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EDITORIAL

In normal times, the June issue of the *Bulletin* would include an extensive report on the BSS Conference. Unfortunately, one of the disruptive consequences of the coronavirus disease (COVID-19) was that we were unable to convene in York in April so there are no talks or outings to report. A more subtle consequence is that the University of Cambridge closed almost all its on-site operations from 5 pm on 20 March with no plans to start up again before September. This closure matters because both Christine Northeast (who undertakes most of the copy-editing and layout of the *Bulletin*) and I are accustomed to making heavy use of the University's computing facilities. In my case, home computing means using an antiquated Unix platform and Christine is hardly any better equipped.

Fortunately, Christine had prepared a number of articles for the June *Bulletin* by the time the shutters came down and John Davis kindly took over the reins to see this issue to publication. We are most grateful to him for stepping into the breach.

In the pages that follow, you will find an excellent collection of articles. Appropriately, many are due to John Davis. Dennis Cowan provides us with another article in his Thomas Ross series. I also greatly enjoyed reading Part 2 of the description of the restoration of the magnificent Drummond Castle obelisk sundial.

An article by Maciek Lose particularly attracted my attention. He describes two double horizontal sundials that were made in Polotsk in the early 19th century. Many details are unlike those found on better-known English double horizontal dials. Sadly, neither dial seems to have survived.

John Foad provides outline details of dials that were reported to him in 2019 and Peter Ransom continues his Postcard Potpourri series.

It is difficult to predict how we shall be placed for the September *Bulletin* but we certainly hope to publish. Please use these interesting times as an opportunity to send us that article that you have never quite got round to writing.

Frank King

THOMAS AND JOSHUA MANN
Engravers and York Virtuosi*

JOHN DAVIS

Provincial dialmakers are much more difficult to track down than those from London, largely because the guild records corresponding to those of apprenticeships in London are not available for elsewhere in the country. Also, only Freemen of the City of London could trade there, so virtually everyone making or selling dials would be listed in one of the London Companies.

A horizontal dial which was recently offered for sale (Fig. 1) has a signature "I Mann York" which prompted this article and allowed several disparate threads to be pulled together to reveal a lively collection of artisans in York at the end of the 17th century.

Fig. 1. The dial sold on eBay, general view. Photo courtesy of Mark Austick.

The first port of call to identify an unknown dialmaker is Jill Wilson's *Biographical Index*[1] and the second edition shows that I Mann is actually Joshua Mann and that there is another Mann, Thomas, listed. There is a small scattering of dials by Thomas Mann included in the BSS survey of *Sundials in Museums*[2] but nowhere does it say that the two Manns were brothers. In fact, the Manns are quite well known as residents of York, but making sundials was only a minor part of their activities which were in the architectural field (Thomas) and in engraving monumental brasses (both brothers).

A good account of the Mann brothers' activities is given in a comprehensive article by R.J. Malden.[3] Strictly, they were not formally part of the group of artists and artisans generally known as the York Virtuosi as they were slightly too early in date, though they were certainly friendly with several people who went on to form the group.[4] The Virtuosi often met at the house in York's Micklegate of Henry Gyles (1645–1709), the well-known glass painter responsible for many stained glass sundials.[5] Thomas Mann was principally an architect and probably the elder brother as in his will, written in 1680 and likely to be near the end of his life, he gives his working tools to his brother Joshua (d. 1688). Thomas had many contacts including Robert Hooke whom he met in London together with other members of the newly-formed Royal Society – one of them was the mathematician John Collins (1625–83; known to diallists for his book on quadrants). Robert Hooke's *Diaries* report several meetings with both Manns though care is needed to distinguish them from Hooke's frequent visits to "Man's Coffee Shop". In October 1675, Hooke was at a meeting where there was a disagreement between Thomas and John Oliver (1616–1701). As well as being one of the surveyors of post-Fire London, Oliver was another glass painter who produced stained glass dials so it is interesting to see this link between the London and York styles. In December 1676 there was a meeting where Thomas met William Leybourne (1626–c.1700; another surveyor as well as a sundial designer and writer) and Sir John Hoskins who was President of the Royal Society: the Manns had good connections.

The two Manns are perhaps best known for their work as engravers of monumental brasses and other brass plaques. Examples at many locations in York are known[6] and some are illustrated online.[7] A full list of York monuments,

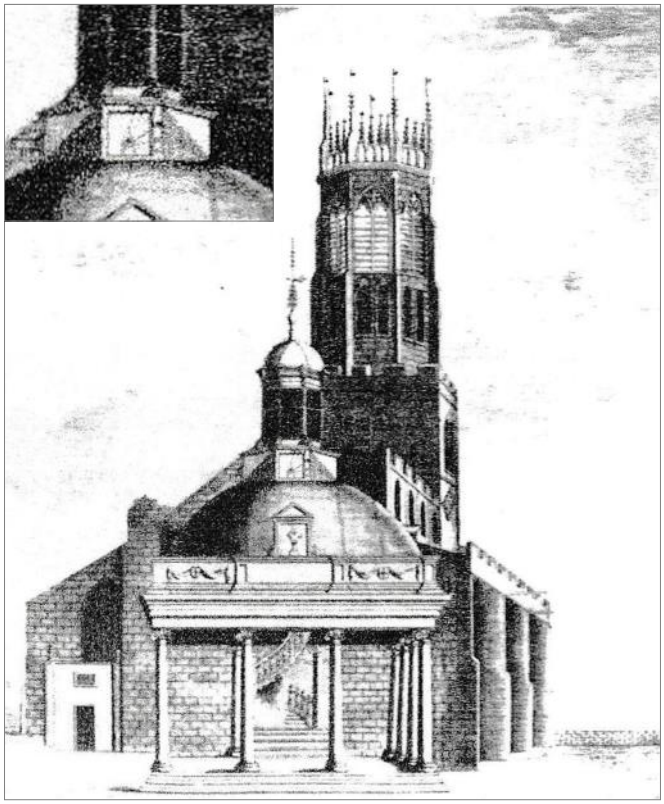

Fig. 2. Drawing, 1709, of Market Cross in Pavement, York, designed by Thomas Mann. Inset: the sundial(s) are on the octagon immediately below the cupola. From Malden, ref. 3.

including those by the Manns, is also available.[8] In the architectural field, Thomas Mann has several grand country houses to his name and also the commemorative Market Cross in York. Although the building was demolished in 1813, we have a full description, and a drawing of 1709 (Fig. 2), of its appearance.[9] It includes:

> "… finished on each Angle with Pillasters which revolves into Scrowles, on wch is 4 Quadrans or Sun Dyalls Lanskipt with severall Inscriptions. (i : e) on ye East Quadran, *Eheu fugaces*, on ye South Quadran *Dum Spectus fugio*, on ye West Quadran, *fugit hora ora*, on ye North Quadran, *Tempus Edax rerum*."

Fig. 3. Ebay dial, signature and motto. Photo courtesy of Mark Austick.

Thus it appears that Thomas Mann was familiar with sundial design and the common mottoes of the time. He was also a practical worker with mathematical instruments as a letter he wrote to Richard Beaumont on the back of a plan for improvements to Whitely Beaumont Hall in May 1674 says that he has "fixed your Quadrant which will only be of use to you for taking of Latitude because the houres and azimuths are calculated for London Latitude and therefore will not serve here [York]." This is most likely to have been a Gunter's quadrant. Also in the letter he says that he has "likewise fixed your Waywiser" and goes on to give a description of its method of use.

Sundials by the Manns

The first sundial to be considered is the horizontal one in Fig. 1 which started this enquiry. It is a fairly standard design with the signature "I Mann Fecit [16]83" and "Lat 54^{gr}" (Fig. 3) and with the very common motto VT HORA SIC VITA. A slightly unusual feature is that the N–S line runs through the points of the octagon rather than the more normal arrangement where it is drawn through the centres of opposing sides. Note that despite Mann's extensive experience in engraving brasses, he has not laid out the spacing of the motto in advance so there is a large space at the beginning but he has run out of room at the end. The deeply-engraved hour numerals are read from the inside, as was universal at this time, and the timescale is divided into half-quarters (7½ minutes) which was already obsolescent. The gnomon (Fig. 4) is somewhat thicker than is usual for the period and has a very well-executed piercing. It is fixed in the standard manner with two tenons and pins (Fig. 5).

Fig. 4. Ebay dial gnomon. Photo courtesy of Mark Austick.

Fig. 5. Ebay dial, underneath. Note the delineation holes to the bottom right of the tenon. Photo courtesy of Mark Austick.

The centre of the dial has the large letters IL which are highly likely to be the initials of the original owner. Normally, it would be virtually impossible to decode these but in this case a strong suggestion can be made. One of the members of the York Virtuosi was John Lambert and there are several reasons to believe that the initials are his. John Lambert of Calton (c.1640–1701; see Fig. 6) was the son of General John Lambert, a prominent member of Cromwell's New Model Army and also a gardening enthusiast and painter of flowers. (The latitude of Calton Hall, near Kirkby Malham is 54.05° N; York is actually 53.95° N.) John Lambert jnr. was an accomplished artist and has been proposed as the painter of a portrait of Henry Gyles (sometimes called a self-portrait).[10] He had a daughter Frances who married Sir John Middleton in 1699. A stained glass window from Belsay Castle of the arms of the two families has recently been attributed[11] to Henry Gyles, partly owing to its incorporation of a 'chubby cherub' – see below for the significance of this.

A very similar horizontal dial is in the BSS Fixed Dial Register (SRN 0256) at Adel, near Leeds in the west of Yorkshire. It is shown in Fig. 7 but unfortunately has since been stolen: it is not thought to be the dial that was recently sold because of the patina colour and the struts supporting the gnomon (which are a later addition, probably from the Victorian period). Notice, though, that it does share the same style of piercing for the gnomon and is likely to have used the same wooden mould for the casting. Gatty reports[12] what is almost certainly the same dial though she says it is engraved "J. Munn, Ebor. fecit ex donatu. 1682" which is surely a misreading of the name. It too has the motto "Ut Hora Sic Vita". The significance of the Adel dial is that the rector there at the time was Cyril Arthington who was a Fellow of the Royal Society and also one of the more peripheral members of the York Virtuosi. It seems reasonable to suppose, then, that there may be other dials made by the Manns for their acquaintances.

Fig. 6. Portrait of John Lambert by John Smith, after John Lambert; mezzotint, 1697 (National Portrait Gallery).

Gatty also reports another horizontal dial "by Mr Munn" for Woodsome Hall, just south of Huddersfield. It was originally the seat of the aristocratic Kay(e) family and is now the magnificent clubhouse to a golf club. The dial was dated 1683 and, in addition, a vertical one is described on the south wall of Almondbury Church, a year earlier. The current staff at Woodsome Hall do remember a dial near the house but it was removed a few years ago when a large tree fell and destroyed the stone balustrading. Although various members recall it being placed to one side, efforts to locate it have so far failed.[13] A source describes the

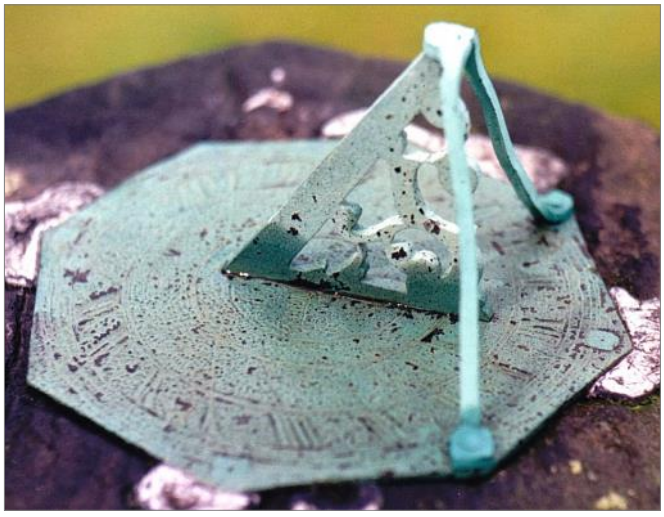

Fig. 7. SRN 0256, Adel, W. Yorkshire, picture taken in 1990 by Robert Sylvester but the dial is now missing.

Fig. 8. Almondbury Church showing a sundial on the outside of the Kaye (or South) Chapel. From ref. 14, plate between pp. 108 and 109.

