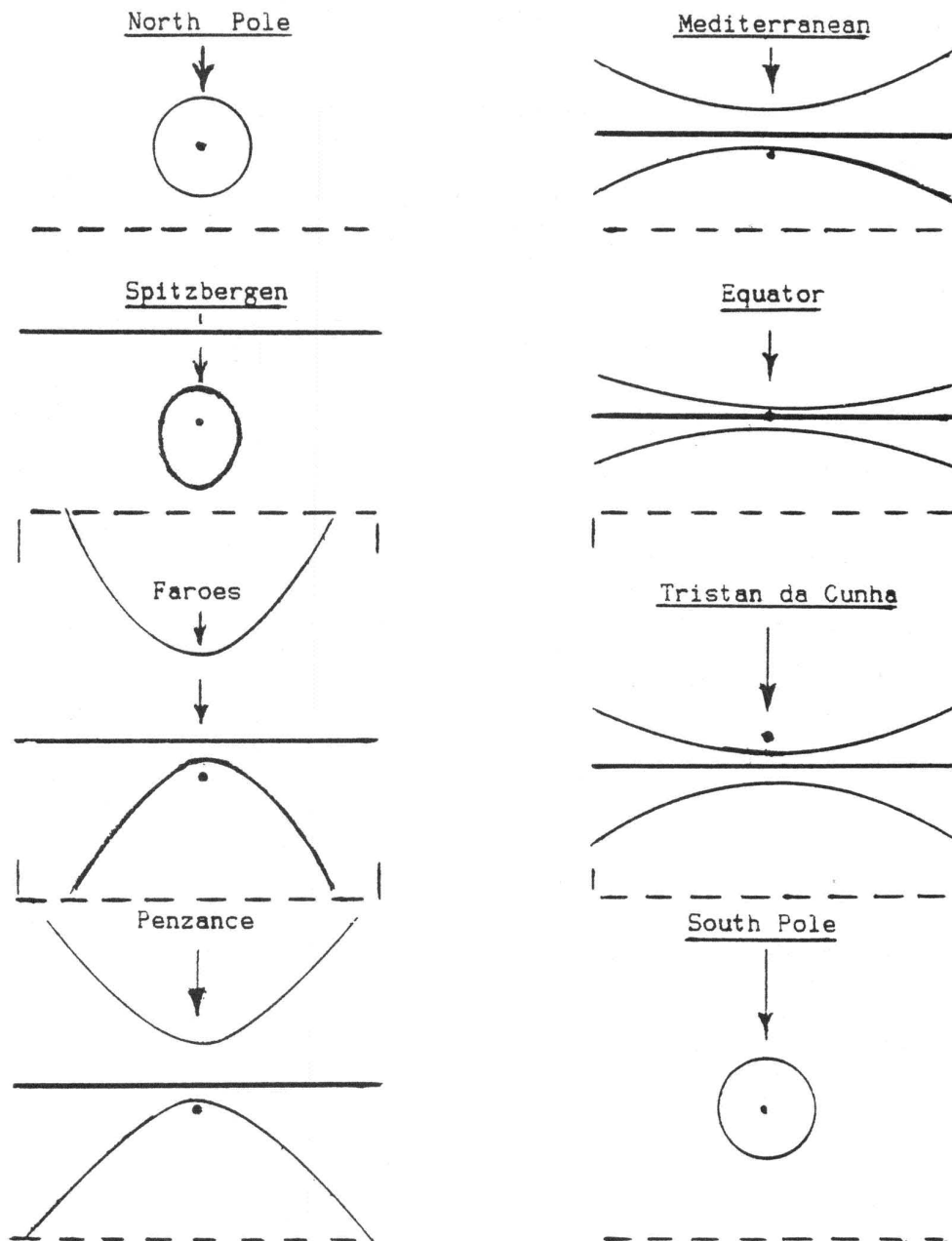


FIGURE 3: Representative curves of shadow regimes on level surfaces the earth at various latitudes

