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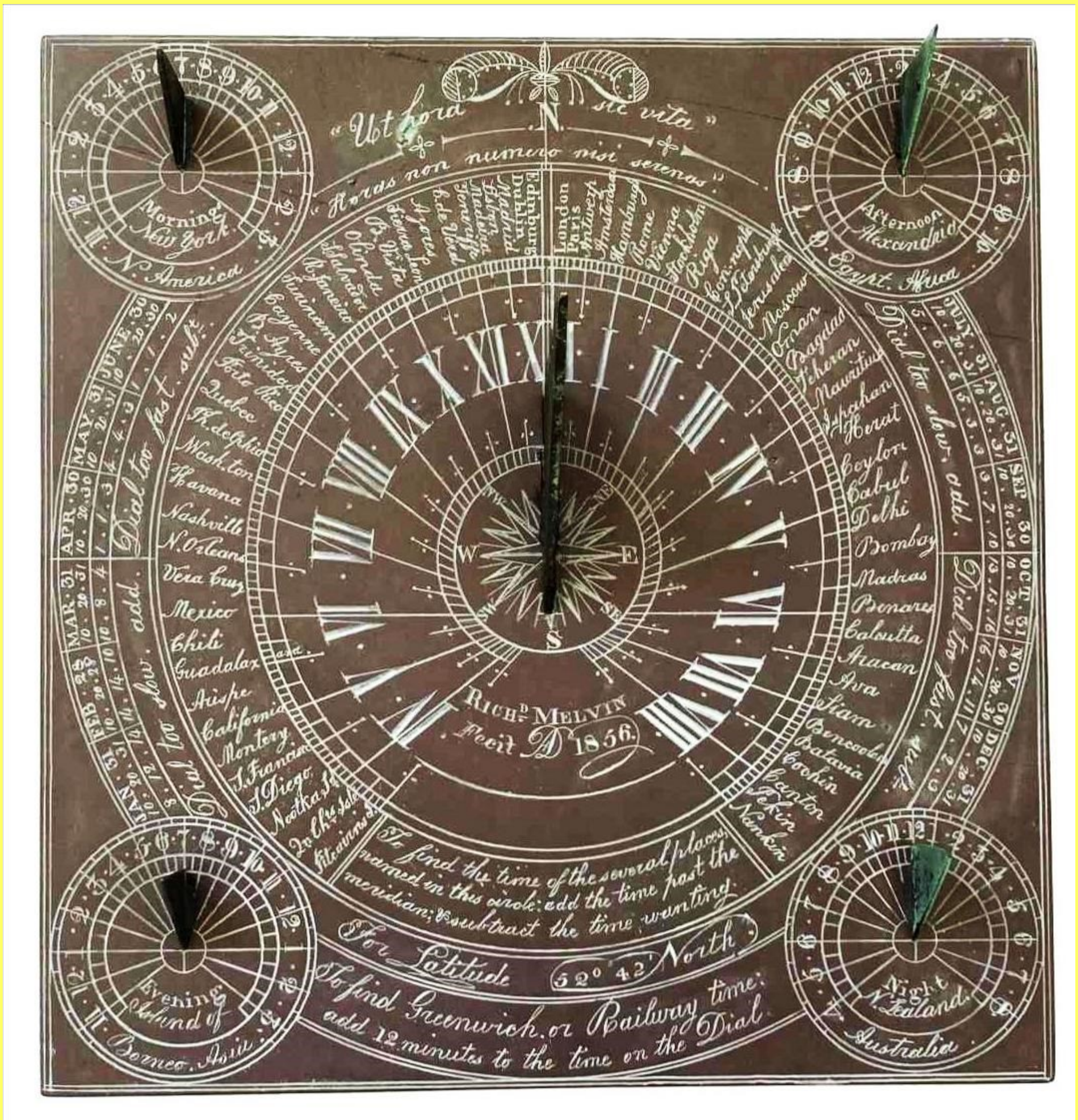

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CONTENTS

EDITORIAL

The June issue of the *Bulletin* included an account of the Exeter Conference and referred to "a BSS examination on sundial knowledge"; it was a major contribution to the success of the conference. In this issue, the questions are reproduced together with the answers. If you find the questions challenging you may take comfort from the fact that no-one gained more than half marks.

Our lead article by Mario Arnaldi especially appealed to me; it was originally published in Italian and contains much original Latin text (with translations) and refers to a Codex for delineating unequal hours.

By chance, we have two articles relating to magnetic compasses. Graham Stapleton describes what might be the final example of a floating compass dial. By contrast, Roar Hagen-Diez introduces us to a more conventional magnetic compass made in Norway. The design was modified so that it could be used for indicating time.

By further chance, we have two articles whose subjects are horizontal sundials with multiple gnomons. The Joseph McNally dial in Peter Ransom's latest picture postcard clearly shows five gnomons and, later in the issue, David Brown describes the restoration of a Richard Melvin sundial with five gnomons. The result is a feast for the eye.

David Hawker writes about the prize winners of the 2023 BSS Photographic Competition.

John Davis describes a medallion which has a badly laid-out sundial on one side with the other side being almost indecipherable. After a considerable amount of detective work, a treasure trove of information was obtained.

Maciek Lose briefly describes two fragments of Hellenistic sundials which he saw in an archaeological exhibition while on holiday in Rhodes.

Almost at the end, there is a report about our inaugural quarterly Sundial Zoom Event on 25 July. It is early days yet, but I am hoping that there will be a second in October. I hope that my other articles speak for themselves!

Frank King

THE MEDIEVAL RULE OF ERFURT WRITTEN IN A CODEX THAT BELONGED TO FRA GIOCONDO OF VERONA

MARIO ARNALDI

This article about the reformed Erfurt rule for building south-facing sundials[1] has appeared previously, in Italian, as Mario Arnaldi: 'La regola medievale di Erfurt in un codice appartenuto a fra' Giocondo di Verona', Gnomonica Italiana *VI, no.19, 2-9 (November 2009).*

In the Medicea-Laurenziana Library in Florence, there is a manuscript codex dating from the 15th–16th century (Ms. Plut. 29,43) which belonged to Fra Giovanni Giocondo from Verona.[2] The codex, entitled *Quaestiones geometricae*, is composed of mathematical-geometric and gnomonic-instrumental texts written by three different hands: two of them are French and the third – the one that also produces almost all the drawings – is by Fra Giocondo himself.[3] The codex contains two treatises on the portable cylinder dial, one on the horary quadrant, one on the *Organum Ptolomei*, and other tools.[4] The only vertical sundial is represented on folio 65r; it is by a French hand while the drawing below has been attributed to Giocondo,[5] who collected this text in France, and almost certainly in Paris where he resided from 1496 to 1499 (Fig. 1).[6]

The Erfurt rule was designed to build particular wall sundials with temporal hours based on the medieval graphic model, but the drawing at the end of the text shows a very different graphic from the one seen in the various manuscripts cited and published by Schaldach;[7] the angular spacings are inverted, showing a design more similar to a sundial for equinoctial hours.

Fig. 2. BN Paris, Ms. Lat. 7294 f. 22v – a. 1433-34. From the Ernst Zinner archive; courtesy of the Frankfurt am Main University.

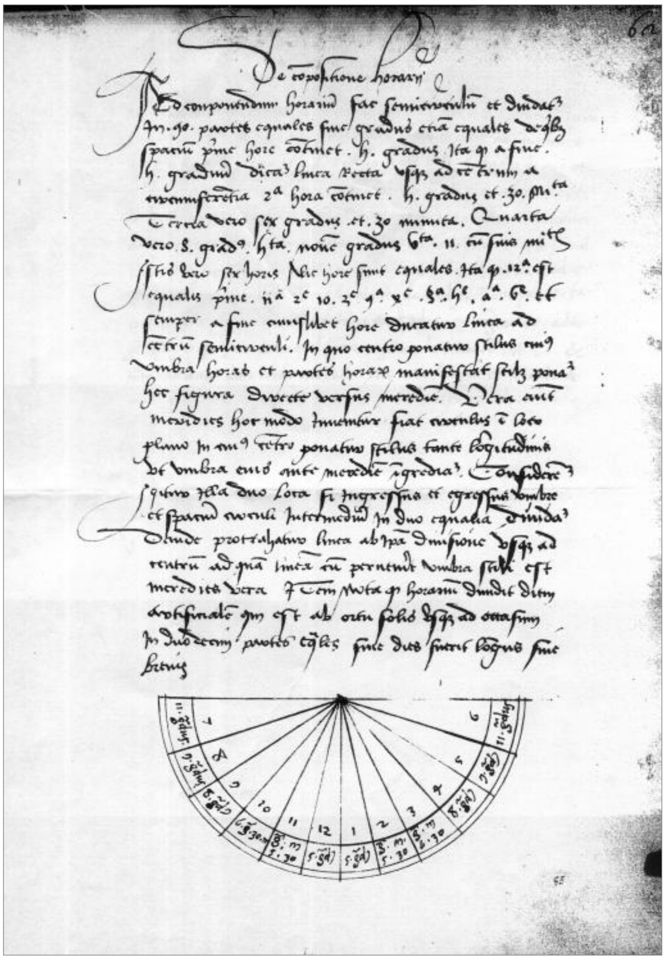

Fig. 1. Ms. Plut. 29.43 f. 65r – end of the 15th century. Courtesy Laurenziana Library, Florence.

The drawing shown at the end of the text in the Florentine manuscript is graphically similar in all respects to the one reported in folio 22v of the ms. Lat. 7294 kept in the Bibliothèque Nationale de France in Paris. Folio 65r of the Laurentian codex was certainly copied from the Parisian manuscript, at least fifty years older, or from some other copy of that. Both texts bear the original Erfurt rule,[8] and both show the same drawing (compare Fig. 2).[9]

The Erfurt Rule

The oldest known manuscript of this rule was made in Erfurt, Germany, in 1364.[10] It is certainly not the original copy, because the rule was already known in Germany at least since 1334.[11]

The text was essentially made up of three parts: the first taught how to build the dial with a numerical series of angular values since the resulting sundial was designed to

De compositione horarii *Ad componendum horarium fac semicirculum et dividatur in 90 partes sive gradus equales de quibus spacium prime hore continet quinque gradus. Ita quod a fine quinque gradum ducatur linea recta usque ad centrum a circumferentia. Secunda hora continet quinque gradus et 30 minuta. Tertia vero continet 6 gradus et 30 minuta. Quarta 8 gradus, quinta 9 gradus, sexta hora 11 gradus. Istis vero sex horis, aliae horae sunt equales: 12a est equales prime, 11a 2e, 10a 3e, 9a 4e, 8a 5e, 7a 6e, et semper a fine cuiuslibet hore ducatur linea ad centrum semicirculi in quo centro ponatur stilus cuius umbra horas et partes horarum manifestat, et ponatur hec figura directe versus meridiem. Veras autem meridies hoc modo inveniatur. Fiat circulus in loco plano in cuius centro ponatur stilus tante longitudinis, ut umbra eius ante meridiem ingrediatur, considerentur igitur ista duo loca scilicet egressus et ingressus umbre et spacium circuli intermedium in duo equalia dividatur. Deinde protrahatur linea ab ipsa divisione usque ad centrum, ad quam lineam cum pervenit umbra stili est meridies vera. Item nota quod horarium dividit artificialem diem qui est ab ortu solis usque ad occasum in 12 partes equales, sive dies fuerit longa sive brevis, et cetera.*	1-4	**The construction of a sundial** To construct a sundial draw a semicircle and divide it into 90 equal parts, or degrees, of which five degrees are contained in the space of the first hour.
	4-9	From the five-degree end, draw a line up to the centre of the semicircle. The second hour will contain five degrees and 30 minutes, while the third will contain 6 degrees and 30 minutes. The fourth is 8 degrees, the fifth 9 degrees, the sixth now 11 degrees.
	9-15	These six hours are, however, equal to the other hours: the 12th will be equal to the first, the 11th to the second, the 10th to the third, the 9th to the fourth, the 8th to the 5th, the 7th to the 6th. And always from the end of each hour a line must be drawn up to the centre of the semicircle, where the gnomon should be placed, the shadow of which makes the hours and parts of hours perceptible. It must also be said that this figure must be oriented exactly toward the south.
	15-20	The true South must be determined in the following way: draw a circle on the horizontal plane and stick a gnomon of sufficient length in its centre to cast the shadow before noon. The following two positions will also be taken into consideration, i.e. the entry and exit of the shadow, and the space between those two points will be divided into two equal parts.
	20-23	Then a line is drawn from the point of separation to the centre, and when the shadow of the gnomon reaches this line, it is indeed the real South.
	23-25	Be aware that this dial determines the artificial day, which has 12 equal parts from sunrise to sunset, whether the day is long or short, etc.

Table 1. Text from the Rostock Ms. Math. Phys. Q.1, f. 154r. Translation by K. Schaldach.

face directly south, and the second part taught how to find the true South with the Hindu circle method, while the third specified the hour system for which everything was designed.

The edition of the original text, from Rostock Ms. Math. Phys. Q.1, folio 154r, has been produced by Schaldach: *Gnomonica It*., ref.1. For convenience, the translation by Schaldach is reproduced here as Table 1.

It was not a totally empirical rule, as Ferrari and Schaldach himself demonstrated in their articles,[12] and it was accurate enough to allow the seasonal hours to be shown with 'acceptable inaccuracy' on a medieval-type sundial at a latitude of 48° (the latitude of Paris, the city from which the rule probably spread).[13]

The constructional instructions present in the first part of the rule almost completely reflected the simplicity of medieval sundials: first of all, a semicircle had to be drawn with the arc facing downwards, marking the centre where a perpendicular gnomon would be placed, after which it was necessary to follow explicitly a numerical table referring to the angular openings of the lines that determined the twelve hours of the day. The semicircle was divided into 90 parts, equal to 180°, the first hour was assigned 5 parts (= 10°), the second 5.5 (= 11°), the third 6.5 (= 13°), the fourth 8 (= 16°), at the fifth 9 (= 18°) and at the sixth hour 11 parts

Temp. hours a.m.	I	II	III	IV	V	VI
Degrees	10	11	13	16	18	22
Parts	5	5.5	6.5	8	9	11
Temp. hours p.m.	XII	XI	X	IX	VIII	VII

Table 2. Details of the hour spacings according to the Erfurt rule.

(22°); the other hours obviously mirrored the first six (Table 2).[14]

The angular values expressed in the text of the Erfurt rule, however, were not supported either by evident calculations or by geometric constructions; they were listed one after the other and accepted on trust by the reader.

The resulting Figure (Fig. 3) corresponded to a sundial facing exactly south and with unusual openings between the hour lines: wider in the central hours of the day and increasingly narrower as the lines approach the horizontal. In the second part of the text the system of 'Hindu circles' was recommended to find the right meridian direction.[15]

Everything suggests that such a constructive rule came into existence as a very first attempt – clumsy if you want – to modernise the sundials for reading the equal hours, which in Italy were called 'Oltramontane' or 'French', which in those years were spreading to the countries beyond the Alps. In reality, the author did not intend at all to build a sundial for equal hours but to improve the reading of the temporal hours shown on a medieval sundial.[16]

As can be seen in Fig. 4, the angular values provided by the rule referred to a spacing of the lines in very precise positions that corresponded to the angles formed with the horizontal line from the shadow of the gnomon to the equinoxes at the end of each temporal hour at the latitude of 48°.[17]

See the comparisons for various latitudes in Table 3.

In this way, the reading error made by a typical medieval sundial was reduced (Fig. 5).