Almondbury Church dial saying "The old Sundial has been replaced over the door of the South Chapel; and bears the inscription 'Ut Hora sic Vita, 1682' " so it would not be surprising if the Woodsome Hall dial also had this motto.[14] The South Chapel is also known as the Kaye Chapel as it is dedicated to that family and hence it is likely that they commissioned both dials from Joshua Mann. Although not in the Fixed Dial Register, a drawing of it was published in 1898[15] and is reproduced in Fig. 8. The Kay family were enthusiastic about new technology and in 1652 Sir John Kay installed a clock in the main hall with bells to ring over the estate, so having a good sundial on hand to regulate it would have been important.[16]

The article by Malden also shows a very intriguing silver Butterfield dial.[17] His Plate 4 is reproduced in Fig. 9 and had the caption "Pocket Sundial by Joshua Mann, 1686. Science Museum." and in the accompanying text he says that it was "offered for sale in 1972 to the Science Museum in London". However, enquiries at the Science Museum show that it is definitely not part of their inventory and they have no record of it being offered to them so, at the moment, its whereabouts are unknown.[18] This is doubly unfortunate as Malden enthuses over the quality of the dial,

	gr	min		gr	min
London	51	32	Yorke	54	00
Dorchester	50	41	Norwich	52	43
Salisbury	51	03	Lincoln	53	16
Canterbury	51	19	Doncaster	53	32
Oxford	51	46	Hull	53	47
Glocester	51	55	Lancaster	54	08
Hereford	52	08	Stocton	54	34
Huntinton	52	21	Durham	54	48
Coventry	52	28	Carlile	54	58
Stanford	52	40			
Morpeth	55	xx	Rothbury	55	20
Newcastle	55	01			

Table 1. Gazetteer from the back of the dial in Fig. 9.

saying that the workmanship is far in advance of that of similar dials by Thomas Tompion and Michael Butterfield himself – high praise indeed.[19] The dial itself has several important and unique features. Firstly, the latitude pointer for the adjustable gnomon is not the bird's beak which is found on around 95% of known dials of this type but, uniquely, a cherub pointing with his left arm.[20] The significance of this is the common appearance of similar 'chubby cherubs' in many of Henry Gyles' glass paintings, both stained glass sundials and armorials. Anthony Turner has shown the likely source of this design – most prominently seen on the Nun Appleton Hall stained glass dial – as being 'The little tambourine player', in an engraved version by Jacob Matham.[21] The cherub is used so frequently that it might almost be regarded as a badge for the Virtuosi.

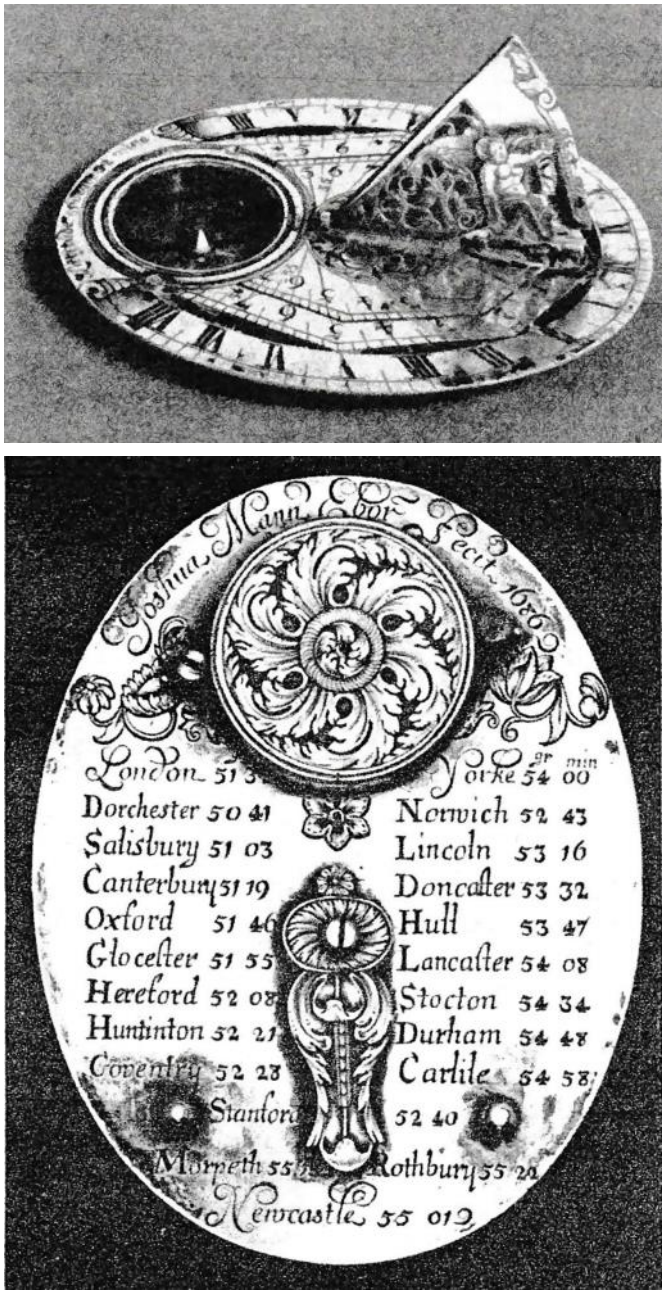

Fig. 9a & b. A Butterfield dial by Joshua Mann, 1686. Reproduced from Malden (ref. 3).

The other interesting feature of the dial in Fig. 9 is the gazetteer of latitudes on the back. This is a standard feature of course but the details, transcribed in Table 1, are not of a standard list but have been carefully customised for a particular client. Notice that the list includes an unusually large number of cathedral cities throughout England and also the inclusion of Morpeth and Rothbury near the bottom – these are relatively small local towns which probably indicate where the owner, who could well have been a churchman, lived or worked. No direct connection to any of the Virtuosi has yet been made but the possibility is quite good.

A dial in the Liverpool World Museum (Fig. 10) is a fairly standard universal equinoctial ring dial. It is 80 mm in diameter and is engraved "Tho. Mann fecit 1673". The provenance is "from the Mayer collection" but other than that nothing is known about it.[22] Whether Thomas made the dial from scratch or just engraved it is debatable but, bearing in mind his repairs to the quadrant and waywiser, it is possible that he was the true maker despite it seemingly being a one-off.

The Mann dial in Kirkleatham Museum is shown in Fig. 11. It was discovered in an allotment in the Port Clarence area (Middlesbrough) in the 1960s and is a nominal 4″ square which, combined with its lack of weathering, strongly suggests that it was made as a windowsill dial to accompany a longcase clock. It is simply signed "Thos Mann fecit 1671", i.e. two years earlier than the ring dial,

Fig. 10. Universal equinoctial ring dial by Thomas Mann (below – the signature Tho. Mann and date 1673). Courtesy of the Liverpool World Museum, inv. no. LivWM407.

Fig. 11. The Thomas Mann windowsill dial in the Kirkleatham Museum (a) plan view, (b) side view showing the gnomon piercing. Courtesy of the Kirkleatham Museum, inv. no. RECKH : 1966.283.

and it also specifies its design latitude as 54^{d} 30^{m}. As the actual latitude of Port Clarence is 54° 35′, it was clearly made for somewhere local and has only travelled a few miles in three and a half centuries. The dial is rather well made and the gnomon is nicely pierced with a design which, whilst not the same as the Joshua Mann ones, does show a family resemblance.

Concluding Remarks

The variety of dials made by both Thomas and Joshua Mann shows that they were accomplished craftsmen able to turn their hands to a wide range of tasks and with a good grasp of contemporary designs. They had good contacts with the local intelligentsia in York and the surrounding district which they used to obtain a range of commissions, all, seemingly, in the local area. The absence of a widespread guild structure in York to mirror that in London means that their expertise did not continue through successive generations of apprentices, though, or enable them to have a truly national clientele.

ACKNOWLEDGEMENTS

I am grateful to BSS member David McKendrick and also to Philip Sands for investigations at Woodsome Hall. Wendy Simkiss (Liverpool World Museum) provided the pictures for Fig. 10. Mark Austick of The Antiques Guys kindly allowed use of his photographs of the dial in Figs 1, 3–5. Sandra Garside-Neville (Hon. Archivist at the Yorkshire Architectural and York Archaeological Society) kindly provided a copy of the R.J. Malden article. Robert Wake (Curator, York Museums Trust) and Shirley Harker and Janet Williamson (Kirkleatham Museum) also provided assistance, as did Geoffrey Lane on the Henry Gyles stained glass. John Foad is thanked for searches of the Register and Jane Desborough for the same at the London Science Museum.

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* This article was originally written to accompany a topical talk planned for the 2020 BSS Conference in York which was sadly cancelled due to the Covid-19 pandemic.
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9. York Minster Library, MS XVI, 1.2. p.92. c.1709. The illustration was published by Francis Drake in *Eboracum*, York (1736).
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13. Philip Sands, personal communications, April/May 2019.
14. Charles Augustus Hulbert: *Annals of the Church and Parish of Almondbury, Yorkshire. Supplementary annals of the church and parish of Almondbury. July 1882 to June 1885,* London, Longmans (1882), p.18.
15. D.F.E. Sykes: *The History of Huddersfield and its vicinity*, Huddersfield, The Advertiser Press, 1898, p. 127. The text reads "An old sundial over the door of the south chapel has the inscription: "Ut Horae Sic Vita, 1682" – as flee the hours, so life."
16. Philip Sands, personal communication, 20 April 2019.
17. Malden, ref. 3, pp. 49-50 and Plate 4.
18. I am grateful to Jane Desborough for searching the Science Museum records for this dial.
19. Note, though, that Butterfield's 'signature' was faked by contemporary makers and Thomas Tompion contracted-out his dial-making to John Rowley for the horizontal dials at least.
20. Mike Cowham: 'Butterfield dial gnomons', *BSS Bull.*, 30(iii), 12-15 (Sept. 2018).
21. Anthony Turner: 'On the origins and meaning of a sundial centre panel', *BSS Bull.*, 30(iii), 2-5 (Sept. 2018).
22. I am grateful to Wendy Simkiss, curator at the Museum, for this information (personal communication, March 2019).

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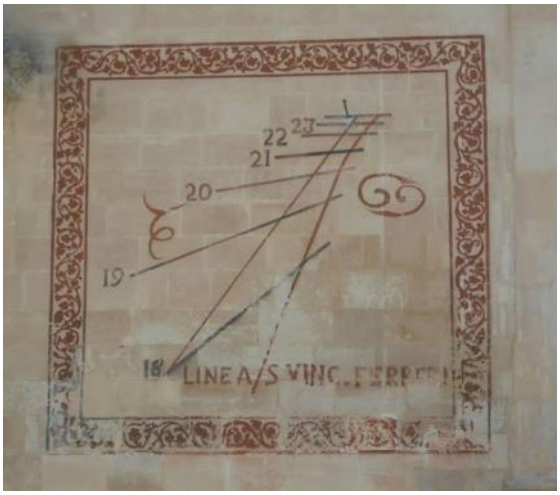
Holiday Snaps



This picture was taken by Christopher Glanusk, a friend of our member Piers Nicholson. It shows a dial on a church in Ragusa, in south-western Sicily: it is approximately west-facing so as the photograph was taken at about 11:30 am European Summer time the sun hadn't quite reached it. It is nicely painted in normal Mediterranean style and shows Italian hours (which is presumably what the inscription "Lineas... " is telling us though it is only partly legible). The 'gnomon' is actually a horizontal support for the nodus though its base seems to be slightly displaced from the equinox line. Quite why there is only one solstice line is unclear as both the zodiac signs are shown. It seems that the dial has recently been seen in the background of the TV detective series Montalbano!

JD

A VILLAGE SIGN AND A SUNDIAL IN LANCASHIRE

IRENE BRIGHTMER

In southwest Lancashire in the Borough of Sefton lies the old village of Thornton, mentioned in the Domesday Survey. It became an extension of the built-up area of Merseyside during the 20th century. It is about eight miles north of Liverpool on the road to Southport. The Parish Council has an impressive sign announcing your arrival, which shows the village sundial and the council logo (Fig. 1). The latter (a cross Moline) comes from the arms of the Molyneux family, formerly lords of the manor. They later became Earls of Sefton, taking this name from the ancient parish of Sefton, from which the council also takes its name.

The original village centre of Thornton is off the busy A565 and has an old pub and a railed-off area, almost a traffic island, on what used to be the edge of the village green. But the centre is now marred by modern roads, signs and housing. Inside the railings are preserved the old sundial on its pedestal of local sandstone and the old village stocks, which, according to the information board

Fig. 2. The ancient sundial and stocks in the old centre of Thornton village, within protective railings from the Second World War.

Fig. 1. Approach to the village of Thornton in the old county of Lancashire.

attached to the railings, were last used for punishment in 1863 (Fig. 2). The railings are said to date from the Second World War when the stocks were damaged by a vehicle crashing into them during an air raid blackout.

The information board also explains that the sundial is thought to be Jacobean and is one of the oldest in the area, pre-dating a lost 1720 dial formerly in the churchyard of the ancient parish church of Sefton. From outside the locked railings it is impossible to see anything more of the dial than the gnomon, unless you are a giraffe, because the pedestal itself is tall and it sits on top of three substantial stone steps.

The sundial and stocks have been Grade Two Listed since at least 1979. In 2003 a report was commissioned by the council on the state of their disrepair, and funding was sought for conservation work to be carried out on both.[1] I was able to obtain a photo of the dial plate from the conservators (Fig. 3).[2] This shows that it is circular and is cracked, which suggests to our editor that the material is

Fig. 3. The old sundial in 2003.
Photo courtesy of Eura Conservation Ltd, Telford.

not of the best quality. The patina is heavy so that the engraving is largely hidden, so it is impossible to decipher a maker or date. The dialplate is heavily leaded on to the pedestal, which was a common technique during the 18th century. The robust gnomon is typical of an early design. I am grateful to John Davis for these comments on the dial, which he suggests may have been locally made and could date from the early 18th century.

It may only have been the stocks that were conserved following the 2003 report, because from its condition it looks unlikely that anything has been done in recent years to the sundial or its pedestal. The conservators who sent me copies of their 2003 survey images, were unable to provide any other information relating to the dial, nor did they have any 'before and after' images. So perhaps only the stocks were restored; they are of cast iron and their condition is once again causing some concern.