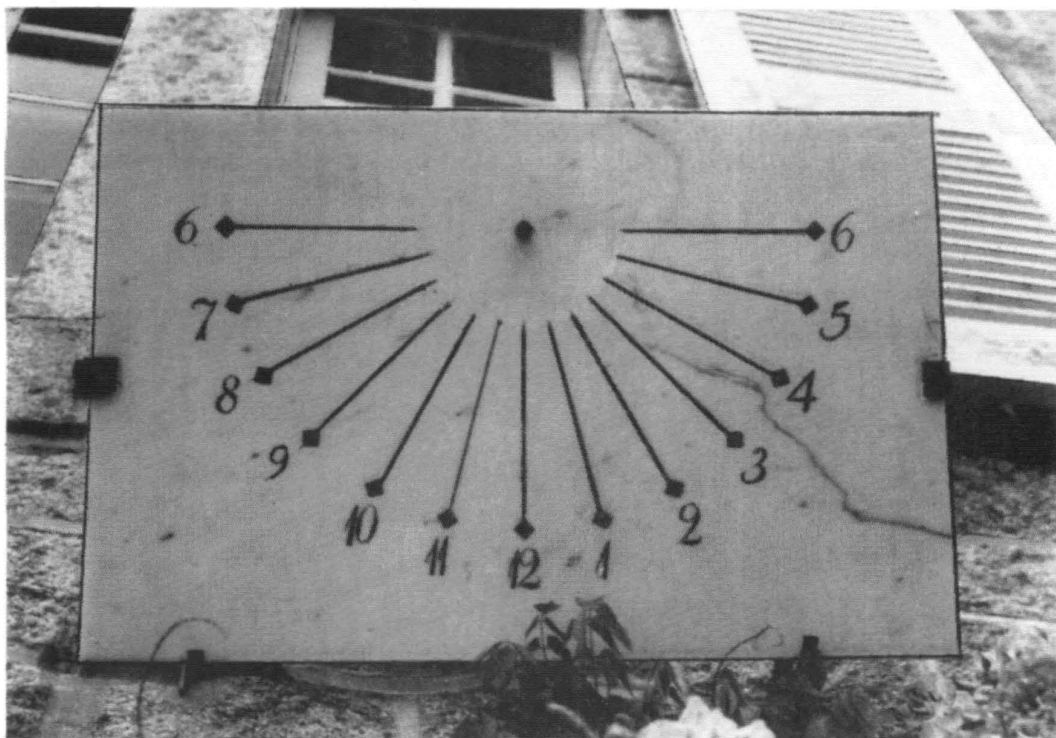
The black dot is the orthogonal projection of the small object casting the shadow from a height of 2.5mm: The straight lines are the shadow curves traced at equinox. The other two curves are traced at the solstices. At and near the Poles, only one two or two curves appear.

A possible confusion may arise here. The identifying numbers are not, of course, those of actual latitude and longitude, they are merely used to indicate the two characteristics of a particular dial, its regime angle and declination. For example you might very well choose to instal a 90°N, 0° declination dial anywhere on the earth's surface.

Consideration of the shadow regime will show the advantages or disadvantages which might result at a particular location, apart from the duration of sunlight available. At 0° latitude daylight is only approximately 12 hours in all seasons, at 90°, summer daylight only. There may be resulting advantages in simplicity, regularity and speed of movement of the shadow, if this is high as in the

90° regime, it is a bonus for intelligibility and precision of indication. Tilting the dial surface may well improve legibility at a distance, and so on.

The best option in many cases may be to have two dials of regime 90°N, 0° dec, and 90°S, 0° dec, and this was my choice for my family garden in south-west Brittany. I call my two dials Peary and Amundsen. Peary stand upon a granite pillar in the middle of the garden looking half upwards north towards the house. During his six months working season shadows of trees from the south do not reach him, and the shadow of his style is as clear in the hour before sunset as at mid-day. Amundsen (my favourite) is slung out from the wall above the kitchen (and carefully secured). His white marble face requires an



Mr. Woodford's "Amundsen" dial above his kitchen door

annual sponging but the original black-painted figures are still quite clear after a decade of winter recording, see illustration. Peary is less fortunate in this respect. Often in summer I have to scour him with a jet from a hose to clean

up after target practice by Stuka-Swifts, a situation not forecast by the theoretical approach to the problem.