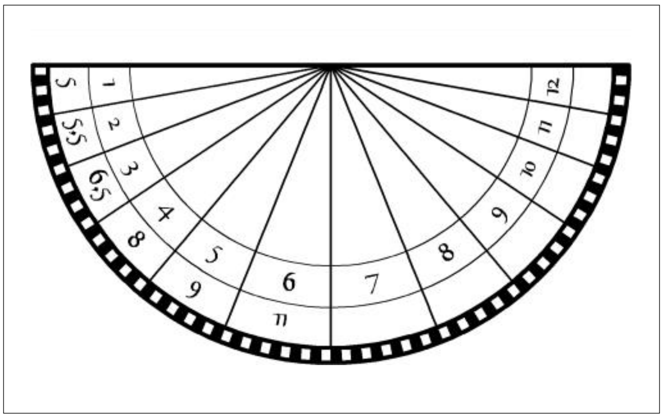

Fig. 3. Graphic rendering of the sundial built with the Erfurt rule.

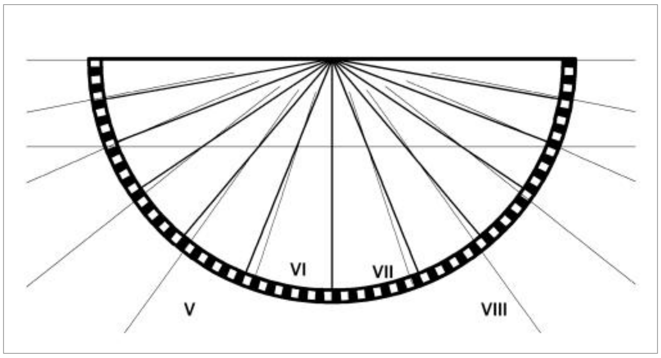

Fig. 4. The layout of a correct sundial for seasonal hours (calculated for the latitude of 48°) superimposed on the one built with the Erfurt rule. From the drawing, it is clearly seen that the hour lines of the two systems all cross on the equinoctial line.

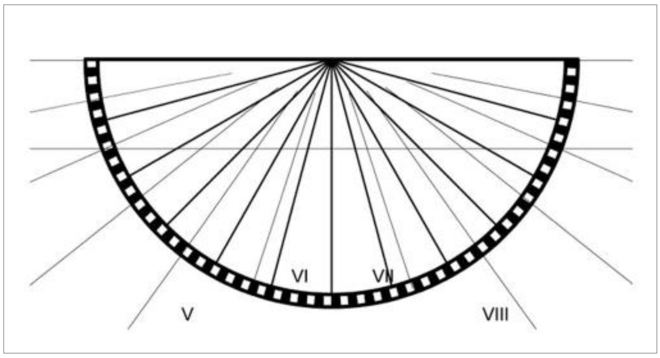

Fig. 5. Superposition of the lines of a correctly constructed sundial with unequal hours for latitude 48° on the hour lines of a common medieval sundial (a semicircle divided into 12 equal sectors). The hour lines no longer have any correspondence with each other.

Latitude	I-XII	II-XI	III-X	IV-IX	V -VIII	VI-VII
40°	11.6	12.3	13.6	15.5	17.7	19.3
45°	10.7	11.5	13.1	15.5	18.5	20.8
48°	10.2	11.0	12.7	15.4	19.0	21.8
50°	9.8	10.6	12.4	15.3	19.3	22.6
Erfurt Rule	10	11	13	16	18	22

Table 3. Angular values (in degrees) at the equinoxes and as the latitude varies, compared with those of the Erfurt rule.

But the suggested method, in addition to having a poor gnomonic value, was devoid of any geometric and mathematical proof, it did not provide other tables for the adjustment to different latitude nor did it state for which latitude it had been composed;[18] in this way, it gave of itself an unfounded impression of universality. Despite these obvious shortcomings, the Erfurt rule was an incomprehensible success. Originating in the Parisian university environment, it was copied in many codices, gaining widespread popularity in Germany, France, and, finally with Fra' Giocondo, also in Italy.

It is difficult to know why the Veronese architect guarded this folio with such care, given that, in addition to the evident inconsistency between the text and its illustration, the European time system of equinoctial hours was not used at that time on the Italian peninsula. Could it have been the curiosity towards an uncommon time system in Italy or perhaps the intuition that such a simple rule could be practicable and easy to use even in Northern Italy with almost irrelevant errors in wall sundials without too many pretensions?

Reform of the Rule

It took about a century of disclosure before the inconsistency of the Erfurt rule was definitively noticed.[19] An attempt was therefore made to repair the error, without rewriting it but by modifying it slightly. And even in this case, a true method based on correct gnomonic principles was not reformulated.

The first change that the Erfurt rule underwent was the adaptation of the hour lines to a reading of the 'common' European hours, simply by giving a new meaning to the hour numbers, effectively inverting the angular values. In practice, leaving unchanged the combinations of the angular values of the hour lines with the series of hours represented by them, the positions in the semicircle were reversed. Here, then, what was previously the sixth medieval temporal hour (noon) became the sixth post-midday or ante-midday equinoctial hour, and what was the twelfth temporal hour (sunset) became the twelfth equinoctial hour (noon).

The two manuscripts we examined (the Florentine and the Parisian one) would therefore seem to be part of an early modernization tradition (only in the illustration but not in the text) that took place before the textual changes that we will see in the mss. Stuttgart Mat 4° 32, folio 134v (16th century) and München, Bayerische Staatsbibliothek, Cgm. 4545, folio 71r (late 15th century).

In the Stuttgart manuscript (Table 4) the second and third parts of the original text are totally missing, while in the version of Ms. München 4545, folio 71r (Table 5), the text is decidedly even shorter.

In the two versions of the reformed rule that we have just read, the text appears drastically reduced (especially in the

De compositione horarii *Ad componendum horarium fac semicirculum quem divide in 90 gradus equales sive in 90 partes. De quibus gradibus spacium prime hore post meridiem continent quinque gradus. Nota quod a fine quinti gradus ducatur linea recta a centro usque ad circumferentiam.*	1-7	**The construction of the dial** To construct a sundial, draw a semicircle which you will divide into 90 equal degrees or parts. The space of the first hour after noon contains five such degrees. This done, let a straight line be drawn at the extremes of these five degrees from the centre to the circumference.
Secunda hora continent quinque gradus et 30 minuta. Tertia hora continet 6 gradus et 30 minuta, quarta hora continet octo gradus, quinta hora novem gradus. Sexta hora continet 11^{cim} gradus.	8-12	The second hour contains five degrees and 30 minutes. The third, 6 degrees and 30 minutes. The fourth hour, eight degrees. The fifth nine, the sixth eleven.
Istis vero sex horis sex alie hore sunt equales ita quod spacium undecime hore ante meridiem est equalis spacio prime hore post meridiem, et decima hora est equalis secunde. Nona tertie. Octava quarte. Septima quinte. Sexta sexte, et a fine cuiuslibet hore ducatur linea a centro semicirculi, in quo centro ponatur stilus [unreadable word] correctus cuius umbra horas et partes horarum manifestat et tunc similis figura ponatur directe versus meridiem.	13-19	The other six hours are equal to these in that the space of the eleventh-hour a.m. is equal to the space of the first hour post-meridian and the tenth hour is equal to the second. The ninth to the third. The eighth to the fourth. The seventh to the fifth. The sixth to the sixth. And at the end of each hour, a line is drawn from the centre of the semicircle. And in this centre is placed a gnomon [...] corrected whose shadow will show the hours and their parts, and then this figure (the drawing of the sundial) is placed precisely facing South.

Table 4. The Stuttgart manuscript Ms. Stuttgart Mat 4° 32, f. 134v.

De horologio murali *Ad componendum horologium murale, fac semicirculum quem divide in 90 partes, de quibus gradibus spacium prime hore post meridiem continent 5 gradus ita quod a fine 5ti gradus ducatur linea recta usque ad centrum.*	1-6	**Of the wall sundial** To construct a wall sundial, draw a semicircle which you will divide into 90 parts, of which parts (or degrees) the space of the first hour after noon contains 5 so that at the end of these 5 degrees a straight line is drawn to the centre (of the semicircle).
Secunda continent gradus 5 cum dimidio. Tertia continet gradus 6 et 30 minuta. Quarta hora continet gradus 8, Quinta continet 9 gradus. Sexta continet undecim; et hoc in una parte (viditur ?), ante meridiem fac similem divisionem.	7-11	The second hour contains 5 and a half degrees. The third is 6 degrees and 30 minutes. The fourth hour, 8 degrees. The fifth 9, the sixth eleven. All this is composed in one part of the dial (the post meridiem one), in the antemeridian, part proceeds with the same subdivision.

Table 5. The Munich manuscript Ms. München 4545, f. 71r.

Munich version), introducing the specification that distinguished the new equinoctial hours from those of the old rule, effectively eliminating the second and third parts of the original rule.[20]

In practice, the numerical sequence of the parts of the semicircle that were reported in the original rule remained unchanged, but the temporal meaning of the hours changed according to the new time system that was taking place in many European countries in those years (Table 6 and Fig. 6).

Hours am	7	8	9	10	11	12
Degrees	22	18	16	13	11	10
Parts	11	9	8	6.5	5.5	5
Hours pm	6	5	4	3	2	1

Table 6. The inverse sequence of the angular values reported in the Erfurt rule adapts to the equal equinoctial hours, no longer to the unequal ones.

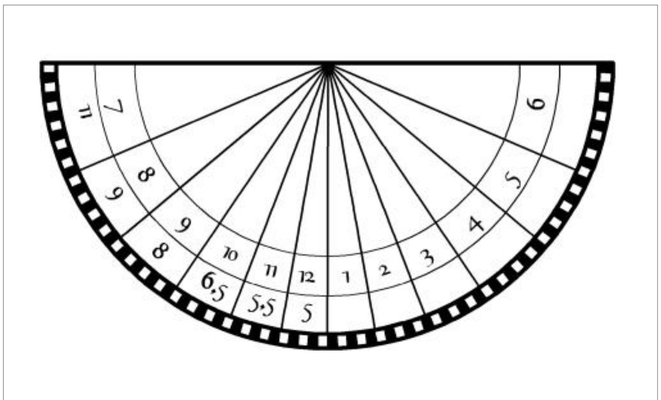

Fig. 6. Graphic rendering of the sundial built with the modified Erfurt rule.

It so happened that, for a mathematical property of hour angles, the inversion of the angular values of the original rule would generate the perfect tracing of a sundial for equinoctial hours for the same latitude of 48°, provided (even if it is not specified in the text), that this time the gnomon protruding from the centre of the semicircle was parallel to the earth's axis, and no longer orthogonal with the wall.[21] The angular values, both in the original rule and in the modified one, were obviously rounded and almost certainly obtained by observation rather than by calculation, but if we overlap the graph generated by the modified rule we will find that it coincides with the hour lines of a sundial for equal hours calculated for the same latitude. Indeed, in this case, the rounding of the reading error, compared to what was obtained using the temporal hour system, is practically irrelevant or almost zero on many hour lines (see Fig. 7).

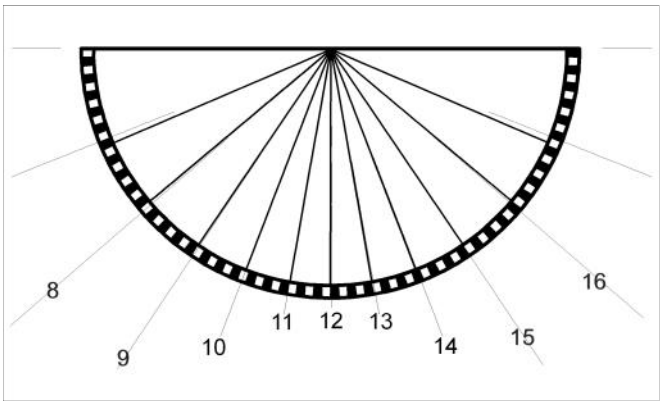

Fig. 7. The sundial built with the modified Erfurt rule, superimposed on a European time sundial calculated for the latitude of 48°.

The modified rule could also be applied to other latitudes without incurring obvious reading errors. It could be used with negligible errors for that epoch, from 44° (Florence) up to 51° (Erfurt),[22] becoming in fact an easy 'semi-universal' method for building simple sundials with equal hours (see Fig. 8).

For now, no other Italian codices are known that report any version of the Erfurt rule and probably in Italy this construction method never took root. Italian hours had become commonplace, so what purpose could a generalised rule serve to build a sundial which, although very simple, showed hour lines not suited to the current time system?

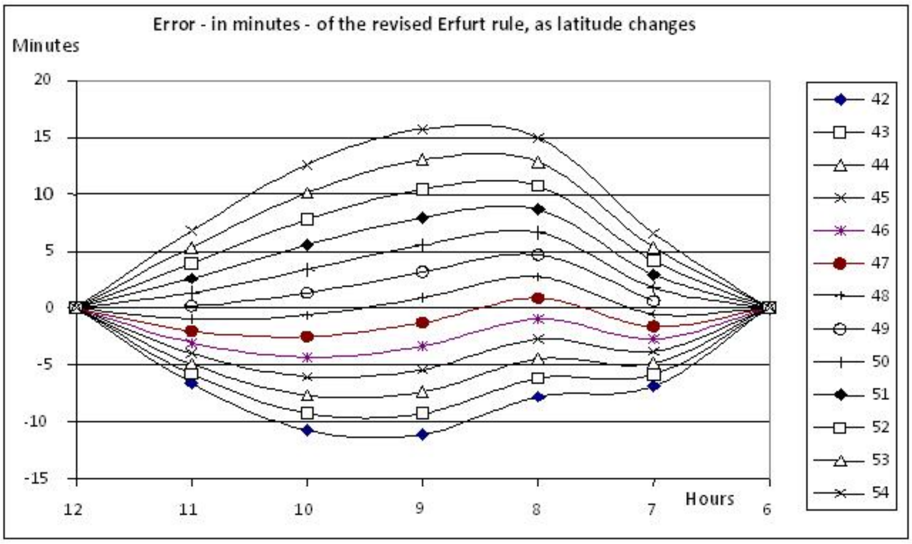

Fig. 8. In the graph, it is possible to see the error difference, in minutes, by applying the 'reformed' Erfurt rule at various latitudes. It can clearly be seen that within a latitude scale ranging between 44° and 51° N the error is small enough to be considered 'acceptable' in a fifteenth-century sundial.

Further Changes

Although by now it was not able to compete with the numerous manuscripts that taught more correct graphical methods, the rule underwent a further variation of some importance by applying a variant to horizontal sundials.

From the Erfurt rule, many variants were derived, more or less similar to each other. Zinner divided the series of manuscripts known to him – over seventy – into four fundamental strands that ranged from the original rule to the version with the identifier of the name of Achas or Ahab,[23] up to the variants for horizontal dials with 16 hours to those with different numerical series.[24] Later, Zinner expanded the series of rules with numerical scales, by adding to the four main ones another 13 with sequences of angular values for different locations and for latitudes: from 40° up to 52°.[25]

APPENDIX

Let us consider a vertical plane facing south and an orthogonal gnomon exiting from point O of it (Fig. 9).

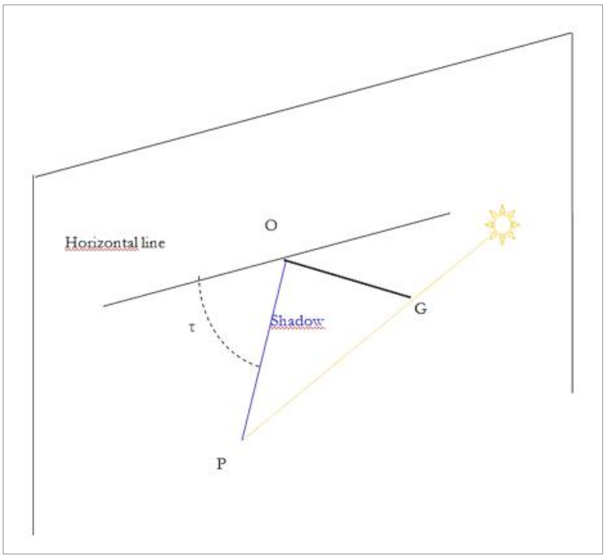

Fig. 9.