The sundial and pedestal may therefore have remained untouched since 1891 when it is reported that repairs were undertaken to the pedestal and that the gnomon was re-set.[3] The inscription was already nearly illegible, but it was just possible to decipher "Thos D….tt". Could this have been the name of the maker or sponsor? This does not correspond with any currently-known maker.

The square-sectioned sandstone baluster is in poor condition, blackened and pitted, and is chipped and broken in places. It sits on three large square steps, also of local sandstone. The steps are stated to pre-date the dial and are the base of a 13th-century wayside cross, which once stood on the spot where the sundial now stands, according to the information board. This is supported by the 1st edition Ordnance Survey map of 1848 which shows an ancient cross on the site. However, certainly by the end of the 19th century the sundial had replaced the cross, which raises two questions: where was the sundial originally located, and where is the cross now? There are no obvious answers.

During medieval times in this area of Lancashire wayside crosses were placed about a mile apart at suitable resting places for funeral processions, when family and friends would carry the deceased person along the bad roads and cart tracks of this low lying peaty area. Prayers would be said at each cross before continuing to the local churchyard, in this case Sefton Parish Church. Sefton parish, like other ancient parishes in this part of Lancashire, was very large. The population of this whole area was small and scattered for centuries until land drainage made it very rich for agriculture, and it became important for feeding the growing populations of Liverpool and Manchester after the Industrial Revolution.

The Victoria County History for Lancashire (1907) reports that a painter was brought annually from Liverpool on the days of the Thornton wakes (which would have been during October) to paint the pedestal white with a black diamond pattern over it.[4] There is an example of a pedestal in the area which is still regularly painted, and there are others which show flakes of paint remaining. There is no evidence of paint left on the Thornton pedestal; the stone is blackened with the soot of decades of atmospheric pollution from the former industries of nearby Liverpool.

In 2020 there is a new housing development on the edge of Thornton named "Sundial Place". It is advertised as a "Luxury development of two, three and four-bedroomed houses". What an opportunity to install a new, accessible sundial in the heart of this development, and make the village signpost even more meaningful!

Do readers know of any other place proud enough of its ancient sundial to display it on their town or village sign?

ACKNOWLEDGEMENTS

I am grateful to our editor John Davis, to staff in the Planning Department of Sefton Council, and to Eura Conservation Ltd of Telford, for all their help in preparing this report.

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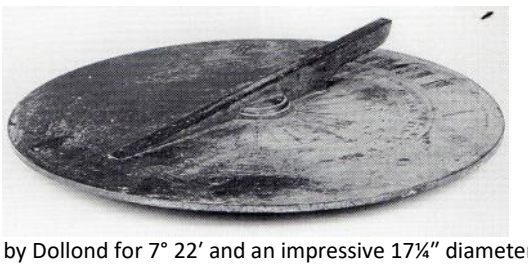
A Low Latitude Dial



Made by Dollond for 7° 22′ and an impressive 17¼″ diameter.

RESTORATION OF THE DRUMMOND CASTLE OBELISK SUNDIAL

Part 2: Conservation and Restoration Work

JAMES TATE, GRACIELA AINSWORTH and ALASTAIR HUNTER

The spectacular gardens at Drummond Castle are internationally recognised. The present layout is Victorian, but there are records of Lord Drummond sending cherries to James IV of Scotland in 1508. By 1605, when James VI (James I of England) conferred the Earldom of Perth on the 4th Lord Drummond, a significant garden would already have existed. The sundial was built in 1630 by the 2nd Earl.[1] It must always have been prominent in the garden although early maps, which do show a geometric layout, do not show where the sundial stood.

Today the sundial is surrounded by a layout of specimen trees, beautiful shrubs and borders, and white marble sculptures (Fig. 1). The sculptures vary in date and completeness, but all are recognisable as archaic or mythological. They contrast with the sandstone sundial. A visitor who descends the flights of steps into the garden from the castle is instantly aware of the sundial's position at the centre, but is unlikely to understand its purpose fully. In fact the sundial has acquired its own mythology that it is a timepiece for the world.

By 2016 it had become dilapidated with cracks in the stone and gnomons missing, and the whole sundial required restoration. In Part 1 of this series of articles, the history and reinstatement of the obelisk has already been discussed.[2] This article explains how the restoration project proceeded and describes the conservation work.

Fig. 1. The obelisk sundial in the gardens at Drummond Castle in 2004. Note: the alignment of the sundial with the path up to the castle is incorrect. Photo: Dennis Cowan.

Project Plan

The gardens are in the care of The Grimsthorpe and Drummond Castle Trust. The Trustees have a long-term aim to maintain the gardens in good order and to preserve their integrity and tranquil beauty for everyone's enjoyment. Information is provided on the garden features. The immediate priority in 2016 was to restore the sundial to a good condition. Reliable information on how it actually worked would be welcome as time went on. The Trustees commissioned Graciela Ainsworth Sculpture Conservation Ltd[3] to provide a survey report on the sundial with recommendations.

The report itemised the works that were necessary for conservation, with associated costs. It stated that the base stone was in such a vulnerable condition that it compromised the structural integrity of the whole sundial from the base up (Fig. 2). In addition to the base, open vertical bedding planes and delaminations were visible in the stone of the supporting shaft and the upper obelisk. A structural engineer's report was recommended. This confirmed that the combination of failing horizontal laminations of the base, and vertical open laminations of the upper sections, was indeed a major structural issue and a serious health and safety risk.

Dismantling the Obelisk

The obelisk had to be dismantled and transported to Graciela's conservation workshop in Edinburgh, a distance of some 56 miles. In early 2017, a scaffold company was

Fig. 2. Base of the sundial obelisk, and the square supporting shaft, in poor condition and unsafe. Photo: Graciela Ainsworth Sculpture Conservation.

hired to build access staging for the project team, ready to take a beam over the top for a block and tackle system with two running pulleys. The team would then be able carefully to take apart and lift the heavy weight of each of the sandstone sections. From the staging they carried out a first

Fig. 4. Removing the polyhedron from the square shaft; note the yellow fibreglass dowel rod. Photo: Graciela Ainsworth Sculpture Conservation.

Fig. 3. Cutting through a mortar joint to remove the top section of the finial stone. Photo: Graciela Ainsworth Sculpture Conservation.

full close inspection of the sundial at height, and considered options. The most well-considered way was to cut through the original joints where only repair mortar was visible (Fig. 3).

Each section of carved stone was splinted and supported during the cutting process. The sections were lowered to the ground in turn with the pulleys and slings, using Plastazote® foam sheets to isolate and protect the stones from damage. The obelisk was dismantled in five main parts.

The sections had a yellow fibreglass rod through the centre. This had been bonded in place with polyester resin adhesive as a means of strengthening the structure during the previous restoration in the 1980s. A partial restoration report found in the Drummond archives specifies some of the materials used. To manage a controlled central break of the resin and avoid damaging the stone, the heavy polyhedron had to be twisted slightly. The stone sections were wrapped, carefully lowered on to the trolley, and wheeled out of the garden to the van.

When the square shaft had been splinted, and cut away at its joint with the base, the exact method of supporting the sundial at ground level was finally discovered. The fibreglass rod and polyester resin ran down through the middle of the polyhedron, through the centre of the shaft, and into the base stone (Fig. 4). In the base it went only halfway down, to a very small depth of 60 mm. It did not

Fig. 5. Delaminating finial stone, shown lying on its side in the workshop. Photo: Graciela Ainsworth Sculpture Conservation.

extend into the foundation. This short length of the 20 mm diameter rod was the only extra strength in the base stone that was splitting horizontally, and that carried the entire weight of the obelisk above.

A decorative design of pebbles surrounds the base. When the base stone was finally dug out it was found to be held in place on top of the foundation by the pebbles alone. The stone was giving way and the structure itself was unstable. It was a disaster waiting to happen. The bottom joint would have been so much stronger, and the dowel rod so much more effective, if a deep hole had been drilled for the dowel rod to go right down into the foundation, which was quite solid.

Conservation of the Stone

The first task of conservation was to carry out research into the treatment and materials that had been used for restoration in the past. To a great extent this would determine how to proceed, and help to decide which materials and chemicals were compatible and appropriate for the work. Much of the fills in the 1980s restoration were starting to fail, delaminate, and fall away. The fibreglass rods and polyester resin had remained intact, although all this had had to be cut and removed.

The failing repairs to the stone were removed and lessened, and trials then started with modern conservation consolidants and grouts. It was decided to use consolidants based on ethyl silicate, and grouts that were lime-based. The stones of the main supporting shaft and the upper sections of the obelisk were examined very closely. They were found to be face-bedded vertically and delaminating badly, which were serious weaknesses, as mentioned above (Fig. 5).[4] Consolidation and grouting work proceeded and all the stones were treated. However, even after this work was done, the face-bedding would be a long-term structural problem.

The large diameter holes for securing the dowel rods through the stone centres were another concern for

Fig. 6. Repair work from a previous restoration that had to be re-set. Photo: Graciela Ainsworth Sculpture Conservation.

structural strength. In particular, cross-sections of the square shaft showed that very little stone remained where deep hollows had been sunk for the dials on the outer faces. It was very worrying, both for the serious risk that the whole structure could collapse, and for the health and safety danger to the gardens staff and the public. Much greater structural integrity was required. Structural engineers were called again for advice, and they recommended fitting brace plates in 316 grade stainless steel on the shaft and the finial. These were designed to be unobtrusive, and were patinated to give a dull surface.

The stone of the polyhedron required work on some areas of previous repair that had been set incorrectly (Fig. 6). These were taken apart and realigned. The large stone itself was in two parts that required separate trials for selecting appropriate materials for the new fills in the stone, which were eventually completed with pigmented lime-based repair mortar. The base stone, which had deteriorated so badly and was structurally unsound, was re-carved as a new piece. 'Swinton Pink' sandstone was chosen as the closest geological match to the original. The new dimensions were copied from the existing mouldings of the original base (Fig. 7).

Every element of the work was documented and submitted as a final report for the Trustees. All materials used, and each area where treatments were applied, were detailed and shown in drawings. The report will serve as an archive record for future conservators, and for guiding important maintenance work.

Fig. 7. New carved base, and repaired lower shaft; compare this with Fig. 2. Photo: Graciela Ainsworth Sculpture Conservation.

Project Review

Laser scanning

Dr Jim Tate proposed a laser scan of the sundial obelisk, as a digital and valuable form of archive record, which was approved by the Trustees. The technique of 3D laser scanning is used in many fields including heritage and archaeology. It can record accurate dimensions and surface profiles, and cross-sections. In combination with photo images, laser scans are useful in creating lifelike digital displays and exhibits. A dynamic virtual sundial could exhibit solar time.

AOC Archaeology provided a scanning service at the workshop. Scanners were arranged round the sundial sections standing on the workshop floor. Each section was scanned separately. AOC then used software to combine the sets of data points, and generate an accurate representation of the whole obelisk. This virtual sundial could be studied and visualised from any angle in 3D (Fig. 8). Initial attempts at sun illumination in the model were demonstrated, but they were not fully realistic. There were complications with incorrect gnomons, and with dial lines that were too fine for the scanning resolution.

Another idea was making a copy of the sundial by 3D printing from the digital data. A first trial, kindly carried out by Frank Placido, Professor Emeritus at the University of the West of Scotland, produced an accurate 1:10 scale model. It showed good potential for a display exhibit or an educational aid.

Recognition of the gnomonics

Jim and his wife Claudine examined the Latin inscription carved in a scroll on the lower part of the shaft, and they recognised that it must hold the key to the sundial workings. Claudine was expert in deciphering the text.[5] This described colours for distinguishing the hours, which hinted that originally the sundial was painted. Samples of material were scanned for particles of colour pigment, using a hand-held X-ray fluorescence (XRF) instrument provided by Historic Environment Scotland, but none were found.

At this stage, the details of how the sundial worked were still unclear. Graciela proposed that Alastair Hunter become involved, to benefit from his advice and knowledge of gnomonics, which was agreed. She had recently worked with him on a number of sundial projects. Alastair recognised the specific sundial terms relating to Babylonian and Italian hours in the text of the Latin scroll, and realised that this was no ordinary sundial. The extraordinary detail and complexity of delineation that is inscribed and surviving on the dials confirms it is exceptional. The Trustees called for a review of the project, and instructed that the sundial obelisk must now be restored to full working order.