G. P. WOODFORD,
Pont L'Abbé, France.

SUBSCRIPTIONS - A WORD FROM THE TREASURER

When our society was formed in May of last year, a subscription of £7.50 was fixed to last until the end of the following March when our first General Meeting of members was due to take place. This amount was arrived at largely by guesswork but based on the likely cost of publishing at least two journals, the starting of a recording programme plus the usual postage and stationery costs (the latter being cut to a minimum, we haven't yet bought printed notepaper).

In the event we have published three Bulletins, have started a provisional recording programme and by the end of March we should have a small but useful surplus. However next year subscriptions will have to last for a full twelve months and we should be publishing four Bulletins instead of three. The Editor tells me he has more than enough material. We would also like to make some modest improvements to the Bulletin, principally in the area of print quality, cover etc.

As the present treasurer I feel it is my duty to advise members at the AGM of the level of subscription that should be set for the year commencing April 1990 and the present committee endorses my view that this should be at least £10 for individual membership and £12.50 for family membership. I am also proposing that overseas members requiring post by airmail should pay a small supplement.

I am well aware that very many members will not, for good reasons be able to attend our AGM and conference at Oxford. I would ask them, if they have strong feelings about the level of subscription proposed to write to me. I will then do my best to bring such remarks to the notice of members present before a vote is taken.

DAVID YOUNG

A GEOMETRICAL PUZZLE

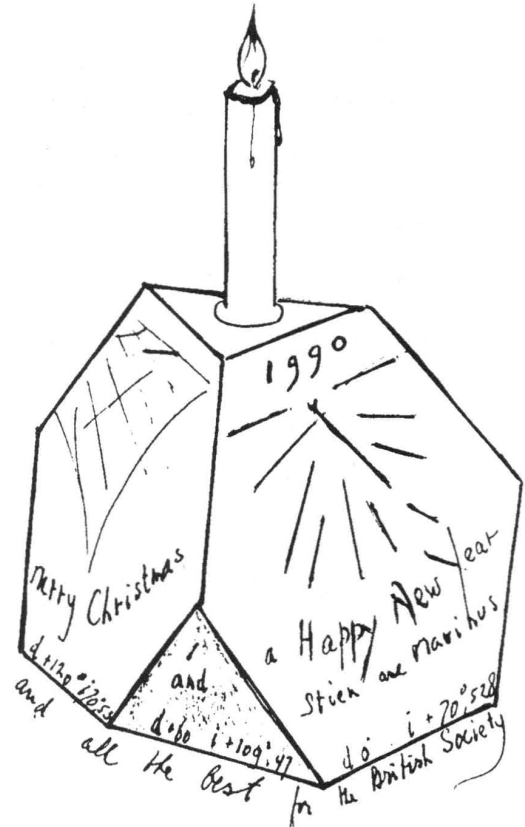
Several readers sent in solutions to the problem set in *Bulletin* 89.2, page 21, some merely delineating the solid, others also adding dials and presenting cut-out constructions. We can only present the most interesting treatment here. One nice solution in the form of a self-illuminated dial was sent as a Christmas card by M. Hagen of *Der Zonnewykerkring*. George Higgs, of Kirkcudbright, Scotland, not only sent the cut-out model printed here, which members may like to make up and fit with the gnomons supplied, but he also gave a complete mathematical treatment of the reclining/declining dials, especially valuable because most of the commonly available dialling books ignore the problem. Two exceptions are Mayall and Mayall who give a geometrical method; and René R.-J. Rohr who discusses the mathematical treatment in some detail. However Mr. Higg's method seems the easier to follow. He writes:

THOMAS DIGGES DIAL 1576

This interesting "body" is, in fact, a tetrahedron with its four apices cut off parallel to the opposite plane faces, to give a total of eight faces, four hexagonal and four triangular. The faces are inclined to the horizontal at about 70° ($\cos^{-1} 1/3$), and the meeting edges at about 55° ($\cos^{-1} (\tan 60^\circ/3)$).