At a certain instant the shadow OP of the gnomon will form an angle τ with the horizontal given by the relation:

$$\tan(\tau) = \frac{\sin(\delta)\cdot\sin(\varphi) + \cos(\delta)\cdot\cos(\varphi)\cdot\cos(\omega)}{\cos(\delta)\cdot\sin(\omega)}$$

Being, as usual

- φ the latitude,
- δ the Sun's declination, and
- ω its horary angle.

At the equinoxes, being $\delta = 0$, the relationship becomes:

$$\tan(\tau) = \frac{\cos(\varphi)}{\tan(\omega)}$$

Limiting ourselves for simplicity to the morning hours only, always at the equinox at the temporal hour h_T we will have

$$\omega = (6 - h_T)\cdot 15° \quad \text{with } h_T \leq 6.$$

So

$$\tan(\tau) = \frac{\cos(\varphi)}{\tan(90° - 15\cdot h_T)} = \cos(\varphi)\cdot\tan(15\cdot h_T) \qquad (1)$$

Let us now consider on the same level a polar gnomon always exiting from O (Fig. 10).

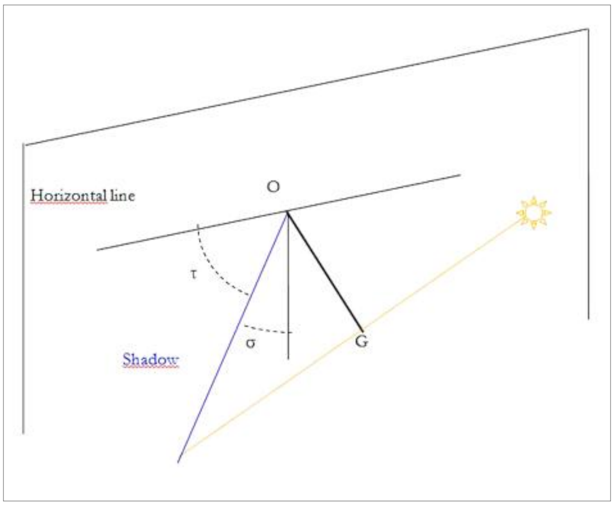

Fig. 10.

The hour line on which the shadow of the gnomon falls at a given hour h_M of true local time forms the angle τ with the horizontal and the angle $\delta = 90° - \tau$ with the vertical (meridian line).

Now the angle τ is given by:

$$\tan(\tau) = \frac{1}{\cos(\varphi)\cdot\tan(\omega)}$$

and being

$$\omega = (12 - t_M)\cdot 15°$$

we have

$$\tan(\tau) = \frac{1}{\cos(\varphi)\cdot\tan\left[(12 - h_M)\cdot 15°\right]}$$

Finally the angle from the vertical:

$$\tan(\sigma) = \tan(90° - \tau) = \cos(\varphi)\tan[(12 - h_M)\cdot 15°] \qquad (2)$$

Observing the two relations (1) and (2) we see that they are equal if we make the time hour with an hour angle ($90° - 15\cdot h_T$) correspond to the hour of true time having an equal hour angle ($12 - h_M$)·15. In other words:

the angle formed with the horizontal by the timeline h_T coincides as a value with the angle that the true timeline h_M forms with the vertical. The match is:

$h_T = 1$ >>> $h_M = 7$
$h_T = 2$ >>> $h_M = 8$
$h_T = 3$ >>> $h_M = 9$
$h_T = 4$ >>> $h_M = 10$
$h_T = 5$ >>> $h_M = 11$
$h_T = 6$ >>> $h_M = 12$ that is, with $h_M = 6 + h_T$

This property is inherent in the reformed Erfurt rule.

Calculating e.g. for $\omega = 48°$ the values of the angles τ at the different unequal hours we have:

Temporal hours	Angle τ from the horizon	Hours of LAT	Angle δ from the vertical
I	10.2	7	10.2
II	21.1	8	21.1
III	33.8	9	33.8
IV	49.2	10	49.2
V	68.2	11	68.2
VI	90	12	90

ACKNOWLEDGEMENT

I am grateful to the late Gianni Ferrari for his valuable contribution to the Appendix.

REFERENCES and NOTES

1. The Erfurt rule was briefly mentioned by K. Schaldach: 'Vertical dials of the 5–15th centuries', *BSS Bull*., 96.3, (Oct. 1996), and illustrated by the same author in K. Schaldach: 'Di due manoscritti di Rostock e la regola di Erfurt', *Gnomonica Italiana*, no. 2, 28-31 (2002), already containing the embryo of the search for a correct construction of wall sundials.
2. Fra Giovanni Giocondo (Verona 1433 – Rome 1515) was a Dominican friar, a man of letters, mathematician, and architect; he carried out the designs of the *Loggia del Consiglio* and the door of the bishop's palace in Verona, of the *Fondaco dei Tedeschi* in Venice, and in 1509 of the fortifications of Treviso. Giorgio Vasari in his *Lives of the most eminent painters, sculptors and architects* (*Lives of Fra Iocondo and Liberale and other craftsmen of Verona*), writes of him that he was "*a man of rare parts and a master of all the most noble faculties*". Over the years between 1496 and 1499, he was invited to Paris by the king of France with the title of royal architect. In Paris, he collaborated in the construction of the Notre Dame bridge. In Paris he discovered eleven letters of Pliny which were later published in 1508 by Manutius and in 1511 he edited the first illustrated edition of Vitruvius' *De Architectura*.
3. The Florentine ms was mentioned for the first time by L. Thorndike: 'Some little known astronomical and mathematical manuscripts', *Osiris*, 8, 41-72 (1948), pp. 54-55, then described by Thorndike (ref. 4, pp. 35-36), subsequently by Ciapponi (ref. 5, p.196).
4. L. Thorndike: 'Notes upon some medieval astronomical, astrological and mathematical manuscripts at Florence, Milan, Bologna and Venice', *Isis*, 50(1), 33-50 (1959), pp. 34-36.
5. L.A. Ciapponi: 'Disegni ed appunti di matematica in un codice di fra Giocondo da Verona (plut. 29,43)', in *Vestigia. Studi in onore di Giuseppe Billanovich*, vol. I, Roma, 181-196 (1984), p.196, line 20. Ciapponi confuses this drawing with a cylinder (!), perhaps present in ff. 63r-64r.
6. Reference is often made in the code to the latitude of 48° which is the latitude of Paris.
7. Schaldach: *Gnomonica It*., ref.1.
8. The title of both manuscripts is *De compositione horarii*, the incipit for both is: "*Ad componendum horarium fac semicirculum et dividatur in 90 partes sive gradus equales*"; the explicit is: "*sive dies fuerit longa sive brevis*" exactly as in the original rule.
9. I take the liberty of saying this because all the other drawings I know have totally different graphics. See also Schaldach: *Gnomonica It*., ref.1.
10. Ms. Göttingen Theol. 124, f. 146r, written by Nicolaus Claudicantis.
11. One of the two sundials engraved on the cathedral of Braunschweig, Germany has been dated 1334 and is traced according to the Erfurt rule. See Schaldach: *BSS Bull*., ref.1.
12. G. Ferrari, 'Alcune note su un orologio murale sulla cattedrale di Brunswick', *Gnomonica*, no. 7, 58-60 (2000).
13. This is one of the reasons why the Erfurt Rule is traced back to Johannes Dank or his close circle of pupils: cf. Schaldach: *Gnomonica It*. (ref.1, p.31 and n.10).
14. The author of this rule speaks indifferently of 'parts' and 'degrees' making no distinction between one and the other; each part or degree equals 2 degrees today. To avoid easy confusion and misunderstandings, the indications of the 'parts' will always be used in the text and graphics of this article; for indications in degrees, the modern will always be used (1° = 1/360 of the circumference of a circle).
15. Regardless of the name, this system for detecting the meridian had been used since ancient times and consisted of a vertical gnomon whose base was the centre of a series of concentric circles traced on a plane perpendicular to it. The meeting points were marked with the apex of the shadow on one of the circles at a certain a.m. time and at the relative post-meridian time. Joining these two places with a line and finding the midpoint, a straight line was drawn which passed through the base of the gnomon and the median point found: this straight line represented the meridian.
16. In this sense the Erfurt rule is very clear: in its explicit (third part) we read: "*Item nota quod horarium dividit artificialem*

diem qui est ab ortu solis usque ad occasum in 12 partes equales, sive dies fuerit longa sive brevis." (tr. Consider that this dial divides the artificial day which from sunrise to sunset is composed of twelve equal parts, whether the day is long or short.)
17. Ferrari, ref.12.
18. C. Roslund, 'The intriguing case of the Braunschweig 1334 sundial', *BSS Bull*., 17(iii), 116-119 (Sept. 2005), at p.117, citing Neumann (M. Neumann, *Sonnenuhren an alten Gebäuden in Braunschweig*, 2 ed., Braunschweig (1991), writes that the Erfurt rule did not show how the sequence of angular values should be applied, nor for which type of sundial it was studied. This statement is not correct, because we have seen that in the final part of the rule, it is clear what type of hours we are referring to; consequently, the sequence of angular values is clear and obvious.
19. I am referring to the definitive awareness because, in reality, it took much less: the two sundials engraved on the cathedral of Braunschweig, in Germany, were dated 1334 and 1346. The latter was probably traced to replace the former. The design of the first is based on the original rule, while that of the second follows the directives imposed by the 'reformed Erfurt rule'. See Schaldach: *BSS Bull*., ref.1, and Roslund, ref.18.
20. In the original rule we read: "*spacium prime horae continet quinque gradus*" (tr. the first hour space contains five degrees), in the reformed one: "*spacium prime horae post meridiem continet quinque gradus*" (tr. the first hour space after noon contains five degrees), and then, skipping the whole ending of the original rule concluded: "*et hoc in una parte viditur, ante meridiem fac similem divisionem*" (tr. All this is composed in one part of the dial (the post meridiem one), in the antemeridian, part proceeds with the same subdivision) (Ms. München, 4545, f. 71r).
21. In reality, there is a mathematical correspondence (see Appendix), but for at least two reasons I am more inclined to consider it a lucky case, rather than a real calculated intuition: (1) the small errors in the values proposed by the rule are not corrected in the rule 'reformed'; (2) in sixteenth-century manuscripts, the correct constructions of sundials are almost all obtained geometrically and not by calculation.
22. These two latitudes must be understood as extreme limits, beyond which, at certain hours of the day, the error is no longer tolerable. At latitudes lower than 51° and higher than 44° the error, of course, was always more tolerable.
23. The name of Ahaz, as an identifier of the watch, also appears on another series of mss, which however does not refer to the Erfurt rule; the incipit of these mss is usually: "*horologium Achab collocare sicut in Almagesti primi libri capitulo primo*."
24. E. Zinner,'Die ältesten Rädenuhren und modernen Sonnenuhren. Forschungen über den Ursprung der modernen Wissenschaft', in *XXVIII Bericht der Naturforschenden Gesellschaft in Bamberg*, Bamberg, 102-105 (1939), pp. 102-105. A rule similar in simplicity to the Erfurt rule, but obtained with straightedge and compass, was proposed by G.B. Vimercato in the mid-sixteenth century in his book *Dialogo de gli horologi solari* and reproposed by A. Gunella, 'Un metodo grafico approssimativo, che si trova nel primo libro di gnomonica in italiano, il Vimercato', *Gnomonica Italiana*, no. 11, a. IV, 36-38 (2006).
25. E. Zinner, *Deutsche und niederländische astronomische Instrumente des 11.-18. Jahrhunderts*, München (1956), pp. 52-55.

Mario Arnaldi graduated in Arts. He is a painter and maker of many artistic sundials. His main interest in gnomonics is research into the history of medieval sundials, and he has published many articles and several books on this subject.
He can be contacted at
marnaldi@libero.it

LI-LO SUNCOMPASS:
The Last Ever Floating Compass Dial?

GRAHAM STAPLETON

Stating something definitively often prompts others to present evidence to show that you are incorrect. The floating compass dial first appeared two centuries ago, and has been made in materials commonplace for their time ever since. This example (Fig. 1) in plastics does appear to be the final iteration, though I would be delighted to learn that this small portable dial made in the mid-1940s is not the last of its kind.

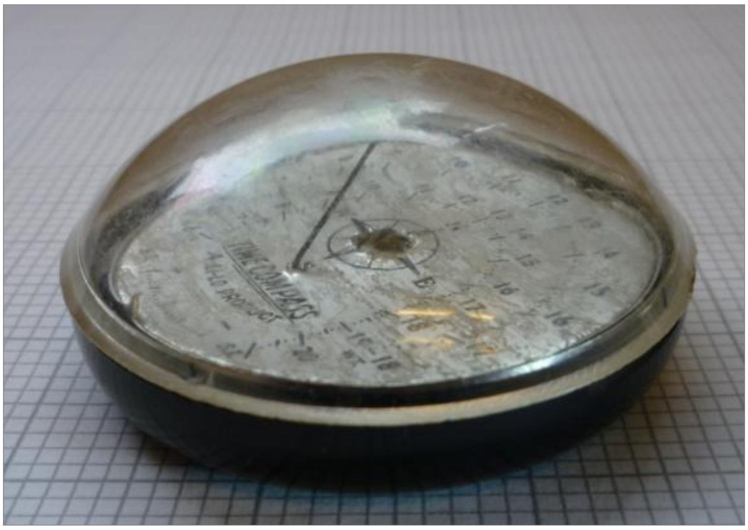

Fig. 1. General appearance of the Li-Lo Suncompass.

The floating compass dial was invented at the end of the eighteenth century, but was not much in evidence until the 1820s.[1] The dial 'floats' because it is balanced on the

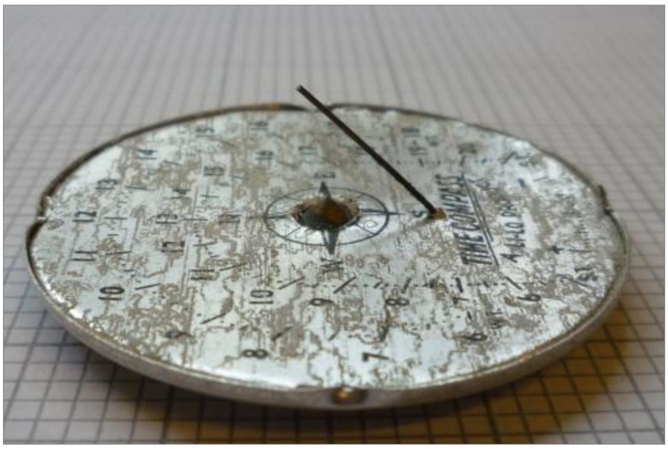

Fig. 2. Upper side of the compass card, showing the dial and wire gnomon.

Fig. 3. Lower side of the compass card, showing the sliding pivot.

same kind of pointed pivot as a compass needle. Indeed, this kind of dial is analogous to a ship's compass, except that the lightweight disc is delineated as a horizontal dial and carries a gnomon.

The dome of the Suncompass is of uncoloured acrylic and is 53 mm / 2.08″ in diameter. The lower half of the case is moulded in dark phenolic resin and carries the inscription "BRITISH PATENT No. 602931 AND CORRESPONDING FOREIGN PATENTS – MADE IN GREAT BRITAIN". What would otherwise be called the compass card is a shallow aluminium tray, into which a metal foiled card is inserted, with a wire gnomon fed through at the dial's origin (Fig. 2). On the underside is a retaining wire which enables the pivot to slide vertically (Fig. 3). When in use, the pivot is pushed up from the underside, freeing the disc to rotate. I infer that the magnetic element is in the cavity between the dial and the tray, but the former is too delicate for me to remove it in order to confirm this.