Numerous faults were identified with the gnomons. Many were missing, some were misshapen or damaged or the wrong way round, others were badly bent and had broken the stone away. Two prongs had been stuck in at different angles on a sunken dial, when there should have been a single one, and they were the wrong length. Style heights could well be inaccurate, and none of the gnomons had a nodus. It looked as if none of the gnomons were original. They definitely had to be replaced. Removing them was done carefully. To take out the gnomons and the lead fixing material without damaging the stone was not easy. The

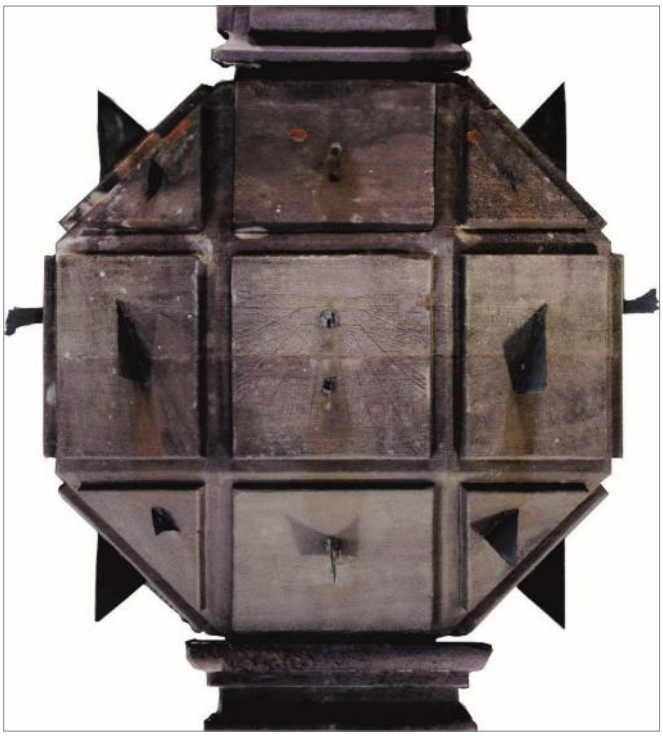


Fig. 8. Computer-generated image of the polyhedron, combining digital data from 3D laser scanning and photography, south view. The image was taken when conservation and repair work on the stone was complete, but with the original gnomons still in place. Photo: AOC Archaeology.

Fig. 9. Residue set of original gnomons removed and analysed. Photo: Macmillan Hunter Sundials.

stone was very vulnerable and in some areas there was almost no sandstone remaining at all.

Jim analysed the gnomons in the laboratories at the National Museum of Scotland in Edinburgh.[6] This showed that all of them were made of cast high-tin bronze (Fig. 9). Tin percentages in the metal were reasonably consistent, and the amounts of zinc were very small, which contrasts with early historic bronzes and suggests a controlled composition. The gnomons were probably all made around the same time, in the 19th or 20th century, rather than the 17th. There was no indication that the gnomons were of different dates from each other, and they probably came from a single source.

Replacement of the Gnomons

The polyhedron was tackled first. Declination and inclination angles were measured on all 24 dials using a Bosch electronic angle finder. Geometric accuracy was important for the calculations to follow. The values were tabulated as a spreadsheet and entered into the sundial equations, as defined by the *BSS Sundial Glossary*.[7] Values for style height, the basic design parameter for a gnomon, and sub-style angle for the orientation of the gnomon on a dial, were calculated.

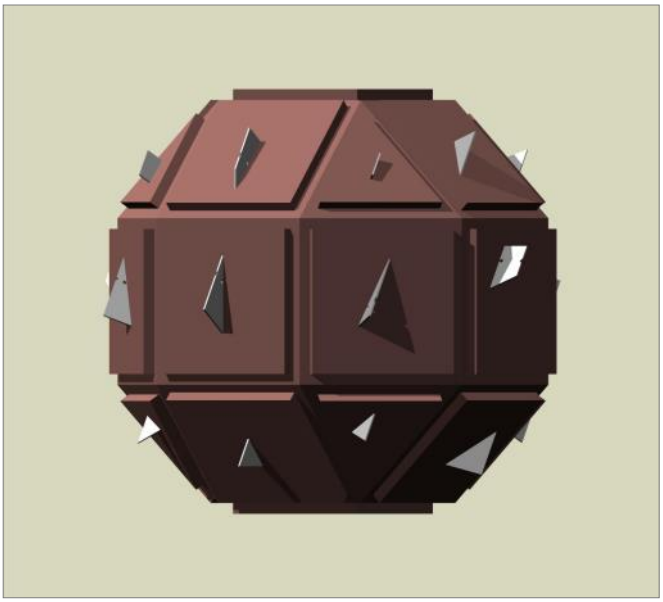


Fig. 10. 3D mock-up of the new set of correct gnomons, after calculation and re-design, south-east view. Photo: Macmillan Hunter Sundials.

But the dials on the polyhedron, which decline and incline in all directions, are complicated. Sub-style angle is defined relative to noon line angle, which is a further calculation, and trigonometry formulae can be ambiguous. The calculations needed to be verified by cross-checking. If any of the gnomon styles did not lie parallel on a polar line it was a mistake to be corrected. The checks were done using a 3D model.

A specific design pattern for the new gnomons was chosen and approved (Fig. 10). Their unified appearance greatly improves on the originals, which were unmatched and unsightly.

Ten of the gnomons required nodus notches. Finding the correct nodus position along a style edge is a problem of reverse engineering. The lines on the dial were already there, so where should the nodus be? On a plane dial, there is a convenient clue in the equinox line, which intersects the *sub-style line* at right angles. The nodus position on the

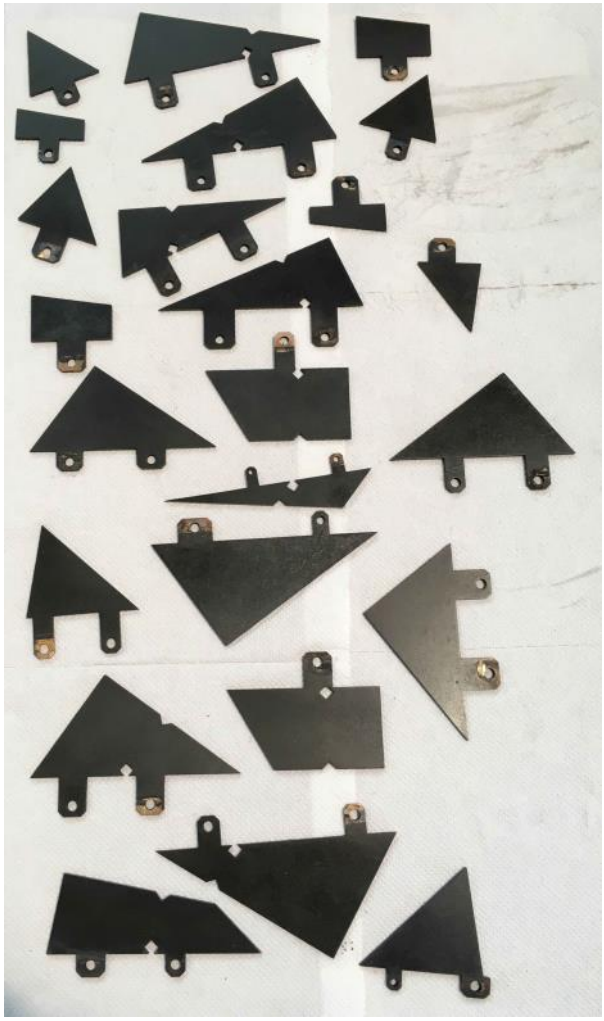


Fig. 11. The 24 replacement gnomons manufactured in bronze by laser cutting, with dark patination treatment. Photo: Graciela Ainsworth Sculpture Conservation.

Fig. 12. Paper templates taped in place to ensure accurate positions for the gnomons. Photo: Graciela Ainsworth Sculpture Conservation.

gnomon style is derived from this. However, on certain dials, the equinox line was hard to distinguish among a cluster of other lines, and on the vertical south dial the equinox line was absent. Cross-checks helped with finding these nodus positions, and a marker notch was cut on the sub-style edge for gnomon location.

The new gnomons have fixing lugs which fit the size and spacing of existing sockets in the stone. These had to be measured, and their position among the hour lines recorded. Then manufacture drawings were prepared. The gnomons were made in phosphor bronze and produced by laser cutting, and patinated and finished with a dark wax (Fig. 11). The polyhedron was marked up with templates taped on to the stone to indicate exact positions and orientation for gnomon replacement (Fig. 12). Following trials, a pigmented epoxy was selected to simulate lead for the gnomon fixings.

On the square shaft, many of the sunken dials have gnomons already carved in the stone, which was repaired where necessary. Replacement gnomons in bronze were required for the large and small dials that have a concave spherical surface. These need a nodus tip at the spherical centre, and some have a polar style edge. The gnomons are shaped to fit the concave profiles. In certain cases, the surrounding stone was so damaged that a deep gnomon lug was needed to make a strong fixing.

The tapering finial has pin gnomons, and the east–west pins are longer than the north–south ones. There were two tasks: to replace pins that were missing, and to check and correct pin lengths. The lengths were derived from hour-

Fig. 13. During dry run build in the workshop. Photo: Graciela Ainsworth Sculpture Conservation.

line spacings on the dials, again a problem of reverse engineering, but there are four separate types of hours, split across twelve individual dials, on four sides of the stone. The restored pin lengths are not exact but reasonably accurate.

Rebuilding the Sundial

A full-scale dry run for rebuilding the sundial was done indoors in the workshop (Fig. 13). This allowed plans for splints and strapping, and sequence of lifting, to be tried out in advance. It helped with building in features so the

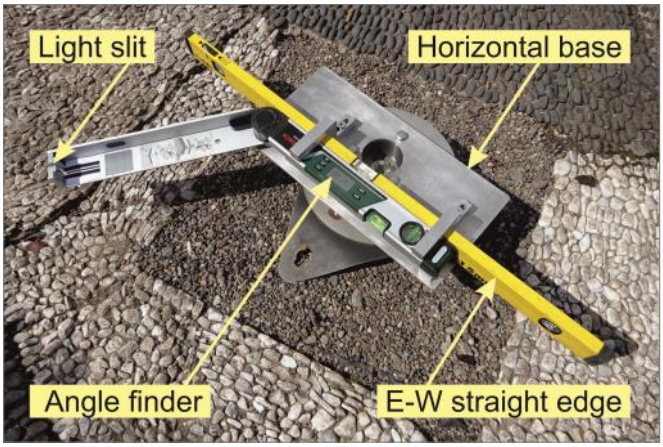


Fig. 14. Purpose-built alignment tool. The straight edge is adjusted to lie on a true east–west line by calculation of sun azimuth (string line not shown). Note re-alignment from the previous base square. Photo: Macmillan Hunter Sundials.

sundial can be taken down again in the future when required. Carbon fibre rod was selected for all the dowels. The sundial sections would be re-bedded with pigmented lime mortar to avoid unsightly and visually disturbing white lines at the joints. At ground level, stainless steel rod would be used to secure both the sundial shaft and the new carved base stone, and it would be bonded into a new hole drilled deep in the existing solid foundation.

Ahead of re-installation in the gardens at Drummond Castle, an accurate survey was completed to find true north alignment. This was calibrated against sun azimuth in bright sunshine (Fig. 14).[8] Previously the sundial had been facing along the path to the castle, as Fig. 1 illustrates.

The sequence of re-building spanned a period of two weeks and is shown in Figs 15–18. The installation was completed on 21 June 2019, the day of the summer solstice. The sun shone on that day and the dials read solar time.

Further parts to this series of articles are planned: interpretation of the Latin scroll, definition of all the dials, dial and shadow simulations in 3D.

ACKNOWLEDGEMENT

The Grimsthorpe and Drummond Castle Trust supported the project work and kindly agreed to this article for the *BSS Bulletin*.

Fig. 15. The new base stone aligned by the east–west string line, and set horizontal by a spirit level. Photo: Macmillan Hunter Sundials.

Fig. 16. The square shaft restored and brought into the garden by trolley, splinted and strapped for protection, ready to be hoisted upright. Photo: Macmillan Hunter Sundials.

Fig. 17. The polyhedron guided onto the top of the shaft, with carbon fibre dowel rod for reinforcement. Photo: Macmillan Hunter Sundials.

Fig. 18. The joints are pointed with pigmented mortar for visual appearance and weather protection. Photo: Macmillan Hunter Sundials.

REFERENCES and NOTES

1. Fiona Jamieson: *Drummond Castle Gardens*. The Grimsthorpe and Drummond Castle Trust (1993).
2. Alastair Hunter: 'Restoration of the Drummond Castle Obelisk Sundial Part 1: History and Reinstatement Ceremony'. *BSS Bulletin*, 32 (i), 2-9 (March 2020).
3. Graciela Ainsworth Sculpture Conservation Ltd. Bonnington Mill, 72 Newhaven Road, Edinburgh, EH6 5QG.
4. Geological sandstone has been formed and compressed in layers beneath the ocean floor. In a quarry this is apparent in sandstone layers or beds. When stone is built into a structure on its edge instead of on its original bedding, it is more liable to split or delaminate.
5. Claudine Tate: *Translation of the Latin inscription on the Drummond Sundial* (2017).
   "You who in this humble garden look up at us, the Hours whose parents are Shadow and the Sun, well-known disciples, under a clear sky, of ever-flowing Time, do you know why we are clad in colour? Because, from the beginning, we have spoken to [Man]. We serve those who inhabit the distant regions where the Sun rises, and the Persians and the Medes and Babylonians, and for this we are marked in red; in the same way green adorns those of us who are assigned to the Occident. Thus we work for the Italians and Bohemians, and we mark Judean hours in yellow. But marked in black are those of us who are useful to the British, the French and the Spaniards. The signs of the Zodiac are also in colour. And we show the circles of the Azimuts [*sic*] in black but we mark parallels to the horizon in blue. Observe also how the astronomical marks referring to your House and Family are shown in gold. And so by their shadows the points of the gnomons indicate those hours, whichever they are."
6. James Tate: *Summary of the Examination of Gnomons on the Drummond Sundial* (2017).
   "The existing gnomons were examined visually, and for metallographic composition by X-Ray Fluorescence (XRF). Green patination indicated copper carbonates and oxides. A cast high-tin bronze was confirmed. Compositions between gnomons were closely similar: 86% ±2% copper, 11% ±1% tin, on average, plus 2% ±2% lead, and minor or trace amounts of iron, nickel and zinc. The variable lead percentages might be due to the lead for fixing the gnomons. Zinc levels were low, 0.5% or lower. There were no groups of gnomons with distinct compositions. The gnomon surfaces were rough and unpolished, and the edges had saw and file marks, consistent with casting the bronze and cutting flat pieces to the correct shape. Thicknesses varied from 2 to 5 mm, and smaller gnomons tended to be the thinner ones."
7. John Davis (ed.): *BSS Sundial Glossary – A sourcebook of dialling data*, The British Sundial Society, pp.40-43 (2nd ed., 2004).
8. A method of setting up a sundial on true north–south alignment should be as accurate and reliable as possible. From experience on many projects, the method of calibrating by sun azimuth works well. In brief, at a particular latitude, on a specific date, a calculation will give sun azimuth for any time (after correcting from civil time to local solar time). The alignment tool shown in Fig. 14 is used to find the angle between the straight edge and the sun passing through the light slit. The line of the straight edge is adjusted in a few steps until this angle is equal to sun azimuth. Then a string is set along the edge, which makes an accurate east–west line for the south face of the sundial.