As a sundial the body can stand on either a triangular or hexagonal base, for table mounting the latter is more stable, but the gnomonics are the same in either case. [Peter I. Drinkwater points out that the MS describes them as "inclynatorie", ie. inclining rather than declining, so that the base would have been triangular, which would be more suitable for mounting on a tall pillar.] In plan view there are two main aspects to choose from: either one hexagonal face facing North and the other to two declining from South to East and West by 60° , or one hexagonal plane facing South and the other two declining from South to East and West by 120° . Calculation of gnomon and hour lines is simple for North and South dials but less so for the East and West faces - as indicated by Thomas!

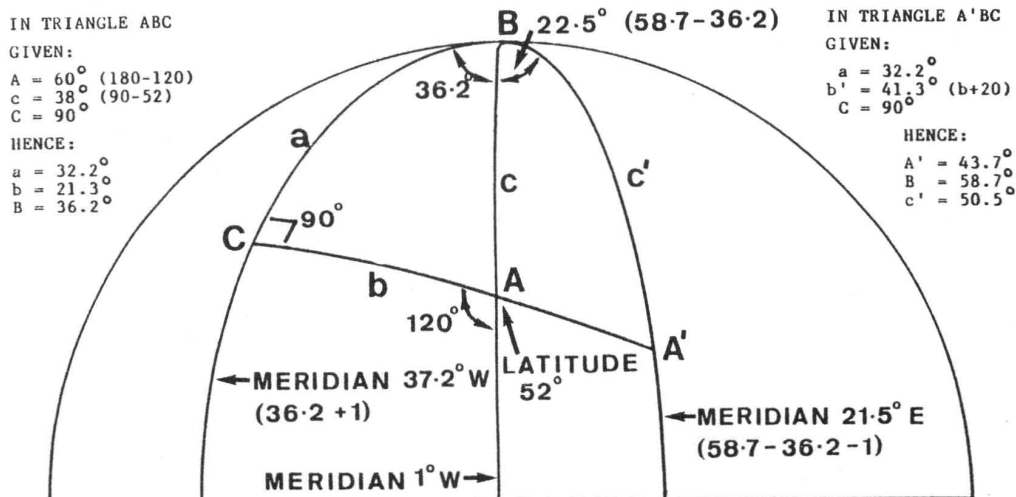
In all cases we transport the blank dial from its "home base" to a new site on the earth's surface where it stands vertical, but without changing its aspect in space. The angles for the gnomon and hour lines are then calculated



for a vertical dial at the new location before returning the dial to its "home base".

For the North and South dials the new site has the same longitude as the "home base" but the latitudes are respectively 20° lower and higher. For the easterly and westerly faces, however, the determination of the latitude of the new sites is more complicated. One method involves the solution of spherical triangles, where a two-stage process enables the use of the relatively simple right-angled triangle to determine the relevant parameters.

To take the case of the South 120° face located at A, Lat. 52° , 1° W, (see fig. below), in the first place translate it in the direction it is facing, ie. on a bearing of 120° from S in a westerly direction until it faces West at C. This gives us the right-angled triangle ABC in which $A = 60^\circ$, $\angle = 38^\circ$, $C = 90^\circ$; which can be solved using the standard relations



for right-angled spherical triangles:
 $\sin a = \sin A \sin c$, $\sin b = \sin c \sin B$,
 $\cos c = \cos a \cos b$, and
 $\cos a \sin b = \sin c \cos A$;
to give $a = 32.2^\circ$, $b = 21.3^\circ$ and $B = 36.2^\circ$.

In the second stage the face is translated back along its first stage course, on the opposite bearing, to A, 20° beyond its "home base", where it stands vertical. Now solve triangle $A'BC$ in which $a' = 32.2^\circ$, $b = 41.3^\circ$ ($21.3^\circ + 20^\circ$) and $C = 90^\circ$ and find triangle $A' = 43.7^\circ$, $B = 58.7^\circ$, $c' = 50.5^\circ$. The dial at A' has Latitude 39.5° ($90^\circ - 50.5^\circ$), Longitude 21.5° ($58.7 - [36.2 - 1^\circ]$) East, and declines 43.7° West of North, ie. South 136.3° West.