The dial has two sets of hour marks: a circular one labelled "W.T." for Winter Time and an arch-shaped set advanced by an hour labelled "S.T." for Summer Time (Fig. 4). Across the bottom of the latter is another scale of ten points, both positive and negative, centred on the meridian. This appears to be to compensate for magnetic variation, as the construction of the dial does not seem remotely robust enough for the regular adjustments of the Equation of Time. My attempts to determine the latitude by measuring photographs were inconclusive, but when I tried the dial outdoors, it seemed to be broadly right and so is probably delineated for 52°.

Fig. 4. Vertical view of the dial face.

The name 'Li-Lo' will have puzzled some readers, as the name is associated with brightly coloured inflatable mattresses, ideally used in swimming pools. Li-Lo was a brand of P.B. Cow & Co. (as in 'Cow Gum', the rubber solution adhesive that some will remember) who produced their first air-bed in 1936, and three years later diverted into manufacturing emergency dinghies and life jackets for the Royal Air Force.[2] The company became one of the largest manufacturers in its time of air–sea rescue equipment, also founding and backing the 'Goldfish Club' for air crew rescued by flotation devices.[3]

Searching for a date of manufacture of the Suncompass, I discovered that, as the inscription hints, its origins lie elsewhere. It is in fact quite simply a 'Rüter Uhr', renamed for the British market.[4] In the desperate economic conditions of Germany in 1945, with raw materials and skilled labour in short supply, wristwatches were hard to come by or were prohibitively expensive imports. Developed as a solution by Dr Rudolph Rüter, a physicist and chemist of Berlin, the 'Rüter Uhr' was quite readily manufactured by series production methods.[5] Aside from the Equation of Time – which may have been addressed in accompanying instructions – if the user crossed into the Soviet zone, they needed to remember that double summer time was in force.[6]

This charming form of dial has, if anything, been more effectively rendered redundant than any other kind of dial by modern infrastructure. Vehicles, steel-framed buildings and power lines all disturb compasses, limiting where they might be used, a pity given their simplicity and ease of use.

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3. The Goldfish Club, online at *https://www.thegoldfishclub.co.uk/HISTORY-OF-THE-GOLDFISHCLUB*
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manaeus2000@yahoo.co.uk

A Dial Amongst a Wealth of Greenery

The variety of vegetation in David Hawker's entry for the 2023 Photographic Competition particularly appealed to this member of the Editorial Team. David's picture, featuring a 1790 dial by Dudley Adams (SRN 3301) at Scotney Castle (NT) in Kent, was entitled "Garden Gate". See page 14 of this issue for a report on the competition.

CHN

Postcard Potpourri 64: Oaklands House, Sedlescombe

Peter Ransom

This card features a horizontal sundial that appears to be the dial recorded as SRN 5883 in the Fixed-Dial Register. The small dials show the times at Jerusalem, New York, Natchez and "Sidney", and the main one is inscribed TILDEN SMITH / VINEHALL; the name Vinehall is prominent in the area. The dial was made by Joseph McNally in 1840.

There is no indication of the date on the card, but the printing on the reverse mentions "Sold in aid of the funds of the Pestalozzi Children's Village, Sedlescombe, Nr. Battle, Sussex" and describes the card as "Oaklands House showing the old sundial and formal garden".

The original Pestalozzi Children's Village was established in Trogen, Switzerland, in 1946, after the Second World War, to accommodate and educate orphans from various European countries. It was named after a Swiss educationalist Johann Heinrich Pestalozzi (1746-1827), whose philosophy was "Learning by head, hand and heart".

The concept spread to other countries, and in Britain the Pestalozzi Children's Village was built on a 170-acre (0.69 km^2) estate in Sedlescombe, East Sussex; it was opened in 1959. Hence, I think the card probably dates from the early 1960s.

The Sedlescombe site was sold in 2019, following a long struggle to survive financially, but the UK-based Pestalozzi International Foundation still exists, offering "life-changing opportunities to young people from underprivileged communities around the world".

ransompeter687@gmail.com

NOTE: For a detailed account of other sundials by Joseph McNally and a discussion of possible connections between him and Richard Melville/Melvin, see John Davis, Michael J. Harley and Harriet James: 'Joseph McNally's slate sundials', *BSS Bull.* 16(iii), 110-116 (Sept. 2004).

LIDA CARDOZO KINDERSLEY, Litt.D. (*Honoris Causa*)

Noted Cambridge Sundial Maker Awarded an Honorary Degree

FRANK H. KING

The summer solstice is of obvious note to every diallist but 21 June 2023 was of particular significance both to me and to Lida Lopes Cardozo Kindersley of the Cardozo Kindersley Workshop in Cambridge. Earlier in the year, the University of Cambridge had nominated Lida for an honorary degree. In a typical year, just eight such degrees are awarded so it is a rare distinction. Lida is a world-renowned letterer, and examples of Workshop lettering can be found in every Cambridge College. Appropriately, the degree awarded was a Litt.D., Doctor of Letters!

The Workshop is also noted for making sundials and an article by Lida about many of these dials featured in the Silver Jubilee edition of the *Bulletin*.[1] It was therefore appropriate that the conferment day should be 21 June. A bonus for me is that I have a formal role to play on Honorary Degree Days. Since 1976, I have been the University Bellringer, a post which has its origins in the 13th century when the University is first recorded as having made a payment for bellringing. These days, my duties include arranging for bells to be rung on various ceremonial occasions, with the annual Honorary Degree Congregation being the most important. The bells are in the tower of the University Church of St Mary the Great, and the west window of the ringing room overlooks the Senate-House Lawn round which the honorary graduands process on their way into the Senate-House itself. I get a good view of the procession and, as soon as almost everyone is safely inside, the ringing stops and I, with my fellow bellringers, rush down the tower staircase, cross the road, and creep into the back of the Senate-House so we can see and hear what is going on.

During the Congregation, the University Orator gives a short speech, in Latin, about each graduand. His speech about Lida included:

> *qui machinata est tituli tam grauitate quam uigore pleni hortulos solaria templa bibliothecas collegia adornant.*[2]
>
> (Her inscriptions bring formality and energy to gardens, to sundials, to churches, to libraries, to colleges.)

I don't ever remember *solaria* being mentioned in the Senate-House before!

By coincidence, one of the other honorary graduands was John Taylor, the well-known horologist, who designed the

Fig. 1. Lida Lopes Cardozo Kindersley and the author in academical dress. Photo: Jadd Virji.

famous Corpus Clock. He is also thoroughly *au fait* with sundials; many of the clocks in his collection were made in the days when sundials were used for setting the time. The University Orator referred to the Corpus Clock and quoted the inscription cut into the stonework underneath:

MVNDVS TRANSIT ET CONCVPISCENTIA EIVS[3]
(the world passes away, and its desires with it)

Lida would certainly have recalled this quotation since she designed and cut the lettering. The motto also appears on a vertical dial [SRN 0912] inside Corpus Christi College.

When everyone stands for the National Anthem at the end of the Congregation, the bellringers creep out again, rush up the tower staircase, and ring the honorary graduates out. The ringers are invited to the tea which, this year, was held in the arcade under the Wren Library of Trinity College. The photograph in Fig. 1 was taken during the tea and shows Lida and me in our finery. Lida is wearing her Litt.D. gown. I am wearing the number one dress of the University Bellringer which includes a cassock, winged collar, bands, and my scarlet Ph.D. gown and hood. We are both wearing doctors' bonnets.

By contrast, Fig. 2 shows the two of us in more normal circumstances.

The walk from the Senate-House to Trinity went past the well-known Gate of Honour at Gonville and Caius College. This is the gate through which graduands from the College pass on their way to the Senate-House for the conferment

Fig. 2. Lida and the author checking a marked-out slate dial prior to cutting. Photo: The Cardozo Kindersley Workshop.

of their own degrees at the end of their studies. It is appropriate that the honorary graduates should pass this gate on their way to tea, though I wonder how many appreciated its significance? The gate is known to many diallists for its array of six sundials [SRN 1716]. I made the bellringers pay attention while I explained why this was such a propitious day. Unfortunately, the shadow of the nodus of the west-facing dial had not quite landed on the dial plate when we were on our way to tea, but it can be seen in Fig. 3, a photograph which I took on my way back. The nodus shadow is on the summer solstice curve at the lower end of the 4 o'clock hour line. One can also clearly see shadows on the dials which face roughly north-west and south-west.

The Cardozo Kindersley Workshop played no part in the making of the Gate of Honour sundials but the dials in Figs 4 and 5 are both Workshop products. Fig. 4 shows the dial at Pembroke College [SRN 3792] taken at 12 o'clock local apparent time on the day of the summer solstice in 2005. This dial was cut directly into the Bath Stone facing of the wall.

Fig. 3. Three of the Gate of Honour sundials, Gonville and Caius College, at 4 o'clock local apparent time on the day of the summer solstice, 2023.

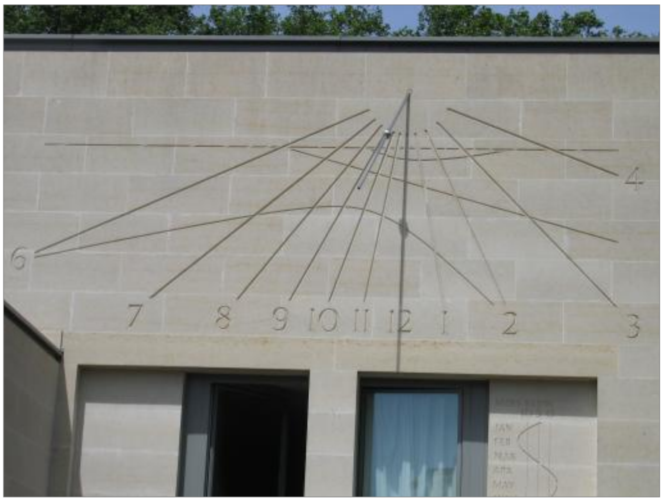

Fig. 4. The Pembroke College sundial at 12 o'clock local apparent time on the day of the summer solstice, 2005.

Fig. 5. The Selwyn College sundial at 15:15 local apparent time on the day of the summer solstice, 2010.

Fig. 5 shows the dial at Selwyn College [SRN 8380]. This slate sundial was cut in the Workshop. The photograph was taken at 15:15 local apparent time on the day of the summer solstice in 2010. How do I know that the time was 15:15? Note that the two families of hour lines show the time as 11½ h Babylonian hours and 19 h Italian hours respectively and the average leads to the time in common hours. The average of 11½ and 19 is 15¼ which can be interpreted as 15:15.

Let us hope for more sundials from the Cardozo Kindersley Workshop in due course.

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3. From the *Vulgate* 1 John 2:17.

fhk1@cl.cam.ac.uk

BSS PHOTOGRAPHIC COMPETITION 2023

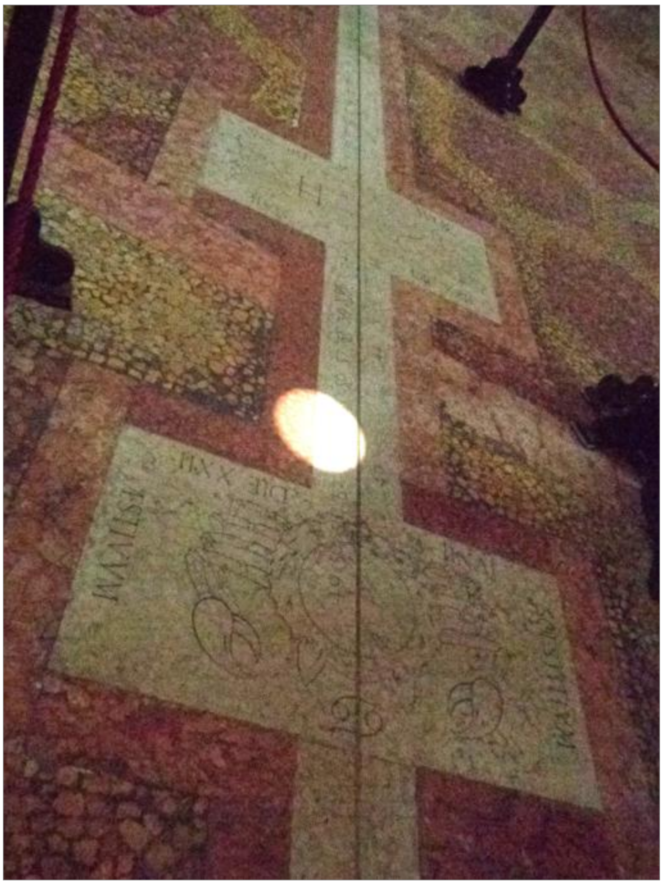
DAVID HAWKER

The Photographic Competition in 2023 attracted an entry of twelve photographs. They were displayed at the Exeter Conference and delegates were asked to vote for their first, second and third choices; a total of 21 voting slips were received. The results were announced and certificates awarded at the gala dinner.

Thanks to those who provided photographs and many congratulations to the winning photographers Mike Shaw, John Allen and Jackie Jones. Thanks too to all those delegates who voted in the competition.

photos@sundialsoc.org.uk

First Place
***The Early Bird,* by Mike Shaw**
(A Gunning heliochronometer)



Second Place
***Creeping Towards Noon*, by John Allen**
(In the Basilica of San Petronio, Bologna)

Third Place
***A Dance to the Music of Time,* by Jackie Jones**
(Polesden Lacey)

RESTORATION OF A MELVIN SUNDIAL

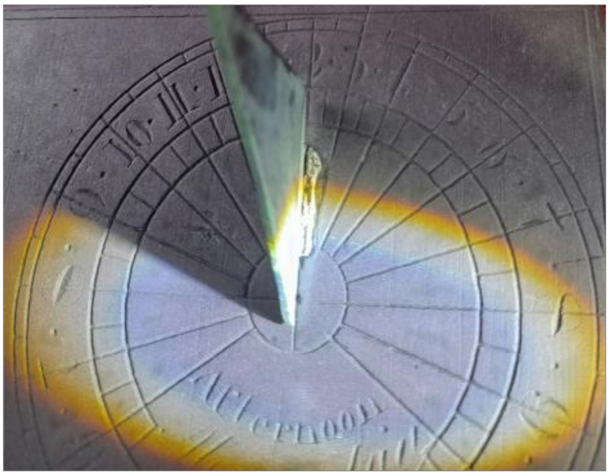
DAVID BROWN

In the late Summer of 2022, a Richard Melvin sundial was delivered to me by a dealer in antique scientific instruments[1] for restoration prior to its eventual sale. The dial was in a poor state with evidence of some of the gnomons having been replaced (one was thicker than the others) and the dial-plate details barely legible (Fig. 1).

The square horizontal dial was typical of Melvin's work; it was signed "*RICH^D MELVIN Fecit AD 1856*" and inscribed "*For Latitude 52° 42′ North".* A further instruction, "*To find Greenwich or Railway time: add 12 minutes to the time on the Dial*", shows the longitude of the intended site for the dial to be 3° W; we deduce that that site was in the region west of Shrewsbury, and south of Oswestry in Shropshire.

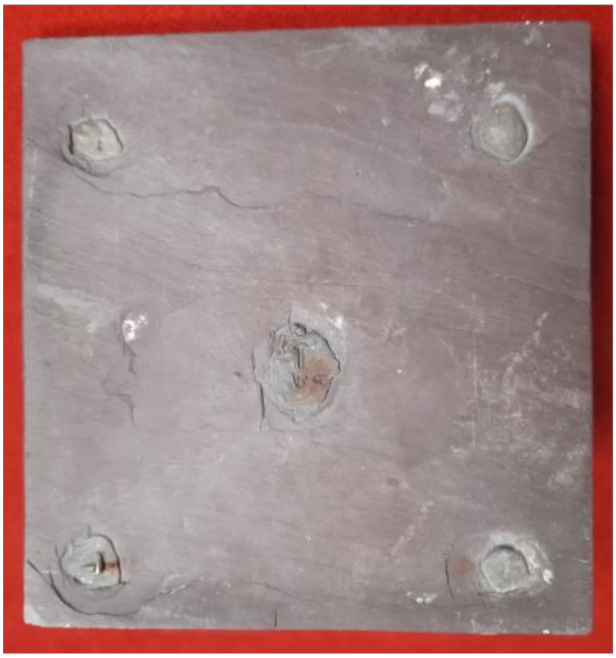
Fig. 1. The sundial as received.