James Tate studied at London University obtaining a PhD in solid state physics which led to a fellowship at Paisley College,

now the University of the West of Scotland, applying science to authenticate Chinese ceramics in the Burrell Collection, Glasgow. He joined the National Museums Scotland in 1980 where he spent his career, becoming responsible for the Department of Conservation and Analytical research in 1986 until retiring in 2012 when he remained a Research Associate at the NMS and at Glasgow University.

He can be contacted at *james.tate@btinternet.com*

Graciela Ainsworth gained a BA Hons in Fine Art from the University of Northumbria (1979–1982). She went on to train in

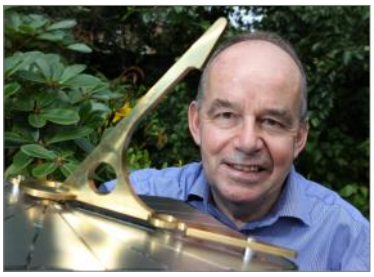
Conservation at the City & Guilds of London Art School, where she was awarded a Diploma in Sculpture Conservation/Restoration (1982–1985). She founded Graciela Ainsworth Sculpture Conservation in 1990.

Graciela is an accredited conservator with the Institute of Conservation (ICON). In 2019 she became a member of The Master Carvers Association. She is a Trustee of the June Baker Trust and a Director of the Scottish Lime Centre Trust.

Graciela's sculpture conservation business has a long-serving team of experienced conservators, who continue to develop their knowledge through involvement in the wide range of conservation projects and challenges that the business undertakes. Along with her full-time career in the conservation industry, Graciela also finds time to complete sculpture commissions and her own art works and to speak at conferences.

She can be contacted at *workshop@graciela-ainsworth.com*

Alastair Hunter studied engineering science at the University of



Oxford and went on to qualify as a Chartered Engineer in Mechanical Engineering. His professional career spanned energy, aerospace, agriculture, and renewables. He has worked in design and development in industry and in academic research in the public sector.

Alastair's fascination with sundials began with the idea of putting one in his garden at home. This quickly became a project to design a better sundial and turned into a small private business. Macmillan Hunter Sundials has now run for ten years, selling a variety of sundial designs to customers in the UK and beyond. The designs seem to have retained an engineering theme but he is learning more about introducing a sculptural look. Increasingly he is called on as a consultant for restoration of historic sundials particularly in Scotland.

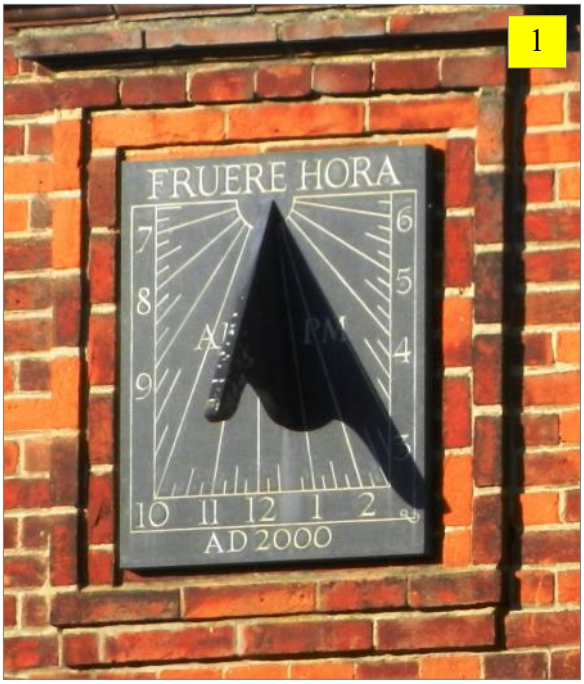
He can be contacted at *sundials@macmillanhunter.co.uk*

NEWLY REPORTED DIALS, 2019

JOHN FOAD

Unsurprisingly, most of the dials newly reported last year are recent projects, and some of them are very fine, but intriguing older examples still turn up and I know there are many more still to be recorded. The most interesting reports that I have received are shown below.

1. This attractive slate dial is framed in the house bricks and enjoins the passer-by to enjoy the hour. SRN 8091, 25 Newton Road, Cambridge, CB2 8AL. Visible.

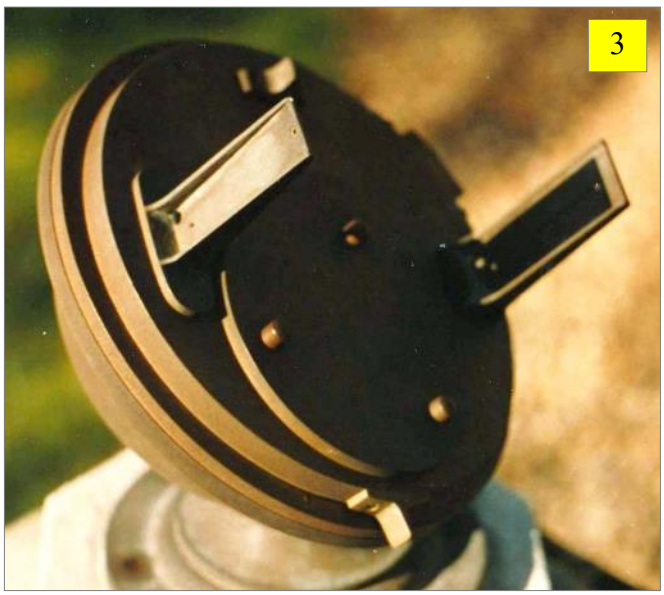


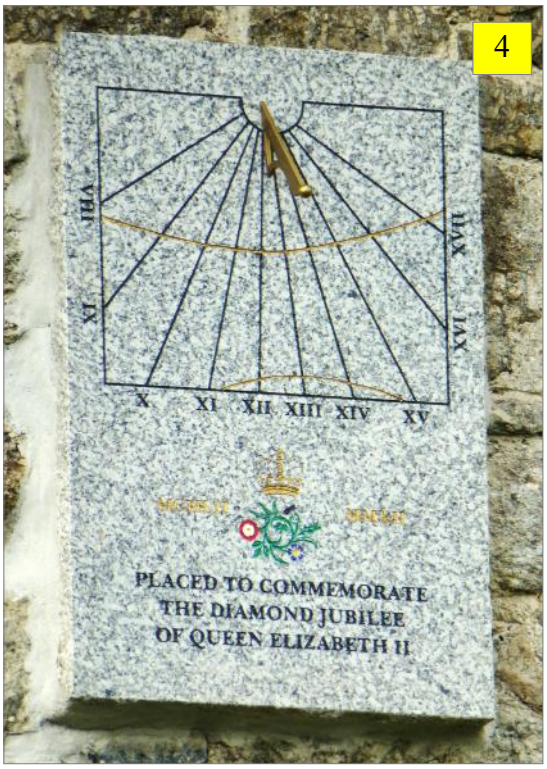
2. A few houses along in the same road is this larger painted wooden dial, a more elaborate and older construction, filling the first-floor corner of the plain plastered wall and equally visible from the pavement. SRN 8092, 18 Newton Road, Cambridge, CB2 8AL, Visible.

3. This Pilkington and Gibbs heliochronometer has been in its present position since 1908. It carries a lengthy motto starting "Nulli optabilis …", which may be found in Gatty with its interesting history. SRN 8093, Somerset. Private.

4. The dial in this attractive village commemorates the Queen's Diamond Jubilee. It is on the end wall of a former church house that adjoins the churchyard, unobtrusive but clearly visible from the lane. It appears that the longitude correction is applied so that the dial shows Greenwich solar time. There are two declination curves, probably the solstices, with a knob nodus at the tip of the short gnomon. Below the dial face is a golden crown, then "MCMLII MMXII" around a floral design. SRN 8094, Lustleigh, Devon. Visible.

5. This dial commemorates Admiral Arthur Phillip, commander of the First Fleet and founder of modern Australia, and is the result of years of campaigning by the Britain–Australia Society. The internal globe on the gnomon is rotatable and tracks the historic route of the eleven ships of the First Fleet. At the top, there is a compass rose and a topograph indicating the distances to key points on the eight-month journey to found New South Wales in 1787. See *Bulletin* 26(iii), p.48. SRN 8095, Bennett Street, Bath, BA1 2QH. Visible.





6. Nothing is known of this simple but well made near-west-declining dial. Although it is in the village centre, the building appears to be disused and it is to be hoped that the dial will not be lost. SRN 8097, 40 North Street, Marcham, Oxon, OX13 6NG. Open.

7. The dial is just inside the main entrance to the RHS gardens, on a square-sectioned stone baluster-style pedestal which previously bore SRN 0512. The fate of that earlier dial, made by Francis Barker in the 1920s, is not known. The present dial has a curved EoT graph at the south, above the motto "Sol Omnibus Lucet". Inside the chapter ring is a second ring with hour and half-hour lines, and a narrow florally decorated border. The gnomon has a broad S-shaped support with floral flourishes. SRN 8099, Royal

Horticultural Society Gardens, Wisley, Surrey, GU23 6QB. Restricted.

8. This is a respectable dial but it sits uncomfortably at the top of a gable on the street frontage of the house. It appears to be mounted at close to its designed declination, but must have originated elsewhere. The motto "Let others tell of

storms and showers, I'll only count your sunny hours" is very widely used on 'garden centre' dials, but is surprisingly uncommon on verticals, two rare and respectable exceptions being the Francis Barker dial at Sandringham House and a Lutyens dial in Hampstead Garden Suburb. SRN 8106, Duke's Drive, Eastbourne, East Sussex, BN20 7RU. Visible.

9. This excellent dial was made in 1775 for a west-declining location. It was moved to its present position in the 19th century, and is strongly canted to provide the correct declination in its new home. The motto across the top is cryptic: "So Doc^{t} Ho In D", understood to be abbreviated Latin for "The Sun teaches the hour in the Day". SRN 8107, Brockwell Park, Dulwich Road, Lambeth, London, SE24 0PA. Restricted.

10. The dial is made of Forest of Dean stone set into grass, and the carved numerals are in-filled with black sign-writer's enamel. It is delineated for summer hours, and there are sunrise and sunset (Bailey) marker stones. The motto, appropriately, is from St Augustine: "Faith is to believe what you do not yet see: the reward for this faith is to see what you believe". SRN 8108, St Augustine's Priory School, Hillcrest Road, Ealing, London, W5 2JL. Private.

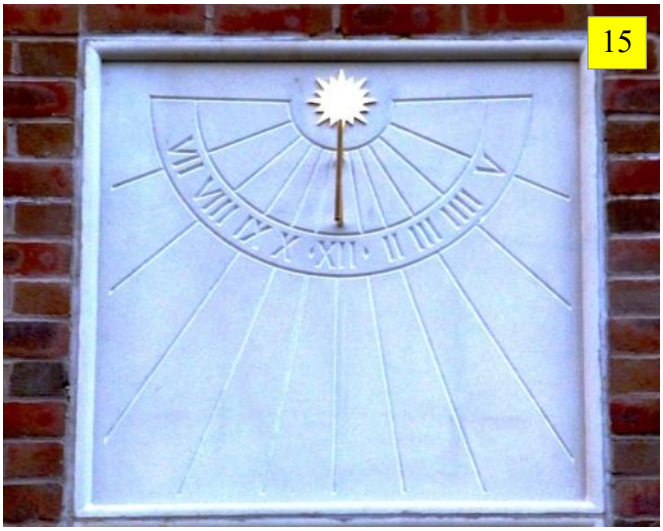
11. This is another school analemmatic dial in Forest of Dean stone, this one fully paved. A carved wyvern (part of the school badge) is placed to the south of the date scale. Two hour ellipses are provided, for summer and winter time, adjusted for longitude, Bath being nearly ten minutes behind Greenwich. Again Bailey point stones are provided, to give the time and direction of sunrise and sunset. SRN 8109, Kingswood School, Lansdown Road, Bath, BA1 5RG. Private.