Hence the South 120° West 20° Recliner at A has hour line and gnomon angles as for a vertical dial at A' Latitude 39.5° , Longitude 21.5° East, declining 136.3° West from South, but with the time retarded by 1 hour 30 minutes (22.5° difference in Longitude). These angles can now be

calculated using the standard formulae for vertical declining dials:

1. Substyle difference $\tan SD = \sin D \cot L$
2. Style height, SH $\sin SH = \cos D \cos L$
3. Difference in Longitude, DL ... $\cot DL = \cot D \sin L$
4. Angular distance of hour lines
from substyle X $\tan X = \sin SH \tan (DL \pm h)$

Where D = declination of the dial, L = latitude, h = sun's hour angle in degrees.

Incidentally, pencilling on a ping-pong ball resting in a liqueur glass can stimulate the imagination! [No mention of the liquid contents is made - Ed].

Mathematically inclined readers may like to apply this method to the case where one hexagonal plane faces North and the others decline by 60° from South. The result is a little surprising!

If you feel smug at having worked through all this, reflect too that in addition, "*the lines in these hexagonalls drawne discovereth the Signe where the Soonne is, the time of his rysinge and settinge, the quantity of the day*

and night, the planet hower, the Almicanteras, Azimuthe and passing of the Soonne by the Celestiall howses wth soondry conclusions that on these may be inferred", and your respect for Thomas Digges will greatly increase.

Now see page 24 of Bulletin 89/2
(note that this was page 25 of Bulletin 90.1 originally)

CHAIRMAN'S NEWS

Arrangements for the Oxford meeting on 24/25 March are now almost complete. Dr. Philip Pattenden has kindly agreed to lead the tour of Oxford sundials, concentrating especially on the Pelican dial at Corpus Christi College, for which he was responsible for its restoration some years ago, and on which he has written a book and supplement. The special tour of the Museum of the History of Science will be personally conducted by Mr. Francis Maddison, Curator of the Museum. The main talks will be delivered by Dr. Alan Mills on the **Evolution of the Sundial**, covering early Egyptian, Greek and Roman, scratch and other types of dials existing before the "modern" dial with the polar gnomon; Christopher Daniel on **Stained Glass Sundials**; and Dr. Andrew Somerville on the **Scottish "Symbolic" dials**.

Over forty members had registered by the deadline of 31st January, including a number from overseas; if any late-comers wish to attend, please enquire and we shall endeavour to fit you in, if the College still has accommodation available.

At the last count we had 212 members, including 30 "family", making a total of at least 242 members plus another 20 who receive the *Bulletin* on an exchange basis because of money exchange difficulties. This rapid growth has put a certain amount of strain on the organisation, especially in connection with producing and despatching the *Bulletin*, now 300 copies per issue. So we would like to have more helpers. If you think you can assist in any way,

please get in touch with one of the members of the Committee.

We would also like to hear from more people able to help with putting dial records on to computer files; a number of members have said they would like to take part in dial recording but are not able to travel - here is a task which could suit even the house-bound, although it is necessary to have the appropriate hardware.

There seem to be quite a number of members who are computer buffs, and who have written various programmes for drawing dials: is anyone willing to form a computer sub-group? Or any other special-interest sub-group for that matter. The Committee, whilst wishing to encourage all aspects of dialling, have found that some areas are so specialised that these require much more expertise in their overseeing than the general areas of interest, if they are to be developed fully.

Mr. E. J. Tyler, who is well known in other antiquarian fields, has joined the Advisory Panel as the Society's translator of German and Dutch texts, and reviewer of Continental journals; whilst Mr. Peter I. Drinkwater, noted author of *The Art of Sundial Construction*, has joined as one of the experts on dialling problems. He specialises in the geometric approach to dialling design. Any member who can contribute special knowledge in some area of dialling is invited to join the Advisory Panel.

A. R. SOMERVILLE

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