The central large gnomon was placed on a 32-pointed compass rose with eight labelled directions. The four corner dials had smaller gnomons. Close examination of the gnomons showed that although the geometries of the four small brass gnomons were correct for the stated latitude, none of their roots was correctly positioned (Figs 2a and 2b) and in some cases they were not fully seated on the dial plate (Fig. 3) or set vertically to it. The principal gnomon was acceptably correct. The details of the



Figs 2a and 2b. Examples of wrongly-positioned gnomons.

Fig. 3. A gnomon not seated correctly.



Fig, 4. The underside with lead fixings.

Fig. 5. Re-incision work in progress.

delineations seemed generally to be lacking in clarity due to accumulated grime, but although there were a few scratches visible, the surface of the dial plate seemed to be in good condition considering its age. The edges of the plate were scarcely chipped and examination of the riven finish of the underside showed the typical lead seating of the gnomons (Fig. 4). The tenon of one of the small gnomons protruded further than the plane of the face, causing the whole dial to wobble on a horizontal surface.

A good scrub-down of the whole assembly with warm soapy water and an old toothbrush was the first task, resulting in a much-improved overall appearance. After drying, this was followed with a 'brass rubbing' of the dial face using a soft pencil on drafting paper. After consultation with the owner, I removed all the small gnomons by grinding away the lead with a rotary 2 mm cylindrical file bit in a small electric drill. They were appropriately labelled and kept safely for later re-insertion. It was also agreed that, in spite of the distinct difference in thickness of one of the small gnomons, I would not replace it with a new one of matching thickness because its patina would be very different from that of all the others.

The next job was to re-cut lightly all the incisions. This slow and delicate job was done with a 2 mm sharp square-edged single-handed chisel. Headband magnifier goggles aided careful working round all the serifs, scrolls and flourishes of the copper-plate letters and numerals. The effect can be seen in Fig. 5 when about a third of the process had been completed. The dial was beginning to come alive again.

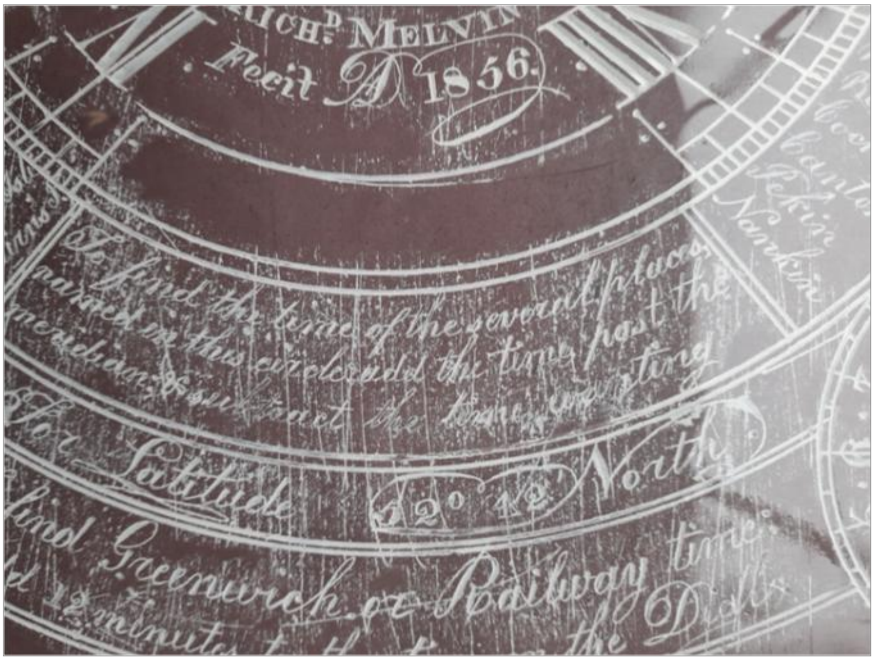


Fig. 6. Scratches revealed after rubbing down the paint.

The dial could have been left in this state, but when it became wet in rain the contrast between the incisions and the slate surface would have been lost. Once again, with the owner's permission, I proceeded with my normal practice which was to paint the incisions in a light matt grey enamel. Clearly, the paint overlapped the incisions and had to be removed once the paint had dried. This was done with careful rubbing with a 400-grit diamond pad. This turned out to be a very revealing process. Even the lightest scratch shows up as the rubbing proceeds, and many deeper scratches – hitherto unseen – were revealed (Fig. 6). This meant more rubbing in those places which inevitably took away some of the outer edges of the dial delineations. These in turn needed to be re-defined and re-painted.

Eventually, all the painting was finished, and the four small gnomons could be re-set in their correct positions. Rather than lead, a coloured epoxy adhesive was used (Fig. 7). All the gnomon tenons were drilled through with a couple of 3 mm holes to give better anchorage, and one of the gnomon tenons had to be shortened to avoid the rocking previously detected.

Fig. 7. The underside with epoxy fixings.

Fig. 8. The finished sundial.

Finally, all surfaces of the slate were given an almost-dry rub-down with wood-finishing oil, and quickly rubbed again with a dry cloth. The result was that the slate surface became permanently dark and the incisions remained white. The sealing of the surfaces in this way also meant that finger marks from handling the dial did not show up (Fig. 8).

The sundial was eventually returned to the grateful owner after a couple of months of on-and-off intensive work.

REFERENCE

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david@davidbrownsundials.com

THE L'ABÉE-LUND SUNDIAL COMPASS

ROAR HAGEN-DIEZ

On 6 November 1914, the Norwegian engineer Johan Henrik L'Abée-Lund (1881-1962) patented his *Uhrkompas*,[1] or sundial compass (Figs 1 and 2). The instrument was later known as the "L'Abée-Lund Uhrkompas".

L'Abée-Lund (Fig. 3) was gifted and creative and is credited with over 40 inventions,[2] but he is best known for his great interest in compasses. As the name suggests, the Uhrkompas (literally, "watch compass") accomplishes something that many people believe is impossible: the use of a magnetic compass to tell the time.

In the 1920s the sundial compass was carefully crafted by the Andreas Jensen Krogh company, one of the finest instrument makers in Oslo. The sundial was housed in a brass casing 52 mm in diameter and 8.5 mm thick and had a thick crystal glass cover. There was a fixed compass card, with two principal scales, and a magnetic needle with an agate pivot. The metallic strip, to the left of the red ant, was part of the mechanism for locking and unlocking the needle. The glass cover was secured in place by a bezel which could be turned by hand. The bezel also carried a small secondary pointer, and the underside of the glass was marked with a black and gold direction-of-travel arrow which pointed away from the secondary pointer. The purposes of the two scales, the bezel, the secondary pointer and the travel arrow are discussed below.

Fig. 1. The first model of the L'Abée-Lund Uhrkompas.

Fig. 3. Johan Henrik L'Abée-Lund, from around the 1920s. Courtesy Jan Henning L'Abée-Lund.

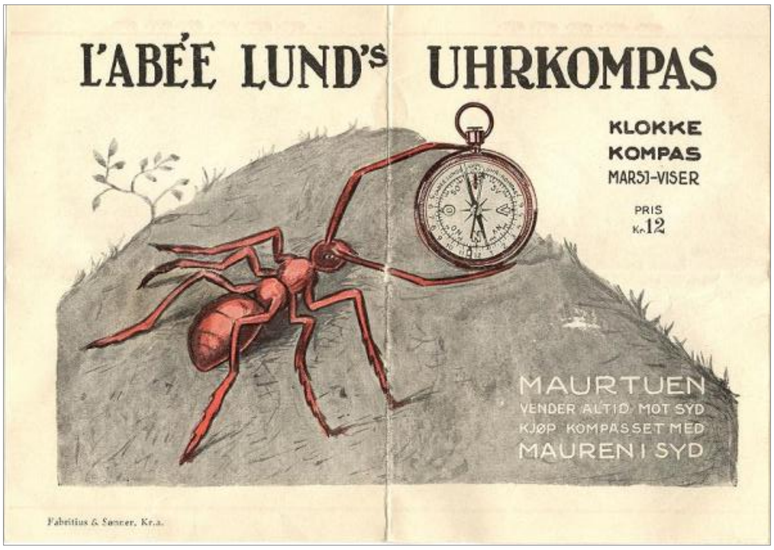

Fig. 2. Cover of the manual for the L'Abée-Lund sundial compass, 1920. The text in the bottom right-hand corner reads "The anthill always faces south. Buy the compass with the ant pointing south". Photo: compassmuseum.com

The Compass Card

The inner scale on the compass card is marked with tick marks at five-degree intervals of azimuth running clockwise round from 0° to 360°. Tick marks at 30° intervals are explicitly labelled. The cardinal and sub-cardinal directions are marked with the Norwegian equivalents of N, NE, E, SE, S, SW, W and NW, except that where S should be there is the figure of a red ant. This was, in part, a marketing feature reflecting the observation that ants tend to build their nests on the south sides of trees.

Up to this point, the description could apply to many compasses that have been marketed over the centuries. The major novelty is that the outside scale is marked out to indicate the time of day. Hours are shown from 5 am to 7 pm running *anti*-clockwise, which is not the case with regular horizontal sundials in the northern hemisphere. Another difference is that 6 am and 6 pm do not align with east and west.

The Relationship between Time and Azimuth

Using a compass to tell the time requires an understanding of the relationship between solar azimuth and local apparent time (LAT); the two scales on the compass card show this relationship for a particular latitude, φ, and time of year or (more precisely) solar declination, δ.

Accordingly, if you happen to be in the right place at the right time of year, you can use the compass directly, as described in Example 1 below. First, we must investigate just what latitude and solar declination give rise to the relationship implicit in the two scales.

By inspecting Fig. 1, one can tabulate, for each hour from 5 am to 7 pm, the associated azimuth relative to the azimuth at 12 noon. The middle column of Table 1 shows the results; the azimuth at 12 noon is taken as 0°. Consider, for example, one hour either side of 12 noon; in Fig. 1, the 11 am and 1 pm tick marks are about 19° either side of the reference zero so 19° is shown against 11 and 1 in the table.

LAT from Fig. 1	Azimuth from Fig. 1	Azimuth calculated $\varphi = 60°, \delta = 9.86°$
5 and 7	108°	107.8°
6 and 6	95°	95.0°
7 and 5	82°	81.9°
8 and 4	68°	68.2°
9 and 3	53°	53.4°
10 and 2	37°	37.0°
11 and 1	19°	19.0°
12	0°	0.0°

Table 1. Two sets of solar azimuth values (relative to due south) for each hour from 5 am to 7 pm, taken from the compass card and by calculation when the latitude is 60° and the declination is 9.86°.

Six hours either side of 12 noon, at 6 am and 6 pm, the relevant tick marks are 95° either side of zero.

After some experimentation, $\varphi = 60°$ and $\delta = 9.86°$ can be shown to give a very good fit. The calculated azimuth values using these parameters are shown in the third column. They agree with the values measured in Fig. 1 to better than half a degree.

In considering why L'Abée-Lund settled on these values, we should note that the latitude of 60° is close to that of Oslo and Bergen, two major centres of population in Norway. Moreover, this latitude is close to that of Stockholm (Sweden), where one might expect another market for this product.

We should also note that the declination of 9.86° happens to be one of four values that coincide with the Equation of Time being zero. It is the only one of the four that occurs in the middle of a month, mid-April.

We also note that, with a declination firmly in the summer half of the year, the sun will be north of due east and due west at 6 am and 6 pm.

We can now demonstrate a particularly simple use of this instrument.

Example 1 – A Very Special Case

Let us make the following assumptions:

- The user is located at 60° north
- The local magnetic declination is zero
- The date is mid-April when…
- The solar declination is close to 9.86° and…
- The Equation of Time is close to zero.

In these exceptional circumstances, the time scale on the compass directly indicates Local Mean Time.

When using this compass, we deem the *central axis* to be the line running from the N mark through the ant mark and onwards past the external support ring and, given that the local magnetic declination is zero, it would be good practice to rotate the bezel so that the direction-of-travel arrow aligns with the central axis. The bezel, as set in Fig. 1, needs to be rotated about 27° anti-clockwise to bring the travel arrow into alignment with the ant.

This compass is not equipped with sights and, when making a solar observation, the user aligns the central axis with the point on the horizon directly below the sun. At 12 noon Local Apparent Time (LAT), the sun is due south and, given zero local magnetic declination, the north end of the compass needle will point both to the N and to the 12 o'clock tick mark. LAT is thereby identified without the need for any correction. Given that the Equation of Time happens to be zero, it is also 12 o'clock Local Mean Time (LMT).

After an hour, the sun moves 19° towards the west. If the user again aligns the central axis with the sun, the north end of the needle will *continue to point north* but, now that the central axis has been rotated, the needle will no longer point to the 12 but to the time tick mark labelled 1 o'clock.

The corresponding point on the azimuth scale is 341° (360°–19°) which suggests that it might have been better for the azimuth scale to run anti-clockwise (the same sense as the time scale) to reflect the fact that solar hour angle and (at this latitude) solar azimuth are both increasing continuously.

In the circumstances chosen, sunrise is shortly before 5 am and the user can make observations throughout the day from sunrise until sunset, shortly after 7 pm, and will be able to read Local Mean Time directly. Stretching these fantasy circumstances even further, we may suppose that the longitude of the user's site is 15° east (in Sweden). The instrument will then indicate Central European Civil Time throughout the day because 15° east is the reference meridian for that time zone.

There is a day in late August when the declination is again 9.86°, but the Equation of Time is not zero then. The instrument will indicate LAT but not LMT. Departing from this special case, let us next consider how to use the instrument when the local magnetic declination is not zero.

Example 2 – Adjustment for Magnetic Declination

Let us retain all the assumptions stated in Example 1 except that the magnetic declination is no longer zero. The user must now rotate the bezel by an appropriate offset. For example, if the magnetic declination is 7° to the west, the bezel must be rotated 7° clockwise. This is shown in Fig. 4 where the secondary pointer (labelled 'small pointer' in the figure) is set so that its little dot is positioned 7° clockwise round from the 0° azimuth mark.

Fig. 4. The sundial compass is held horizontally with the direction-of-travel arrow pointing towards the sun. The picture shows a later model than the one in Fig. 1.

To determine the time now, instead of aligning the central axis of the instrument with the sun, the user should align the direction-of-travel arrow with the sun. When the sun is due south, at 12 noon LAT, the secondary pointer and the travel arrow will be aligned *true* north–south. The north end of the needle will point to *magnetic* north, which is 7° to the west of true north and hence 7° west of the secondary pointer. This way, the north end of the needle will again point to the N and indicate 12 noon LAT, which is also 12 noon LMT.

To align the travel arrow with the sun at 1 pm, the user will have to rotate the instrument 19° clockwise from its orientation at 12 noon. The north end of the needle does not rotate. In effect, the scales rotate round it. The north end of the needle will now indicate 1 pm LAT which is also 1 pm LMT.

Provided the user makes observations only in mid-April, the north end of the needle will directly indicate LAT (which, as before, is the same as LMT) from sunrise to sunset. No corrections are necessary.

Example 3 – Adjustment for Other Days of the Year

Let us retain the assumption that the local latitude is 60° north but remove all the other assumptions made in Example 1.