12. This dial of 2019 replaces a painted wooden dial of almost the same design, made in 1991, which had not survived. The motto (The light of hope is the light of life) refers both to the proximity of the Physics laboratories (=optics) and to the 1990/1991 events in Europe which resulted in the collapse of the Soviet Union and the resulting sense of hope for the affected nations. The wyvern can be seen again. SRN 8110, Kingswood School, Lansdown Road, Bath, BA1 5RG. Private.

13. This image of a dial appears on a grave slab that is mounted on the interior south wall of the cathedral nave. It is one of a number of symbols associated with death, carved in relief. The picture represents Death breaking the urn of Life with an arrow. A flame bursts forth from the punctured vessel, from the tip of which the soul flies away in a north-westerly direction. An hour-glass from which the sand has run out, this sundial, two spades, and a coffin complete the

doleful ideogram. The grave slab commemorates the death of Patrick Prince in 1673. SRN 8111, St Magnus Cathedral, Broad Street, Kirkwall, Orkney Islands, KW15 1NX. Open.

14. The dial is mounted on a rustic stone wall. Around the top sides is 'DIAMOND / JUBILEE", and around the

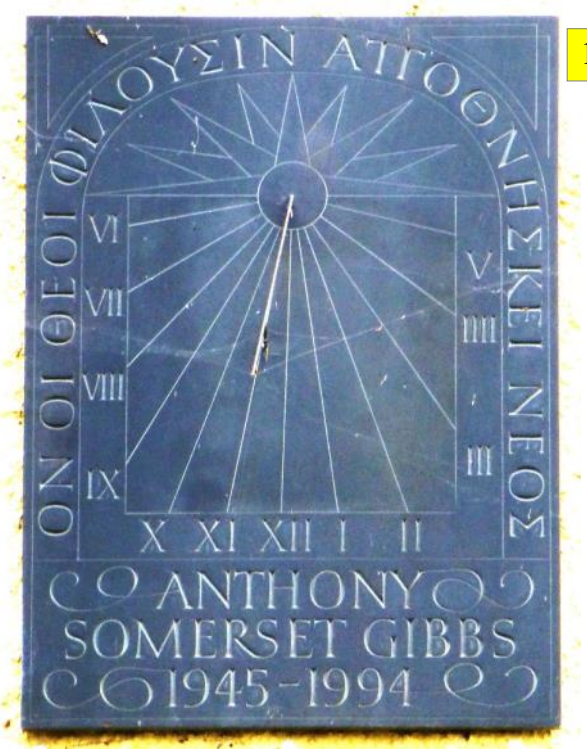


lower sides are labelled for the hours IX - XII - VI. All the carving is in relief. Decorative hour lines that will never see the sun are carved to fill space at the top of the dial. SRN 8112, The Sunny Patch, Middle Street, Shaldon, Devon, TQ14 0DT. Open.

15. The dial is recessed into a brick wall and was carved on site, and shows hours VII - XII - V, with no divisions. There is a gilded bronze sun symbol at the base of the gilded bronze rod gnomon. SRN 8113, Princethorpe College, Princethorpe, Warwick-shire, CV23 9PX. Private.

16. This is yet another analemmatic dial, in a peaceful rural setting. The area is filled in with grey paviours, and the hours are marked by granite slabs with Arabic numerals for 7 am to 6 pm. SRN 8115, Long Ashton Burial Ground, Church Lane, Long Ashton, Somerset, BS41 9LU. Open.

17. This square dial, set as a diamond, is on the east end of the south wall of the house, at first floor



level. Hours are marked with radial numerals from VIII to V, with XI and I replaced by dot markers for more comfortable spacing. Inscriptions include initials A, S, M, the date 2015, and the image of a wren. The owners' first house was called Farthings and they chose to have the wren from the farthing coin carved on the dial as a memento. SRN 8116, Well End House, Cobbaton, Devon. Private.

18. The dial is at first floor level on the south side of the pub. It was made in 1994. Some while later the pub burnt down and the dial was removed and a new gnomon was made and the dial was refixed by the owner on the rebuilt and extended pub. We do not know if it is correctly aligned. The motto is a fragment from the Greek playwright Menander, but is perhaps better known in Plautus' Latin version: "Quem di diligunt adulescens moritur" (thank you, Wikipedia). In either case it can be translated as "Those whom the Gods love die young". SRN 8117, Rose & Crown Public House, Stoke St Gregory, Somerset, TA3 6EW. Visible.

19. This dial is easily missed, mounted high up on a house opposite the main visitor entrance to Middleham Castle. It is fixed to the house wall at roof line and can be shadowed in part by the guttering. It appears to be of gold or cream paint on a duck-egg blue background, on a base material of cement or plaster. Some peeling reveals crumbling, lighter material underneath. SRN 8118, The Castle, Middleham, North Yorkshire, DL8 4QG. Open.

20. Another dial difficult to spot (and to photograph!), this is adjacent to a third-floor window at the south end of the

building, possibly 13 metres above ground level. It has a patchy yellow-brown colouration, and is probably a version of Pearson Page's Design No 4206. The motto across the top is "Vigila Oraque" and the (false) date in a central rectangle below the gnomon is 1629. Both are in Gothic Blackletter script. If it is from Pearson Page, the delineation has been adjusted for its east aspect, and an appropriate gnomon has been used. Upright numerals are used for the morning hours III - XII, though it will never see 3 am! SRN 8119, 5 Oxendon Street, London, SW1Y 4EE. Visible.

21. This attractive new dial is mounted on the stonework of the building, between two upper floor windows, easily visible from the street. Hour lines radiate from a shield with a black lion holding a flowering rose stem, and with eight small roses around the rim. The rod gnomon has three tapering small rings as a finial, and a single strut branching into two fixing feet. The gardens, which are open by appointment, are well worth a visit. SRN 8121, Pettifers, Main Street, Wardington, Oxon, OX17 1RU. Visible.

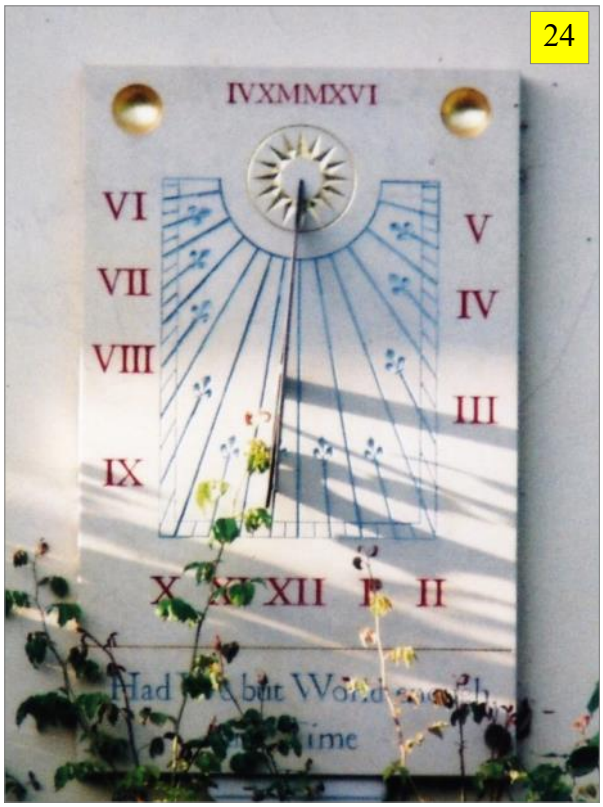
22. This millennium dial, with a time capsule, is on the Village Green adjacent to 'The Rose Inn'. It is mounted on a good square-sectioned plinth on an octagonal base, and is a four-ring armillary sphere with an arrow gnomon. It was unveiled on 10 December 2000 by the oldest and the youngest residents born in the village at that time. SRN 8122, The Village Green, Moor Lane, Willoughby, Warwickshire, CV23 8BH. Open.

23. This pillar dial is located in the parkland grounds to the south-east of the Hall. The rectangular dial block is mounted on a tall circular-sectioned column on a square base. The block has three dial faces with gnomons intact, with some hour lines but no numerals. There is a shield carved on the upper part of the column below the north-east face but no markings are visible. The initials and date

"EHS 1707" are scratched into the lower part of the column, and are assumed to provide a true date for the dial. Above the dial cube is a ball finial carrying an iron rod with part-twist ornament. This supports the remains of a wind-vane, perhaps including the form of a fish. Note – there is said also to be a stone vertical sundial supported by two corbels on the wall of an octagonal pigeoncote at the Hall – information and photographs are requested! SRN 8123, Honington Hall, Honington, Warwickshire, CV36 5AA. Private.

24. This attractive dial is visible from the adjacent churchyard of St Peter & St Paul's Church. It is supported on a corbel at the upper floor level of the building. Across the top is the unusual palindromic date "IVXMMXVI", possibly indicating 4 October 2016. Across the bottom of the dial plate is "Had we but world enough and time", from Andrew Marvell's poem *To His Coy Mistress*. SRN 8128, The Priory, Vinesse Road, Little Horkesley, Essex, CO6 4DB. Visible.

registrar@sundialsoc.org.uk



A Bentley Gnomon

BSS members love sundials and many are also keen on cars. It is not often, though, that these two enthusiasms can be brought together. Member Bert Degenaar, who featured in a description of the Zuylenburgh Collection of mathematical instruments in a recent issue of the *Bulletin*,[1] is the proud owner of a vintage Bentley which he sometimes uses for tours around England and Wales. He found, though, that while the small 'aeroscreen' windshields might be good for racing, they provided scant protection against the English weather on long trips. He solved this problem by a larger custom-made secondary windshield which can be fitted as an alternative for these occasions. It needed a central stay which also serves to support the rear-view mirror and is made to look like a gnomon for a horizontal dial. One would need to drive in a southerly direction for it to be operational, and for distances to be limited if the latitude was to remain correct! A lovely touch, and made to the best Bentley standards.

Fig. 1. The Bentley with its original aeroscreen windshields. Photo: Bert Degenaar.

Fig. 2. The larger 'touring' windshields with the cast-brass central stay and rear view mirror support in the form of a gnomon. Photo: Bert Degenaar.

Reference

1. Douglas Bateman: 'Sundials in the Zuylenburgh Collection in Utrecht', *BSS Bull.*, 31(iii) 2-6 (September 2019).

JD

IN THE FOOTSTEPS OF THOMAS ROSS
Part 31: The East Coast Obelisks

DENNIS COWAN

Ancient obelisk sundials are thought to be unique to Scotland and in volume 5 of *The Castellated and Domestic Architecture of Scotland*,[1] Thomas Ross had the following to say:

"*This name, while it fairly describes the appearance of the dials of this class, has a further fitness from the circumstance that the Egyptian obelisks are believed, amongst other purposes, to have acted as gnomons.*

"*The constant parts of these dials are a square shaft, a bulged capital, and a tapering finial. Where the dial is of the normal type and unaltered, the shaft is divided on each side into five horizontal spaces by incised lines, thus presenting twenty compartments. These compartments are hollowed out with cup-shaped, heart-shaped, triangular, and other sinkings, which are generally lineated so as to mark the hours, and were without doubt always meant to be so. The sharp edge of the figure casts the shadow, which is especially distinct in the angular shapes and at the top of the heart sinkings, where there is often a certain amount of undercutting.*

"*Stone gnomons of various forms are frequently left in the cup hollows, and metal stiles are to be found in all the dials. Occasionally some of the spaces are left blank, and on the north side initials, dates, and arms sometimes occur. The capital is always bulged out so as to form an octagon in the centre, with an upright facet on each of the eight sides, having a dial on each. Above and below each facet over the four sides of the shaft are sloping facets, with a reclining dial or a proclining dial on each, the former being those dials whose faces slope towards the sky, and the latter those whose faces slope towards the ground.*

"*The eight triangular pieces formed by the meeting of the square and octagon are cut out, and most effective shadows, from an artistic point of view, result from this arrangement, giving an air of dignity to the capital, which is wanting in the one instance (at Drummond Gardens[2]) where this arrangement is departed from. The upright facets of the octagonal part have heart shaped and cup-shaped sinkings, as in the shaft; but the proclining and reclining parts seldom have sinkings. Nor has the tapering finial, although usually covered with dials, ever any sinkings; like the shaft, this part is divided by horizontal incised lines, the number of spaces, for which there appears to have been no rule, varying according to the height of the finial.*

"*The obelisk-shaped dials are generally set on some kind of base, consisting either of steps or a pedestal; the former frequently alternate, being set square and diagonally as they ascend. The pedestals have a general resemblance to each other, being frequently ornamented with representations of the sun and moon.*

"*With this general description of the obelisk-shaped dials, we will now proceed to the consideration of individual examples.*"

Ross identified ten obelisk sundials in the eastern side of Scotland; four have been included in previous separate articles, whilst three of the remaining six will be described here.

Firstly, Bonnington is a large estate to the west of Edinburgh and a fine example of this type is in the owner's private garden. Of this dial, Ross says:

"*This dial is situated in the garden of Bonnington House; it stands on three steps placed anglewise* [Fig. 1]. *The dimensions of the dial are shaft, 3 feet 10½ inches high; the capital, 1 foot 6 7/8 inches high; and the finial about 3 feet 4 inches high; or 8 feet 9 3/8 inches in all, and including the three steps, 10 feet 2 7/8 inches. The width of the capital is 1 foot 7 1/8 inches, and of the shaft 10½ inches. The remains of an iron finial are visible on the top of the finial. Like the dial at Barnbougle,[3] this one has on one of the compartments of the north side the Cunnyngham arms. A shake fork and the presence of three stars seem to indicate the Cunnynghams of Belton, and on the compartment beneath there is a lion rampant.*"

This fine obelisk is still in the position where it was seen by Ross around 130 years ago and it follows the normal pattern of the type. It has had restoration to the top section of the shaft and there is damage to the second bottom section as can be seen in Fig. 2. Some of the remains of the iron finial have also gone, leaving only a thin rod of iron.