The user must begin exactly as in Example 2: set the bezel to accommodate the magnetic declination and align the direction-of-travel arrow with the sun at each observation. The needle will indicate a time but, in general, the indicated

Fig. 5. The underside features an engraved table with numbers calculated for the middle of each month. When the date is not in the middle of a month and the time is not one of the chosen values, interpolation is necessary. Photo: TheCompassCollector.

	ANTE MERIDIEM				POST MERIDIEM		
	7	9	11	12	1	3	5
JAN			10	35	55		
FEB		0	25	40	55	80	
MAR	5	10	25	35	40	55	60
APR	25	25	25	25	25	25	25
MAY	40	35	25	20	15	5	0
JUN	60	50	35	25	15	0	•10
JUL	60	55	40	30	20	5	0
AUG	40	35	30	30	25	20	20
SEP	5	10	15	20	25	30	35
OCT		•20	0	10	20	40	
NOV			•10	10	30		
DEC			•5	20	40		

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Table 2. Correction table on the underside of the instrument.

time will need correcting. Suppose that the magnetic declination is again 7° west and, at some time in the afternoon, the user aligns the travel arrow with the sun and the needle comes to rest as in Fig. 4. The north end of the needle indicates about 14:25 (though the label in the figure shows 14:30). In mid-April, LAT really will be about 14:25 but suppose it is mid-July? The procedure is to add a number (of minutes) provided in the table engraved on the bottom of the brass case. The underside of the instrument is shown in Fig. 5 and a translation is provided in Table 2.

There are 12 rows of numbers, one for each month. A few numbers are prefixed with a dot. Those numbers must be subtracted rather than added. Against each month there are up to seven values which show the required corrections for seven selected times (7, 9 and 11 am, 12 noon, and 3, 5 and 7 pm). The nearest of these times to 14:25 is 3 pm, and the number at the intersection of the July row and the 3 column is 5. Accordingly, 5 minutes must be added to 14:25, suggesting that the time is 14:30.

The numbers in each row apply to the middle of each month and interpolation is required when the date is not close to the middle of a month. Since all even-numbered hours are omitted except 12 noon, a second round of interpolation will generally be needed. There are many other questions, most notably: is the indicated time LAT or something else? These questions can be answered by studying Table 2…

Understanding the Table

At sunrise and sunset, the sundial compass should have a major advantage over an ordinary sundial. It is almost impossible to see a shadow when the sun is on the horizon, but taking a bearing of the rising or setting sun with a compass should be straightforward.

Suppose a user decides to test the instrument at sunrise on the day of the vernal equinox. The sun is due east, so the north end of the needle will point at the Ö (for east) where the indicated time is about 06:25. We might expect the table to advise that 25 minutes should be *subtracted*, to give equinoctial sunrise as 06:00, the LAT of sunrise when the declination is zero.

The vernal equinox is a few days after mid-March and the earliest time column in the table is for 7 am where the March entry suggests adding 5 minutes which, added to 06:25, gives 06:30, hardly the expected result!

For an explanation, it is necessary to examine the numbers in the table and determine how they were derived.

The April row immediately stands out because all seven entries are the same: 25 minutes. We know that there is no need to make an adjustment to the LAT values in mid-April because the outside scale on the compass gives LAT directly throughout the day. There is also no need to take the Equation of Time into account either since that is close to zero all day. The only possible reason for adding 25 minutes to every indicated time is to make a longitude correction.

One degree of longitude equates to four minutes of time so 25 minutes equates to 6¼°. Why would you want to know the LAT at a location 6¼° east of your present position? This makes sense only if your geographical position is 8¾° east, where adding 6¼° takes you to 15° east, the reference longitude for Central European Time.

We have already shown that the design latitude for this instrument is 60° north and it now seems that the design longitude is 8¾° east. It was noted that 60° north is roughly the latitude of both Bergen and Oslo. Simple study of a map shows that 8¾° east is almost exactly the mid-point from where the 60th parallel crosses the west coast of Norway to where it crosses the border with Sweden. Unfortunately, 60° N, 8¾° E is not a very interesting location. It is close to a road through a forest so is readily accessible to anyone wishing to test the sundial compass in its design location!

It is not only in mid-April that the outside scale gives LAT directly. This scale also directly indicates 12 o'clock LAT *every day* of the year. The sun is always due south at noon

JAN	10
FEB	15
MAR	10
APR	0
MAY	–5
JUN	0
JUL	5
AUG	5
SEP	–5
OCT	–15
NOV	–15
DEC	–5

Table 3. The 12 o'clock column with 25 deducted from each value.

when the north end of the needle always indicates 12 o'clock.

The 12 o'clock column in the table is therefore as noteworthy as the April row. The sum of the 12 values in the 12 o'clock column is 300 so the average value is 300/12 which is 25. If we subtract 25 from every value in the 12 o'clock column we obtain the Equation of Time corrections for each mid-month entry in the table. These values are shown in Table 3.

The inference is that these are L'Abée-Lund's assumed mid-month values of the Equation of Time; they are all correct to the nearest 5 minutes.

We may now determine L'Abée-Lund's corrections for converting raw indicated times to LATs. For each entry in Table 2:

1. Subtract 25 and then…
2. Subtract the month Equation of Time value shown in Table 3.

For example, subtract 25+10 from each entry for January and subtract 25–5 for each entry in May. The result is shown in Table 4.

The values in Table 4 can be applied to convert the time indicated on the outside scale of the compass into LAT. Notice that no corrections are needed in mid-April.

Returning to the time of sunrise at the vernal equinox, we previously noted that the indicated time was 06:25 and added 5 minutes. Table 4 suggests that we should subtract 30 minutes instead to give 05:55. This is much closer to the required 06:00.

Here we note that Table 4 is not self-consistent. On a given date, the afternoon corrections should reflect the morning entries but with a sign change. For example, the entries for May are consistent: 20, 15, 5, 0, –5, –15, –20. By contrast, the entries for March are not consistent: –30, 25, –10, 0, 5, 20, 25. In particular, –30 and +25 do not match. Either value could be correct or both could be wrong. If +25 is correct and –30 is changed to –25 then we would have exactly the right value for revising 06:25 to 06:00. This is too good to be true…

To the nearest minute the correct 7 am and 5 pm values are –28, and +28. This would adjust 06:25 to 05:57. We can refine this result using interpolation; we note that –28 is the 7 am correction in mid-March and in mid-April the correction is zero. The 7 am correction is increasing about one minute every day. The vernal equinox is several days after mid-March and the appropriate 7 am correction for the vernal equinox is actually –23 minutes. This would correct 06:25 to 06:02.

How can the unaccounted for two minutes be explained? The answer is that the original 06:25 estimate of the point on the time scale corresponding to due east is a reading error. The time corresponding to due east is close to 06:23 but it is very difficult to read the time scale to the nearest minute!

Summary of Functionality

The foregoing analysis explains how L'Abée-Lund intended the sundial compass to be used. It is not known how he calculated the values in the table on the underside of the compass but they are correct to within five minutes. It might have been better to use the values in Table 4 (corrected where required and perhaps with the values shown to the nearest minute). It would then have been necessary to supply an Equation of Time chart as well as an explanation as to how to adjust for longitude. Additional tables could be supplied for different latitudes.

	ANTE MERIDIEM				POST MERIDIEM		
	7	9	11	12	1	3	5
JAN			–25	0	20		
FEB		–40	–15	0	15	40	
MAR	–30	–25	–10	0	5	20	25
APR	0	0	0	0	0	0	0
MAY	20	15	5	0	–5	–15	–20
JUN	35	25	10	0	–10	–25	–35
JUL	30	25	10	0	–10	–10	–30
AUG	10	5	0	0	–5	10	–10
SEP	–15	–10	–5	0	5	10	15
OCT		–30	–10	0	10	30	
NOV			–20	0	20		
DEC			–25	0	30		

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Table 4. The values in this table show the corrections to be added to the observed times to obtain LAT rather than civil time. Each value in the table is derived in two steps from the corresponding value in Table 2. First, the longitude correction, 25, is subtracted from every value in Table 2 and then the Equation of Time values (shown in Table 3) are subtracted. For example, in Table 2, the entry for 7 am in mid-March is 5. Subtracting 25 gives –20. The Equation of Time value for mid-March is given in Table 3 as 10. Subtracting this value from –20 gives –30, as shown here.

Of course, L'Abée-Lund could simply have marketed a perfectly ordinary compass and explained how to determine LAT given solar azimuth and knowing the latitude, solar declination.

Further Details of the Design

It is quite common for a compass to be equipped with a lever of some kind to prevent the needle from swinging. This is sometimes called a travel lock. The first version of the L'Abée-Lund compass was unusual in that the lock prevented the needle from swinging until the user pressed in the knob at the centre of the external support ring and held the knob in. The white metallic strip seen to the left of the ant in Figs 1 and 4 is part of the locking mechanism. It is easy to believe that the mechanism might ice up in freezing weather.

Another detail not referred to above is that the direction-of-travel arrow has a strip of luminous paint on it. This is clearly visible in Figs 1 and 4. It could be useful for taking bearings at night but is not essential when determining the solar azimuth!

Marketing the Sundial Compass

The red ant seen in Figs 1, 3 and 4 was part of a promotional gimmick. The marketing slogan was *Med Mauren i syd* ("With the ant in the south"). The 1920s was a period of unprecedented change in the way goods were produced. With the advent of new technologies, mass production improved, and factories could produce more significant quantities of goods more efficiently than ever before. This technology also impacted marketing, as more products could now reach a much wider audience. The mass production of goods also decreased prices, making them more affordable for consumers. As a result, these years were a pivotal time for marketing, as it laid the foundations for modern mass-marketing techniques. The first batch of sundial compasses was sold for 12 NOK (≈ 1 GBP) in September 1920, in today's money about NOK 265 (≈ GBP 34.05).

One of L'Abée-Lund's commercial stunts was to use large walls or fences, with only the slogan painted in black and white; 'with the ant in the south' (see Figs 6 and 7). People took notice of this advertising, some with great curiosity. Others vented their anger in the local newspapers, where they demanded the removal of the posters. A few days later, the marketing campaign was revealed, and the full explanation of the Red Ant story was told.[3]

The marketing campaign was a great success, and L'Abée-Lund sold over 12,000 sundial compasses, before disaster struck. A severe snowstorm battered the south Norwegian mountains at Easter 1921. A group of four friends went cross-country skiing from Finse to Geiteryggen where they would spend their Easter holiday together. A freezing blizzard hit them with extremely high winds. After 50 hours in the storm, one of them gave up. He was later found frozen to death.[4] In the aftermath, the skiers blamed the

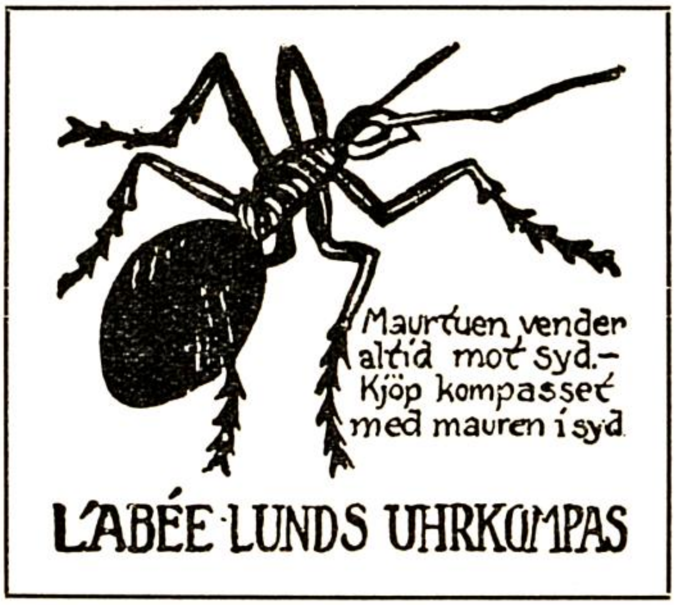

Fig. 6. Marketing advertisement from 1920, reading "The anthill always faces south. Buy the compass with the ant pointing south".

Fig. 7. Simple newspaper advertisement from 1921.

sundial compass for the accident. They claimed that the compass was not waterproof, and that the magnetic needle kept getting stuck. As a result, there was public outcry in the newspapers.

L'Abée-Lund claimed that there was nothing wrong with his instrument: the only ones to blame for the accident were the skiers themselves. The danger of going unprepared into the Norwegian wilderness was potentially fatal.

The following year L'Abée-Lund published a 20-page booklet called *På Ski Med Kart og Kompass* ("Cross-country Skiing with Map and Compass"). Subtitle: *23 gode regler for fjellturer* ("23 Good Rules for Mountain Hikers"). He also released his new sports model of the sundial compass, as seen in Figs 4 and 8. With the same diameter of 52 mm but now 10 mm thick, a new waterproof

Fig. 8. The new, improved, second model of the L'Abée-Lund Uhrkompas, with a screw lock. Notice the beautifully crafted magnetic needle now with the lettering N and S. Photo: TheCompassCollector.

Fig. 9. Map scale etched into the side of the sundial compass. Photo: TheCompassCollector.

patent for the release mechanism of the magnetic needle was made and the push-button locking mechanism of the early models was replaced by a more secure screw lock. The needle was made more readable with the lettering N and S being added.[5] A map scale was now placed on the side (Fig. 9), to assist in measuring distances on the map. When the same scale is present on both the map and the compass, the distance between two points can be easily determined by reading it from the compass, here 1:100,000.

The improved sundial compass was marketed as the Number One *must-have* for everyone who enjoyed the freedom of hiking. The advertisements now contained proof from members of the committee of navigational instruments, various meteorologists and, finally, one of the participants of the terrible snowstorm accident, an engineer named Jordal. All of them gave the new and improved sundial their seals of approval.

L'Abée-Lund also exported his sundial compass to Sweden. It is found in the Åhlens & Holms mail order catalogues for the spring and summer of 1931. It is uncertain if the Uhrkompas was exported to Denmark. Most likely, they were brought to Denmark from Norway or Sweden. The last time it featured in L.H. Hagen's winter sports catalogue was in 1932 (Oslo). After this, the Uhrkompas more or less disappeared from sale, primarily due to the availability of new and more modern compasses.

The last of these dials were made in a third model, where the patent had been removed and an hourglass logo replaced the red ant. Otherwise, the design was kept the same (Fig. 10).

Fig. 10. The third model, with the ant replaced by an hourglass and the patent removed.

ACKNOWLEDGEMENTS

Special thanks go to Jan Henning L'Abée-Lund for sharing his grandfather's story, to Helmut Sonderegger for listening and understanding my problems, and a special gratitude goes to Rolf Wieland for his invaluable assistance with the mathematical calculations in this article. His expertise and guidance have greatly enhanced the accuracy and reliability of the data presented.

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Roar Hagen-Diez is a Norwegian layman passionate about local history and many other things, including sundials. With expertise in multimedia design, he delves into the art, science, and history of timekeeping. Appreciating their craftsmanship and historical significance, he brings sundials to life, preserving their legacy for future generations. He can be contacted at *roardiez@hotmail.com*

HAPPY 30TH BIRTHDAY, NASS!

FRANK H. KING

The annual conference of the North American Sundial Society in 2023 was held in Ann Arbor, Michigan, and, of the various ways of marking the 30th anniversary year of the Society, the splendid cake shown in Fig. 1 was of particular note. This was on show before the Saturday dinner and, after being cut into pieces, it was served as the final course.

Fig. 1. NASS 30th Anniversary cake.

As with all NASS Conferences, there was a full-day bus tour looking at sundials in the region, and I was particularly struck by the dial in Fig. 2 which was in the garden of the Music School of the University of Michigan. Appropriately, the gnomon was in the form of a treble clef.

Fig. 2. Sundial in the garden of the University of Michigan Music School.

Next year's NASS Conference will be held in Vancouver, British Columbia. I once read that Vancouver is the best city in the world to live. The conference will be held over four days from 20 to 23 June 2024. I certainly hope to attend myself. May I recommend the occasion to others? UK visitors will find that spelling is easier to cope with in Canada than in the US; on the other hand, distances are measured in kilometres.

Pondering musically-themed sundials nearer to home, I was reminded of the one made by David Brown for a friend of his who now lives in Cambridge. Fig. 3 shows this dial prior to installation. Although the gnomon is not directly visible, its shadow clearly shows a bass clef. It turns out that both David and his friend were trombone players, so a bass clef is appropriate. Note numerous other musical ornaments such as the sharp signs for the morning half hours and the flat signs for the afternoon half hours. The half hours in the chapter ring are marked by semibreves and 12 noon is marked by a double sharp sign. There is an empty stave with bar lines (substituting for the more familiar sunburst round the gnomonic centre); the motto, perhaps, speaks for itself.

Fig. 3. A sundial in Cambridge made by David Brown (SRN 7719). Photo: David Brown.

fhk1@cl.cam.ac.uk

A PORTABLE DIAL PUZZLE

JOHN DAVIS

Fig. 1. Front and back of the sundial medallion.

This story started in April 2023 when pictures of the item shown in Fig. 1 were sent to Sue Manston on the BSS Help and Advice Desk. It had been purchased by Irena Newcombe in Devon, as part of an assorted auction lot of small metal items. The initial question was 'is this a sundial?', to which Sue gave the immediate answer of "yes, it is a horizontal sundial", but with some details that were new to her. Follow-up questions were more difficult, including was the "1707" date on it likely to be real and who might have made it? Also, there was a question of what it was made of: it was initially very dirty but even after a good wash in soapy water it was still quite heavily patinated. It did not look like a copper-alloy, and there was a distinct possibility, based on Irena's rub test, that it was silver – and hence reasonably valuable – which scraping a small area on the edge seemed to indicate. At this stage, Sue involved me as someone with a particular interest in the metallurgy of dials and Irena was persuaded to send it to Suffolk for analysis.

On receiving the well-packaged dial I was immediately taken by how relatively heavy it felt. It weighed 65.97 g, which was quite a lot for a disc with a diameter of 59.3 mm and around 2.3 mm thick, plus the tab for hanging it from a strap and an integral gnomon. An analysis by X-ray fluorescence (XRF) disappointingly confirmed that this was not silver but a form of pewter, with a high percentage of lead.[1] It was not a modern pewter, though, which is now lead-free on health grounds, but it could well have been used in the 18th century.

Sue had by this time reverse-engineered the spacings of the hour lines in an attempt to determine the design latitude but she had found that the angles did not match any expected sequence: in particular, the 11, 12 and 1 hour lines are too widely separated for any latitude. A side view of the dial (Fig. 2) confirmed that it did not have a properly-designed

Fig. 2. Three-quarters view of the dial showing the low-angle gnomon.

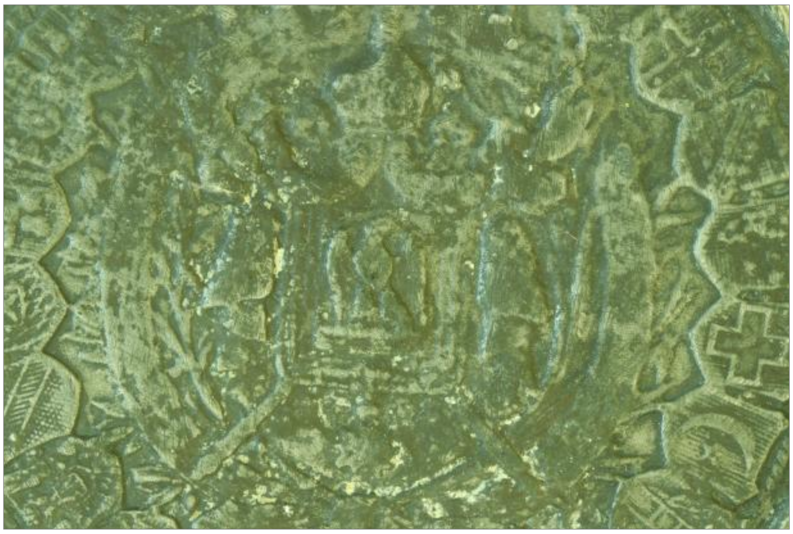


Fig. 3. Close-up of the centre of the reverse side of the dial showing the central coat of arms.

Fig. 4. The French coat of arms for the First Empire. (Wiki commons)

geometry and that the gnomon angle was 38°, which might conceivably match southern Europe or America but which was incompatible with the hour-line spacings. However, despite the nonsense dial, I had become intrigued by the reverse or 'medallion' side with its very detailed heraldic pattern which had clearly entailed a lot of work. The pattern had not been engraved directly but whether it had been cast in a mould or produced by striking an engraved die against a blank, as is done for coins, was not clear. The sundial side of the disc, by contrast, looked to have been produced by punching individual characters, perhaps with the lines being engraved. The medallion side was damaged and rather scuffed in places but it could be seen that the ring of arms around the outside was very detailed and looked properly 'heraldic' rather than the pastiches often seen, even though not all of the shields had typical British blazons. The script nearer the centre was not legible.

On advice, Irena had contacted the Portable Antiquities Scheme[2] (even though the item did not come into the formal category of 'treasure') where Dr Kevin Leahy, one of their experts in metal items, took on the challenge despite his main area of expertise being in Saxon metallurgy. He enlisted the help of Clive Cheesman who has the title of Richmond Herald of Arms and who quickly picked up that the central shield (Fig. 3) appeared to be the arms of Napoleon Bonaparte, also used by the First (French) Empire (Fig. 4). This of course would date the item rather later than the 1707 of the dial. Some elements of the outer shield were also recognised, including the Turkish *ay yıldız* (star and crescent) at the 4 o'clock position and, at 7 o'clock, UK royal arms (post-1837). This suggested that the whole scheme was not for the Napoleonic empire but a Gallocentric layout of the heraldry of Europe.

Finally, consultation amongst the heralds produced a complete match to a medal by Albert Barre, dated 1855 and made for an "Exposition Universelle des produits de l'Agriculture, de l'Industrie et des Beaux-Arts" in Paris which showed Napoleon III, Empereur, on one side and an heraldic feature closely matching the sundial on the reverse (Fig. 5).[3] Clearly, the die (or mould) for the reverse side of this medal had been obtained at a later date and reused after

Fig. 5. Medallion by Albert Barre issued at the Exposition Universelle, Paris, 1855. It has the head of Napoleon III on the face with the reverse showing the Imperial coat of arms within a wreath of olive leaves surrounded by a banner and a ring of the national arms of the participating foreign nations. Diameter 60 mm, silver. Sold for $400 in 2020.[3]

Fig. 6. Close-up of the dial (front) side showing the supposed date with a pewterer's 'touchmark' (?) between the '17' and '07'.

Fig. 7. A pewter dial recently sold in America with some similarity to the medallion dial.

some minor modifications such as the addition of the hanging hole and the scratching out of the inscription. The sundial itself must have been a separate production. Its 1707 date is thus false but it is interesting that it is close to the 1705 which is found on most of the infamous 'Thomas Grice' fakes, probably made by Pearson Page Jewsbury at their works near Birmingham between the wars.[4] They were probably not the makers of the medallion sundial though, as they worked in brass rather than pewter and were quite competent at sundial layout, whatever their other failings. Perhaps a clue to the maker is what appears to be a pewterer's 'touchmark' punched between the '17' and '07' (Fig. 6) but this has not yet been explored with The Pewter Society.[5]

Pewter dials are generally rare and more often seen in America than in the UK. A typical example sold online for around £100 is shown in Fig. 7. It was $3^1/_{16}$ inches in diameter and was described as "possibly American, c.1720-1820" and was blank on the reverse. Certainly, the low-angle gnomon looks not unlike that on the medallion dial and is suitable for America. Note, though, that the lettering and lines are raised, not engraved or punched.

The medallion dial, being pewter – and the rather cheap 'ley (or lay) metal' form, at that[6] – rather than silver, is not likely to have a high monetary value. Nevertheless, it is an interesting part of dialling history that someone thought it worth repurposing the French medal die to produce a novelty sundial. As such, we hope that it finds its way to a suitable museum collection to show the variety of sundial types that must once have been common.

ACKNOWLEDGEMENTS

I am very grateful to Irena Newcombe for the opportunity to explore her medallion and to Sue Manston for her H&A Desk correspondence. Kevin Leahy (PAS) and Clive Cheesman (College of Heralds) very kindly solved most aspects of the heraldry.

REFERENCES and NOTES

1. The XRF analysis showed that the composition, in weight.percent, was Pb (lead) 58.3; Sn (tin) 32.3; Sb (antimony) 4.7; Cu (copper) 3.5; As (arsenic) 0.38; Fe (iron) 0.32; Zn (zinc) 0.06. Separate analyses were made to study the very thin surface patina and, as expected, they showed that the black colouration was predominately metal sulphides/sulphates with some chlorides as well, and some calcium compounds (probably carbonates) in isolated areas.
2. The Portable Antiquities Scheme (PAS) is run by the British Museum and its database can be searched at *https://finds.org.uk/*
3. Lot 1154 at Classical Numismatic Group LLC, Feature Auction 114, 14 May 2020.
4. Jill Wilson: *Biographical Index of British Sundial Makers* (3rd edition), BSS Monograph No. 12 (2019), p.92.
5. *www.pewtersociety.org*
6. Two general types of pewter are recognised; 'Fine', used for items such as tableware, and the cheaper general-purpose 'ley metal' with a higher percentage of lead, used for other items.

john.davis51@btopenworld.com

The BSS 2023 Conference Sundial "Examination"

For the benefit of readers of the June 2023 *Bulletin* not present at the 2023 BSS Conference in Exeter, the "examination" paper compiled by Martin Jenkins and distributed during the outing on the Saturday afternoon[1] is reproduced on the next four pages. The answers are given on page 36.

1. *BSS Bull.* 35(ii), p.19 (June 2023).

British Sundial Society
2023 Conference Sundial Examination

Instructions and Rules

Name:

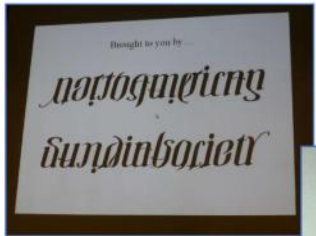
- Write your answer/answers underneath the question box.
- Maximum time allowed: 30 minutes (not per question!).
- No cheating or colluding : severe penalties apply!
- No cussing during the examination.
- Maximum possible score: 59 correct answers.

Fabulous Prizes

When 'time' is called please pass your examination paper to the person on your right.
'Peer review' impartial marking will be adopted.
The JUDGE'S decision is FINAL.

Reputedly the oldest dial in England, where is it?

Where is this dial?



What is the name given to this type of text manipulation?

Fred Sawyer has used this technique on some of his sundials.

Where is this dial and who is the gentleman with it?

Who wrote this and which book is it from?

There is nothing half so green that I know anywhere as the grass of that churchyard: nothing half so shady as its trees; nothing half so quiet as its tombstones. The sheep are feeding there, when I would kneel up, early in the morning, in my little bed in a closet within my mother's room, to look at it; and I see the red light shining on the sundial, and I think within myself, "Is the sundial glad, I wonder, that it can tell the time again?"

Where is this dial (A)?

Where is this dial (B)?

What city is this well known dial in?

Who made this dial?

Where is this dial?

What do we associate its location with?

Where is this dial, and what was it used for?

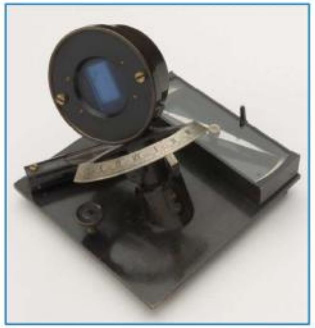
This instrument is used to measure the curvature of a surface. What is it called?

In what year did BSS member Anton Schmitz make this dial?

Where in Devon is this lovely public dial.
What does it commemorate?

What is the purpose of this type of dial?

In which South American city is this dial?



What type of dial is this, and what was it used for?

This is the Quisato sundial in Ecuador.

Give 2 of its claims to fame.

Who carved this dial?

This lovely dial is on what building and where?

Which park is this dial in?

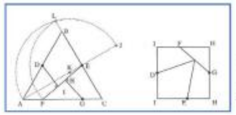
What is the correct name for this type of indented sundial?

Who painted this dial and where was it supposedly located?

Where is the observatory housing this quadrant? Who is the gentleman responsible for it?

Where is this dial? On what building is it?

What city is this dial in?
What year was the photo taken?



A customer has commissioned Ben Jones to make him a sundial. Ben suggests a triangular dial, similar to the one in Padstow.

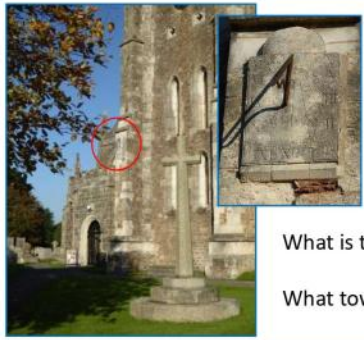
However, part way through the carving the customer changes his mind and states that he would prefer a square one. Not wishing to waste the material Ben decides to turn over the slate and cut the triangular piece in such a way as to form a square. (Superglue will suffice for the joins!).

What is the name of the mathematical solution that Ben employs to convert a triangle into a square?

Who is this dial attributed to?
Which Spanish town is it in?

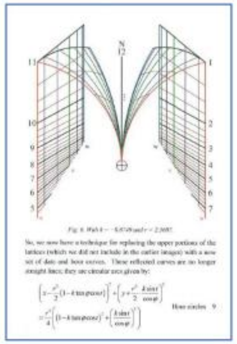
Who made this wonderful heliochronometer?

What date is given to it?



What is the name of the church?

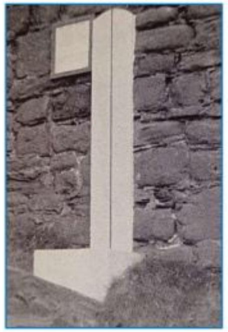
What town is it in?



Our Patron Fred Sawyer loves inventing new types of dials.
What type of dial is this?
(Note: One of the development equations is provided to assist with your decision).

This is the easiest question in the quiz!

Where is this dial?



Where is this noon line?
Name the town and island.

We all know where this observatory is but who had it constructed?

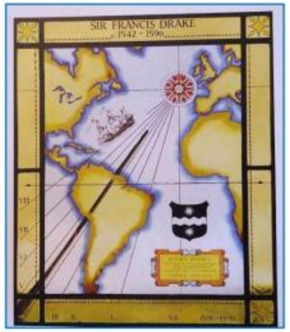
What is the name of the cathedral in Bologna, Italy which houses this meridian dial?

What date is given to it?

Who designed it?

What is the scientific name for this type of reflected sundial?

Extra mark for naming its location!



Where is this beautiful glass dial?

What does it commemorate?

Who designed it?

HOLIDAY SIGHTINGS

Sundials in the Palace of the Grand Master of the Knights of Rhodes

MACIEK LOSE

During a recent holiday in Rhodes, I visited the Palace of the Grand Master of the Knights of Rhodes, and in the exhibition there, I spotted two apparently unusual Hellenistic sundials recovered from archaeological excavations in Rhodes Town.

The first one (a) is split in two halves along the noon line in a manner similar to Augsburg equinoctial crescent sundials from 20 centuries later. It is about 30 cm across.

A nearby information panel indicates that it is made of Pentelic marble (a white, fine-grained marble quarried at Mount Pentelikon, north of Athens) and that the relief decoration is of a goddess protector of plants with a polos [crown] on the head.