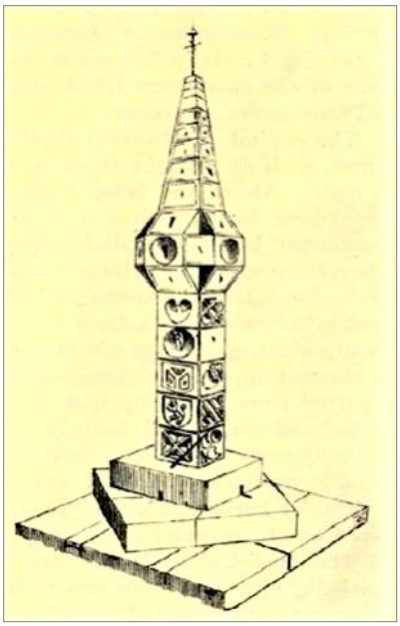


Fig. 1. Ross's sketch of the Bonnington obelisk sundial.

Fig. 2. The Bonnington sundial today with the damage to the second bottom section of the shaft visible.

Fig. 3. The shake fork with the three stars and the lion rampant below.

The shake fork with the three stars and with the lion rampant below that are mentioned by Ross can still be clearly seen today (Fig. 3). An interesting section on the east face of the shaft has a cup hollow with a stone gnomon, with two mini cup hollows (and gnomons) on the gnomon itself (Fig. 4). The shaft has five sections whilst the finial has an impressive nine sections; however, the finial is in poor condition with no complete gnomons surviving, and little in the way of hour lines or numerals exists today.

Fig. 4. The cup hollow with two further mini cup hollows on the stone gnomon.

Next we travel over the River Forth to Leven in Fife where Ross describes another obelisk. He says:

"*This dial is believed on sufficient evidence to have been the town cross of Leven. All knowledge of its existence was lost till, on the 15th January 1889, Mr. James Anderson of Norton, Leven, observed it broken and built into a garden wall. He had it taken out, and found the shaft in two pieces, with a portion of the centre lost, as well as the upper portion, but the capital was entire. The whole has now been restored, and set on three steps, on one of which is the following inscription: LEVEN CROSS, FORMERLY ON CARPENTER'S BRAE, REMOVED 1767, RESTORED AND REBUILT BY JAMES ANDERSON OF NORTON, 1889. It has been handed over by Mr. Anderson to the custody of the trustees of the Greig Institute. The dial stood on Carpenter's Brae, and it was taken down to allow the passage of Mr. John Gibson of Durie's funeral in 1767. After the burning of Durie House in 1764, Gibson lived in the High Street of Leven. The height of the upper part as restored is purely conjectural, and the whole height as it now stands, exclusive of the steps, is 7 feet 3 inches.*

"*We have to thank Mr. Andrew Dewar, architect, Leven, for this drawing* [Fig. 5]."

Despite what Ross says above, it is unlikely that this obelisk was ever designed to be the town or market cross. It was more likely to have been a sundial that was moved from elsewhere to act as the cross. This is a view shared by John W. Small in his book *Scottish Market Crosses*.[4]

The sundial is no longer at the Greig Institute, as it was moved from the garden there around 1982 to make way for

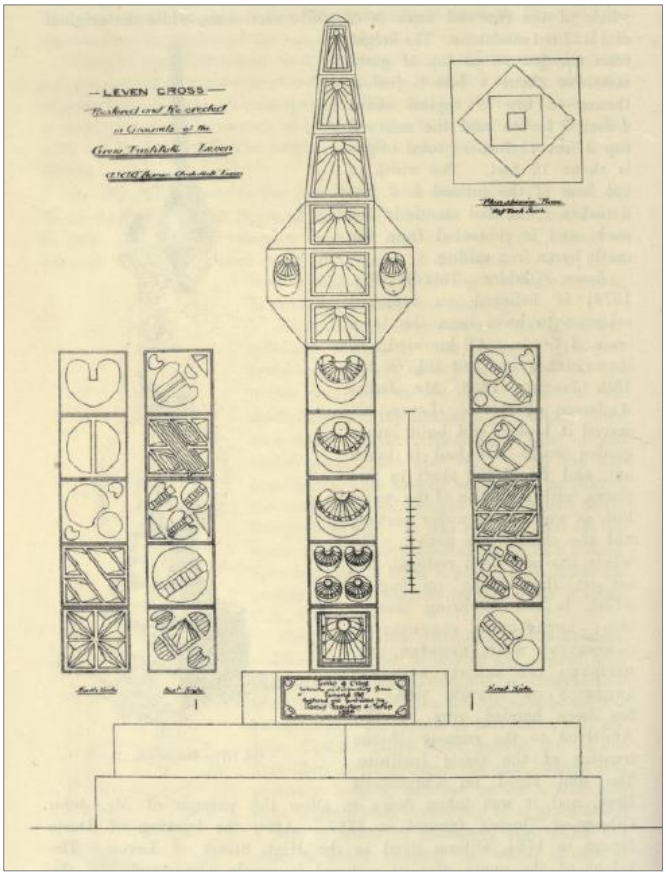


Fig. 5. Ross's architectural drawing of the Leven obelisk sundial.

Fig. 6. The mish-mash appearance of the Leven sundial today.

a road widening scheme. It was placed in the grounds of Fife Council's Carberry House nearby (not to be confused with Carberry House[5] in East Lothian which also has an obelisk sundial in its grounds).

Ross noted that the restoration of the upper part (the finial) was purely conjectural; unfortunately the architect's drawing showed only the south face of the finial and this design was replicated on all four faces! The difference in the stone of the replacement finial and the original capital is easy to see, and there is no evidence of gnomons ever having been fitted to the finial dials. None of the original metal gnomons on the rest of the structure have survived.

A more recent restoration has replaced much of the shaft in grey sandstone whilst the original parts of the obelisk are in red sandstone. It has however been carried out faithfully to the original architect's drawing. The shaft has five sections and the finial three, but the whole structure, which sits in amongst trees, is orientated nearly 180 degrees out. It has a rather mish-mash appearance today as can be seen in Fig. 6. It is fair to say that it is not one of my favourite sundials.

As part of the millennium celebrations, a near full-sized granite copy, known as the Millennium Cross (Fig. 7), was made and placed in the sunken garden in Letham Glen on the outskirts of Leven. Unfortunately it was never designed to act as a sundial as gnomons were never fitted and the cup hollows on the capital are marked only as circles (Fig. 8).

Fig. 7. Leven's Millennium Cross.

Fig. 8. One of the circles on the Millennium Cross that should have been cup hollows with some of the incorrectly marked out dial faces!

The four south-facing markings on the finial on the original sundial have been replicated here and indeed on every other face that has been marked out.

However, none of the hour lines on any of them are correct and have evidently been carried out by someone with no knowledge of sundials.

The shaft, which has only four sections rather than five, has no dials marked and instead has designs based on the local area (Fig. 9). This is a pity as a great opportunity has been missed after going to so much work and effort, but not completing it as a working sundial.

Fig. 9. Sections of the shaft on Leven's Millennium Cross with designs based on the local area.

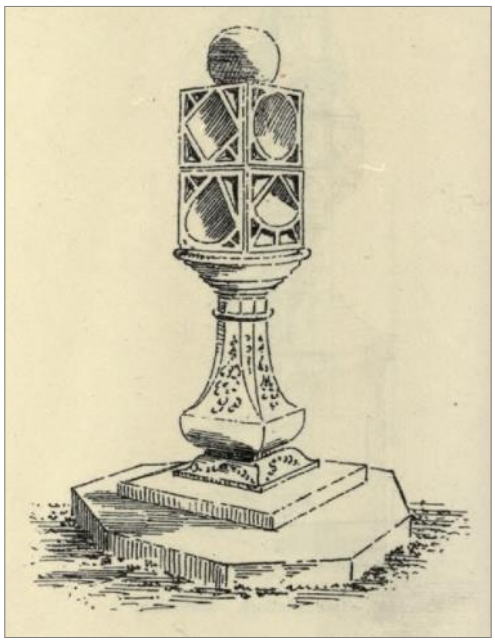


Fig. 10. Ross's sketch of the Panmure sundial now at Brechin Castle.

Further north in the county of Angus, Ross merely refers to a sundial at Panmure House by saying:

"*This dial* [Fig. 10] *appears to us to be a part of the shaft of an obelisk.*"

Despite what Ross said, I am not convinced that it was ever an obelisk shaft as it just doesn't seem right. There are a number of reasons. The sphere on top is marked out as a dial, although it is difficult to see any detail owing to the lichen, but it looks to me to be original to the rest of the structure. If that is the case it could not have been part of an obelisk as the capital would have stood there. Intriguingly there is a shield-shaped cut-out on the sphere with a piece to fit lying below it (Fig. 11). What was its purpose? There is also a step on top of the shaft below the sphere, which would not be present on an obelisk shaft (Fig. 12). Why just two sections of a shaft when it should have been four or five? Furthermore at least one of the faces does not appear on any other obelisk that I have seen (Fig. 13).

Fig. 11. The sphere of the Brechin sundial with a shield-shaped cut-out and the piece to fit lying below.

Fig. 12. The step on top of the Brechin shaft which would not be present on an obelisk sundial.

Fig. 13. The unusual face on the Brechin shaft.

This sundial resided at Panmure House in Ross's time, but that house was demolished in 1955 and at some point it made its way to Brechin Castle around 15 miles to the north. It is thought to be of 17th century date, but is now on a 19th century octagonal pedestal (Fig. 14) and is much lichen encrusted. This can be seen on the heart-shaped sinking on the east face (Fig. 15) where some of the hour lines are just visible today. However, comparing Figs 10 and 14, it is clearly on a different pedestal from when it was seen by Ross.

Happily though, there was a surprise further on in the garden. A fine horizontal sundial was sitting on what was

Fig. 14. The Brechin sundial today on a different pedestal from the one seen by Ross.

Fig. 15. The lichen-encrusted heart-shaped sinking on the shaft's east face.

Fig. 16. The original Panmure pedestal now with a horizontal sundial on top.

obviously the obelisk's original pedestal. This sundial was not seen by Ross, but there is no doubt that the obelisk's pedestal has been re-used here (Fig. 16).

Fig. 17. The octagonal horizontal sundial now on Panmure's original pedestal.

On top of the pedestal today is an engraved copper alloy octagonal dial (Fig. 17) with a one-minute time scale and Roman numerals from 4 am to 8 pm read from the inside. It is also inscribed with what appears to be "Brechin 56 deg 20 min" or it could be 30 min. Either option is surprising as Brechin is at 56 degrees 47 minutes.

It includes an equation of time in table form, split on either side of the gnomon and is complete with a noon gap. It also shows noon time for various cities around the world signified by a series of XIIs within an inner octagonal chapter ring. Much of the detail though is difficult to read today.

This may be a significant London sundial dating from the late 17th to early 18th century that has not previously been recognised and it certainly requires further investigation.

ACKNOWLEDGEMENT

Many thanks to John Davis for his comments on the Brechin horizontal sundial.

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2. D. Cowan: 'In the Footsteps of Thomas Ross Part 7: Scotland's Grandest Sundials', *BSS Bulletin*, 25(iv), 22–27 (December 2013).
3. D. Cowan: 'In the Footsteps of Thomas Ross Part 4: The Hidden Sundials of South Queensferry', *BSS Bulletin*, 25(i), 16–18 (March 2013).
4. John W. Small: *Scottish Market Crosses,* Eneas Mackay, Stirling (1900).
5. D. Cowan: 'In the Footsteps of Thomas Ross Part 24: The Carberry House Sundials', *BSS Bulletin*, 30(iii), 16–18 (September 2018).

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Postcard Potpourri 51
Butley Priory, Suffolk

Peter Ransom

Here is another priory dial to complement the last Postcard Potpourri! Again, this is not listed in the Fixed-Dial Register, though that may not be surprising as it looks a rather temporary dial. The date (1905) is clear enough as are the Roman numerals, but perhaps they have been painted on the wall. The motto (TIME PASSETH) appears on the door lintel. I wonder whether the clerical person in the picture was the maker; at least he provides some scale for the size of the dial!

Butley Priory lies to the east of Sutton Hoo, was founded in 1171 and suppressed in 1538. The 14th century gatehouse then fell into decay but was restored for use as a private house about 280 years ago. Today it is used as a venue for private functions, events and retreats. There is a lot about the priory in Wikipedia for those interested in further details.