(Viewed from above.)

The second sundial (b, c) – of which only half is preserved – is very small, with the preserved part being only some 6-7 cm across. The small size might suggest it to be for a private house rather than for a public place.

The information panel further notes that “several sundials have been found in the city, indicating that time must have been a precious commodity for ancient Rhodians”.

Maciek Lose

BSS ZOOM EVENT: 25 July 2023, 16:00 UTC

FRANK H. KING

The inspiration for the July 2023 BSS Sundial Zoom Event must be credited to our noted Latvian member, Martins Gills, but its genesis goes back to the days of the Covid-19 lockdowns. The BSS lost its 2020 Conference and Newbury Meeting and, when it became clear that we would lose the 2021 Conference too, the Trustees decided to arrange a Zoom event instead.[1] The feedback afterwards was very enthusiastic with many proposing that there should be regular such events, perhaps four times a year.

The three principal speakers in 2020 were Roger Bailey, Woody Sullivan and Fred Sawyer. The challenges of arranging four mini-conferences a year and regularly securing speakers such as these resulted in me leaving the proposal in abeyance. Two factors caused me to resurrect the idea. First, it became clear that post-pandemic attendance at our conferences and meetings was well down on what it had been. Secondly, Martins Gills suggested a format which didn't require so much administration and rehearsal.

The idea was simply to go through the pages of the most-recent *Bulletin* inviting comments and questions on each article in turn. He explained that he had been taking part in something similar in Latvia and sent me a link to an example Zoom event. I assiduously studied this recording and, notwithstanding my lack of understanding Latvian, I could see how the format might be made to work for the *Bulletin*.

I mentioned the idea at the 2022 Newbury Meeting. There was some enthusiasm for the proposal but decidedly limited enthusiasm to help with the associated organisation! In May this year, I decided to grasp the nettle and try a Zoom follow-up to the June *Bulletin*. Martins had kindly agreed to attend to the technical aspects of Zoom and I would play the continuity role. We settled on a date, 25 July, and a time of day, 16h UTC. This was 5 pm UK time – late enough for those such as Steve Lelievre on the West Coast of North America to be up and about and early enough for those in eastern Europe and the Middle East not yet to have gone to bed. Our most easterly participant was Syed Kamarulzaman in Malaysia who must have had a very late night!

I notified the BSS membership about the idea in the June Newsletter and, after publication, I sent out a further notification by email. In this, I drew attention to an article which showed several photographs of sundials on a monument in Hong Kong.[3] The photographs had been taken by a non-diallist and there was almost no information given. I sought a volunteer to investigate these dials and was delighted when Geoff Thurston replied with an offer to explain the gnomonic details.

I could see that some articles in the June *Bulletin* were likely to receive more attention than others and that the length of an article was not a good guide as to how much attention it might attract. The very short article about the Hong Kong dials stood out as requiring further investigation but I wasn't sure which other articles might generate extended discussion. Accordingly, when I sent out the Zoom URL and Passcode to the BSS membership, I invited participants to let me know which articles they might ask questions about or make comments on. I received a nil response! I became just a little concerned that Geoff would be the sole contributor, so I asked Graham Stapleton if he could say a few words about the Belgian sundial which was the subject of a short article by Frans Maes[4] and about which Graham had previously contributed a Reader's Letter.[5]

I also remembered Martins mentioning that participants of the Latvian Zoom events particularly appreciated introductory comments by authors of the articles. I had rather kept quiet about this observation on the grounds that some potential authors might be put off submitting articles at all if they felt they might have to defend what they had written as in a *viva voce* examination. Nevertheless, I decided to ask David Coffeen, the author of the lead article in the June *Bulletin*,[6] whether he might say a few introductory words. To my great delight he agreed and, he, Geoff Thurston and Graham Stapleton can be hailed as the three stars of the Zoom event! As a bonus David had one of the most interesting backgrounds for us to enjoy (see Fig. 1).

Fig. 1. David Coffeen introducing the lead article.

Of course, ALL those who wrote articles must be regarded as stars too since, without them, there would be no *Bulletin* and no post-publication Zoom event! Accordingly, very many thanks to all our authors. Please keep the articles coming in.

I could see no easy way to estimate timings. At one extreme I could see a sequence of protracted discussions which I would have to curtail and at the other extreme I could see us turning over the pages quite rapidly with almost no one saying anything. For the latter contingency, I thought it prudent to prepare a mini-talk, based on an aspect of one of the articles, which I could hold over to the end. I call this a Postscript, a kind of optional extra. Those who have had their fill can forgo the Postscript and leave!

Although I have given numerous Zoom talks, I have little experience of managing Zoom meetings. Appreciating that it could all go wrong, I decided to limit the advertising to BSS members alone. When we are a little further along the learning curve, we may be able to broaden the scope. It is not essential to have read the *Bulletin* or to have a copy nearby. Everything relevant is shown on

Fig. 2. Sara Schechner commenting on the Wooden Puzzle article.[7]

Fig. 3. Steve Lelievre commenting on the Belgian Dial article.[4]

the screen and non-member diallists should be able to follow the thread.

Martins and I plus two others had a rehearsal in advance and we decided on various Zoom protocols. I hold a Zoom licence (for unlimited minutes and up to 100 participants) and, immediately after starting the meeting, I handed over the role of Zoom host to Martins. We agreed that we would mute almost everyone and invite people to 'raise a hand' when wanting to contribute. I find it very hard to see the raise-hand icon so I was pleased to leave that to Martins. We didn't discuss the Zoom chat feature but we may revisit that. It was only when looking at the recording afterwards that I noticed many chat messages, with several erudite comments being contributed by Sara Schechner. Sara made some interesting spoken comments about the Wooden Puzzle described by Peter de Groot.[7] She noted that the wooden sundial reminded her of Zappeck-type dials which were made by an Austrian company, Stefan von Götz und Söhne. She also provided another interesting background (see Fig. 2). I also particularly enjoyed the background that Steve Lelievre provided (Fig. 3).

In the event, I started with a five-minute introduction which I hope can largely be dispensed with in future such events. Ten articles were looked at. The average time spent on the first three articles was 12-minutes and the remaining seven averaged about three minutes each. The Postscript lasted 20 minutes and was based on a figure Johan Wikander's article about three Norwegian sundials.[8]

I received many friendly messages by way of feedback. It is early days yet, but I am hoping these events will evolve with practice. As you read through this issue of the *Bulletin*, you may notice points to query or comment on. In which case, please let me know!

REFERENCES

1. Frank King, Roger Bailey, Woody Sullivan and Fred Sawyer: BSS Zoom Event – 17 April 2021, 16:00 UTC, *BSS Bulletin* 33(ii), 37-39 (June 2021).
2. *https://lists.uni-koeln.de/mailman/listinfo/sundial*
3. CHN: 'Holiday Pictures – Nan Lian Garden, Hong Kong', *BSS Bulletin* 35(ii), 7 (June 2023).
4. Frans Maes: 'How to Use the Belgian Altitude Dial?', *BSS Bulletin* 35(ii), 8-9 (June 2023).
5. Graham Stapleton: 'Belgian Portable Altitude Dial' (Reader's Letter), *BSS Bulletin* 34(iv), 40 (December 2024).
6. David Coffeen: 'A Newly Discovered Horary Quadrant from the French Renaissance', *BSS Bulletin* 35(ii), 1-7 (June 2023).
7. Peter de Groot: 'Wooden Sundial Puzzle', *BSS Bulletin* 35(ii), 15-16 (June 2023).
8. Johan A. Wikander: 'Octaval and Unequal Hours: Three Norwegian Sundials', *BSS Bulletin* 35(ii), 10-14 (June 2023).

fhk1@cl.cam.ac.uk

Stairwell Sundial, University of Michigan

The sundial in Fig. 1 is in a stairwell of the University of Michigan Energy Institute; it is one of the dials which were seen on the bus tour during the NASS Conference in June (see also page 25 of this issue). It is Dial 1085 in the NASS Registry.

The dial is marked out on the inside of a cylindrical wall. The centre of the eight radial arms supporting the skylight forms the nodus. The hour numbers are in Arabic numerals at the top of the dial surface, and the hour lines are formed by series of dots. The visit was around the middle of the day in early June when the sun was so high that the shadow of the nodus is largely behind the staircase.

The vertical smudges at the top are actually the names of places; they form the labels of a toposcope.

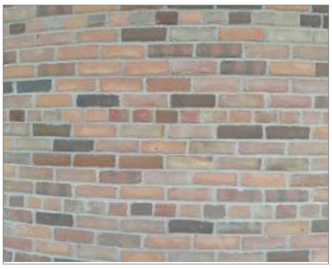


Fig. 2. Readers interested in brickwork bonds may enjoy this detail of the outside of the cylinder. It is very like English Garden Wall Bond but there are five courses of stretchers between courses of headers instead of three.

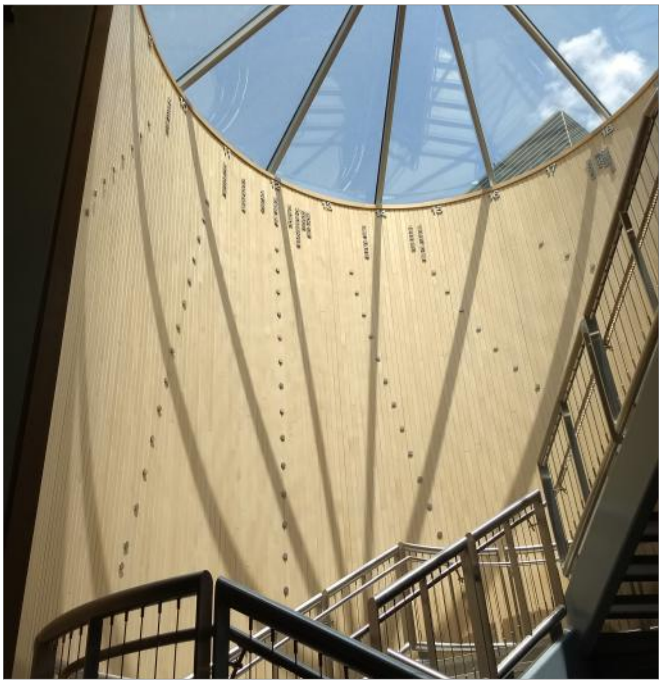


Fig. 1. Cylindrical Sundial.

FHK

BSS Sundial "Examination" – Answers

PAGE 29	Instructions and Rules	Bewcastle Cross, Cumbria c.670 AD. [SRN 0390] *BSS Bull*. 95.1, 2-8 (Feb. 1995) and *BSS Bull*. 95.2, 10-17 (June 1995)	Holyrood Palace, Edinburgh. [SRN 1490] *BSS Bull*. 25(iv), 24-25 (Dec. 2013)
	Ambigram.	Greenwich Observatory, CStJH Daniel. [SRN 2157]	*David Copperfield*, by Charles Dickens.
	(A) St Cuthbert's Church, Bewcastle, Cumbria [SRN 8430]; (B) Chicksands Priory, Shefford, Bedfordshire. [SRN 2291]	Oxford. [SRN 0987]	David Brown. [SRN 4072] *BSS Bull*. 12(ii), 55-58, 59-63 (June 2000)
PAGE 30	Munnar (tea plantation), India. *BSS Bull*. 31(ii), 35-37 (June 2019)	Anuradhapura, Sri Lanka. For the Buddhist monks to determine time to eat lunch. *BSS Bull*. 31(ii), 7-9 (June 2019)	Spherometer, 2011.
	Roadford Lake, Diamond Jubilee of HM Queen Elizabeth II. [SRN 8077] *BSS Bull.* 35(i), 22-24 (Mar. 2023)	To indicate noon with a bang!	Cartagena, Colombia.
	Dipleidoscope, noon transit.	1 Highest dial on earth. 2 Can be seen from space. 3 Lies on the equator.	Ben Jones. [SRN 8324] *BSS Bull.* 24(iv), 47-48 (Dec. 2004)
PAGE 31	Durgan School House, Durgan, Cornwall. [SRN 8429] *BSS Bull*. 32(i), 12-13 (Mar. 2020)	Ruskin Park, London Borough of Lambeth. [SRN 8431] *BSS Bull*. 30(iii), 32 (Sept. 2018)	Scaphe.
	George Young, Raunscliffe House. *BSS Bull*. 27(iv), 10-11 (Dec. 2015)	Samarkand, Uzbekistan. Ulugbek 1394–1449.	St Andrew's Church, Norwich. [SRN 2575]
	Bath, BSS Conference 2019. [SRN 3424] *BSS Bull.* 31(ii), 42 (June 2019)	Dudeney's dissection (Henry Ernest Dudeney 1857–1930).	Salvador Dali, Cadaques.
PAGE 32	Matthaus Hahn, 1783.	St Mary's Church, Ottery St Mary, Devon. [SRN 1035]	Hybrid Peaucellier Sundial. *BSS Bull*. 33(ii), 39 (June 2021)
	Tipton St John Village Hall, Devon. [SRN 8406]	Peel Castle, Isle of Man. [SRN 0592]	Jai Singh (1688–1743), Jaipur.
	San Petronio, 1655, Cassini. *BSS Bull*. 31(ii), 20-26 (June 2019)	Catoptric sundial. Trinità dei Monti, Rome.	Buckland Abbey, Devon. 1996, 400th anniversary death of Drake. CStJH Daniel. [SRN 3801]

A SELECTION OF ITEMS AVAILABLE FROM BSS SALES

BSS Bulletins: Back issues (more than 2 years old) can be purchased at £3.50 each or £7.00 for three issues. Please enquire for bulk orders or for posting abroad or for more recent issues.

Binder for *Bulletins*: Yellow with BSS emblem on spine. Holds up to 12 issues	£5.50
Alan Cook: *Mass Dials on Yorkshire Churches* (2008), BSS Monograph No. 3	£6.50
John Davis & Michael Lowne: *The Double Horizontal Dial* (2nd Imp. 2021) BSS Monograph No. 5	£17.50
Ian Butson, Jill Wilson & Tony Wood: *Sundials in Museums in the British Isles* (2010), BSS Monograph No. 7	£8.00
Alan Cook: *Addendum to Mass Dials on Yorkshire Churches* (2011), BSS Monograph No. 9	£6.00
Tony Wood: *Somerset Scratch Dials* (2015), BSS Monograph No. 11	£10.00
Jill Wilson: *Biographical Index of British Sundial Makers from the Seventh Century to 1920* (2019), BSS Monograph No. 12	£18.50
John Davis: *Sundial Glossary and sourcebook of dialling data* (3rd ed., 2020) BSS Monograph No.13	£14.00
John Davis: *The Portable Saxon Sundial at Canterbury Cathedral* (2021) BSS Monograph No. 14	£10.00
John Lester (ed.): *Mrs Crowley's Sundial Sketchbooks of Devon and Cornwall* (2008; published jointly with the Antiquarian Horological Society)	£15.00
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BSS: The Sundial Register of the British Isles 2019 (DVD or USB; publicly accessible dials only)	£15.00

BSS bow tie (£7.00), BSS tie (£9.00), BSS Ladies' scarf (£16.00), BSS lapel badge (£3.50)

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All the above, and more besides, are available from *sales@sundialsoc.org.uk*; please note that postage and packing are charged separately.

For the complete BSS Sales List, see *http://sundialsoc.org.uk/shop/books-and-publications/*

***Front cover**: Dial made by Richard Melvin in 1856 and recently restored by David Brown (see his account on pages 15-17). Photo courtesy of Jason Clarke.*

***Back cover**: The L'Abée-Lund sundial compass, dating from the early 1920s. Roar Hagen-Diez describes its design and use, and tells the story of how it was marketed, on pages 18-24. Photo: Roar Hagen-Diez.*

Editorial team: John Davis, Frank King and Christine Northeast

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