There is no information about the photographer or maker of the postcard: it is unused and apart from the words "Postcard", "Correspondence" and "Address" there is just the number 641.

ransompeter687@gmail.com

READER'S LETTER

Wonky Sundial Corrected

I was interested to read John Wilson's article on 'Wonky sundials' in the March 2020 issue of *the BSS Bulletin*.[1] It brought to mind a visit to the National Trust of Scotland's Pitmedden Castle in 2006, and its garden centrepiece: a magnificent polyhedral dial. There are a couple of other sundials also, and my attention was drawn to a horizontal dial, its orientation inevitably being out by 180 degrees. I asked the curator if she had a screwdriver and if she would be happy for me to adjust it. On hearing that I was a BSS member she readily agreed, and in a matter of moments I had it corrected, to the bemusement of a small group of onlookers. I have to admit that I did not check the orientation of the polyhedral dial!

I am sure other BSS members must have similarly corrected sundials in public gardens.

David Le Conte (with backpack) corrects the orientation of a sundial at Pitmedden Castle.

Reference

1. John Wilson: 'Wonky sundials – Our heritage safe in their hands?', *BSS Bulletin*, 32(i), 10-11 (March 2020).

David Le Conte

Who was 'EC'?

There are several dials known which are signed simply with the initials 'EC'. This is sometimes thought to be the well-respected London maker Edmund Culpeper (1660–1738) but the early style and the dates on some of the dials (examples of 1625 and 1642 are known) suggest this is not always so. So who was the earlier maker?

Edmund Culpeper's trade card, seen below right, shows he made a wide variety of instruments into the beginning of the 18th century, including the eponymous 'Culpeper microscope'. He always had the latest designs and signed his name in full.

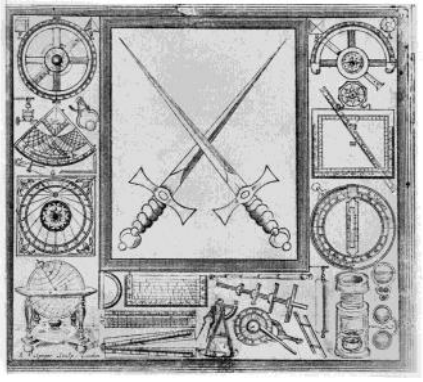
The earlier 1625 sundial below shows the origin of delineation quite close to the centre of the plate and a thin knife-edge gnomon with a cross pattée for noon, a design which was already obsolescent.

The thicker gnomon on the 1642 dial is clearly a replacement with the buttress support at the north added at the same time.

JD

*An "EC * 1625" dial with thin fimbriated gnomon.*

*An "EC * 1642" dial with a replacement gnomon (probably Victorian).*



Edmund Culpeper's tradecard.

TWO DOUBLE HORIZONTAL SUNDIALS CONSTRUCTED AT THE JESUIT ACADEMY IN POLOTSK, BELARUS

MACIEK LOSE

Double horizontal sundials are compound gnomonic instruments primarily consisting of a standard horizontal sundial with a polar oriented gnomon together with a stereographic projection of the celestial sphere on to the horizon plane with the vertical gnomon. The latter component, as a separate gnomonic instrument, is known as *horizontal instrument*. These complex sundials, usually equipped with a number of additional scales, were developed in the early 17th century by English mathematician William Oughtred (1574–1660, Fig. 1) with the first examples crafted ca. 1630 by his collaborating artisan Elias Allen (1588–1653). Only a few dozen historical double horizontal sundials and related instruments are known, with most made in the 17th century by a small group of instrument makers whose master–apprentice links in most cases can be traced back to Elias Allen – the first but also most prolific maker of double horizontal sundials.

Fig. 1. Portrait of William Oughtred, inventor of the double horizontal sundial and other gnomonic and mathematical instruments, by Wenceslaus Hollar, 1644. Source: public domain.

Fig. 2. A double horizontal dial by Elias Allen, ca. 1630 offered by Sworders in their 3 December 2019 sale. Notice the missing elongated tail of the horizontal dial's gnomon (which has since been restored). Now DH-80. Source: Sworders Fine Art Auctioneers.

The most comprehensive modern source on this rare type of sundials is the monograph *The Double Horizontal Dial* by John Davis and Michael Lowne.[1] In the decade since its publication a number of previously unrecorded instruments of this type have surfaced – mainly as auction and dealer offers but also through literature searches. These include: three dials by Elias Allen himself (Fig. 2),[2] one dial with Elias Allen's signature but thought to be a contemporary forgery,[3] and individual examples by John Allen[4] and Nathaniel Witham,[5] these being the second and first known dials by those makers respectively. In addition, there is one unattributed dial.[6] Of the continental examples, two pocket Dieppe diptych dials by Charles Bloud have come to light[7] which include stereographic projections in the compass bowl, indicating that a dial recorded in the monograph (catalogued as DH-12) was not a solitary piece by this renowned maker. Another 17th century horizontal dial with a stereographic projection, thought to be of English origin based on its craftsmanship but otherwise falling outside known categories, was offered by a Parisian dealer.[8]

Fig. 3. Gabriel Gruber (1740–1805), director of Polotsk Academy from 1784 to 1800 and most likely the initiator and designer of the Polotsk sundials. This commemorative plaque by sculptor Janez Pirnat is on Gruber Palace in Ljubljana (now containing the National Archive of Slovenia), erected according to his design. The palace address is Zvezdarska ulica 1, which translates as Stellar Street 1, a name most appropriately corresponding to Gruber's interests!
Source: http://www.w-volk.de

Fig. 4. Top: The complex of the former Polotsk Academy on a photograph from ca. 1900. The church of St Stephan was blown up in the communist period, in 1964. Bottom: The project of the extension of the Polotsk Academy by Gabriel Gruber, ca. 1800.

All these new findings raise the number of recorded historic instruments from the 17th and early 18th centuries to more than seventy, and require a systematic study of their own. However, the most surprising and unusual finding of recent years, which should be highlighted to the international scientific community, is that of two, apparently non-extant, double horizontal sundials constructed in the early 19th century at the Jesuit Academy in Polotsk.

At the time of their creation the historic tradition of double horizontal dials had generally passed. The location in today's Belarus, then on the outskirts of the European scientific community, and the people engaged in the story – a cosmopolitan brotherhood of the Jesuit order and Russian Tsar Nicholas I himself – make it a highly fascinating tale not only in terms of dialling.

Polotsk Academy

The Jesuit College in Polotsk was founded by the Polish king Stephan Bathory in 1580. In 1772, when the first partitions of Poland took place, the territory was annexed by the Russian Empire. The following year Pope Clemens XIV dissolved the Jesuit order but his *breve* was not executed in Russia by command of Empress Catherine II (the Great). Thus from 1773 the existence of the Jesuit order became limited to the territories under Russian governance and in the following years Polotsk College attracted many brothers from all over the Europe.

Between the years 1785 and 1800 its director was Gabriel Gruber (1740–1805, Fig. 3), a prominent figure from a former Austrian province of the Jesuit order, previously court engineer to Emperor Joseph II – a polyglot with profound knowledge and experience in multiple disciplines from painting, architecture, engineering and shipbuilding to mathematics and astronomy. This 'Renaissance man' of the Jesuit order was also a highly influential figure at the court of Tsar Paul I, becoming the first rector of the Aristocratic College at St Petersburg State University in the year 1800 and Superior General of the Order in 1802. Under Gruber's directorship, a scientific museum was built at Polotsk College (Fig. 4) which included galleries of natural history, architecture, physics and astronomy as well as laboratories for students. The school, according to the preserved inventory lists, also had specialized and well equipped workshops which were run by experienced brothers. In 1812, the Polotsk Jesuit College was raised to the status of Academy, which reflected its growing reputation and the influence of the Jesuit order; it was also a political tool to secure its obedience to the Russian authorities during the Napoleonic invasion.

Fig. 5. Part of the plan of Polotsk from 1786. The sundial was located in the south-facing gardens adjacent to the complex of the Jesuit Academy, labelled with "11" on the map. Source: http://www.karty.by

The earlier of the two sundials in Polotsk was constructed during Gruber's directorship, in the southern part of the regular gardens adjacent to the buildings of the Academy on the natural terrace on the banks of the Dvina River. It was a most suitable location for the instrument due to its southerly exposure and lack of obscuring buildings in direct proximity (Fig. 5). Although there is no direct historical evidence, it is very likely that the sundial was constructed not only from the inspiration of Gabriel Gruber, but also according to his design, based on his thorough theoretical and practical knowledge of geometry and engineering.

Soon its unusual properties attracted the interest of the public and of guests of the Academy. Readings from it were part of the programme of the astronomy classes, together with astronomical observations performed with an 8-foot telescope.[9]

Παντα δείχνουν (Pantadeíchnoun) or The one that shows everything

Both sundials were extensively described in the article: "*Opisanie rzadkiego Kompasu zwanego Παντα δείχνουν" (Description of a rare Compass named Παντα δείχνουν*),[10] written in Polish, at that time the primary language of the Academy, and published in 1818 in the Academy's periodical – *Miesięcznik Połocki (Polotsk Monthly)*. The author's initals, X.I.C., suggest that it was either Jakub Condrau (1779–1837),[11] a Swiss-born Jesuit, then teacher of physics, mechanics and higher mathematics in Polotsk, or Józef Cytowicz (1771–1846), a Polish lecturer of mathematics, astronomy and architecture at the Academy.[12] While existing sources differ in assigning authorship of the article,[9,13] it is more likely that it was authored by Jakub Condrau, who is also credited with the Academy's mathematical textbooks, "*Elementa geometriae theoreticae et practicae*", printed in the same year as the article,[14] and "*Trigonometria plana et sphaerica*", issued in the following year.[15]

The preface of the article gives basic information on the location, size and furniture of both dials; it also includes an interesting reference to a double horizontal dial of a similar design seen by the author in one of London's public parks:[16]

> *Of the exceedingly large number of compasses,[17] descriptions of which can be read in variety of gnomonic works, I do not know if any is so sophisticated and so useful as the one described here. Not only used to measuring and finding of time, but also to performing many astronomical observations it can be used; besides, it has that unusual feature, that not only with sun- and moonlight, but also without that's help, it shows many useful things. So far, I haven't read any Author who would give an adequate information on it. The first compass of this variety, I saw in London in a public garden: the second of the beautiful craftsmanship being 16 inches in diameter by the students of mathematics of the Polotsk Academy for the Petersburg's horizon[18] was made, presented to His Highness Count Razumowsky at a time acting Minister of Enlightenment: the third of the similar size is located in Polotsk in the academic garden. The latter two dials differ from the London one in that they include parallels of altitude (Almicantharat) and twilight circles.*

After this comes an amusing and somewhat linguistically tangled paragraph encouraging readers afraid of gnomonics:

> *Giving this description, I'm not afraid of any common objection that complex sundials are hard to use; given that was the true, it doesn't mean that complex sundials are not useful, but rather that their construction is difficult and use uncommon for many. That would be a harm to public than, if I was for this reason to abandon my intention.*

The following seventeen pages give a description of the dial – or more precisely instructions for the construction and use of a similar dial. It is split into two parts – the first one presenting composition of the major elements of the dial and its delineation method and the other extensively explaining varied uses of the sundial – *in sunlight, in moonlight and with stars, as well in cloudy circumstances.*

The sundial, according to its Greek name *Pantadeíchnoun – The one that shows everything*, allowed for many astronomical aspects to be read, including:

- astronomical time of day and night from moonlight or from the meridional passage of stars,
- day of the year,
- solar declination,
- sign of the zodiac and ecliptic longitude of the Sun,
- moments of astronomical sunrise and sunset,
- azimuth angles of solar sunrise and sunset,
- moments of the apparent sunrise and sunset, considering effects of atmospheric refraction,
- instants of civil, nautical and astronomical dusk and dawn,

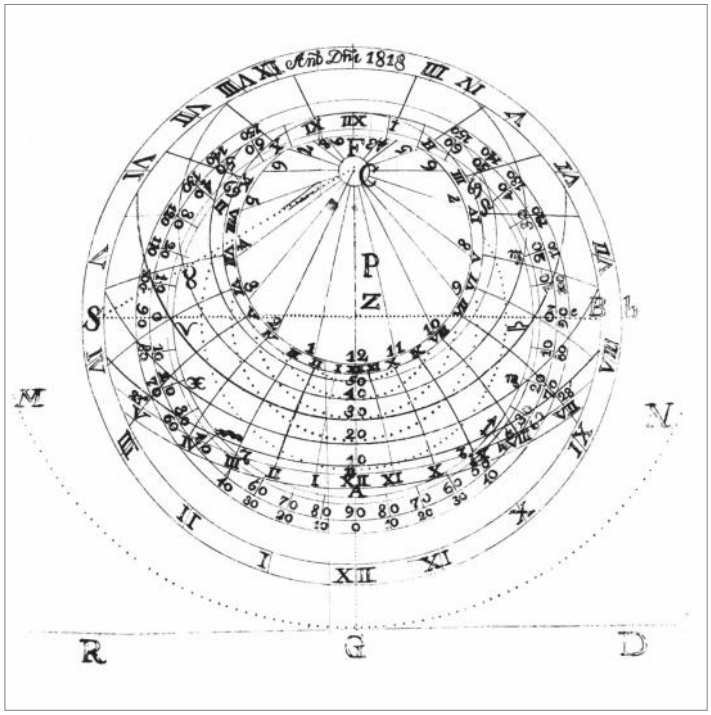


Fig. 6. Scheme of the Polotsk double horizontal sundial accompanying the article by Jakub Condrau, published in "Miesięcznik Połocki" (Polotsk Monthly) in 1818. Note the central location of the horizontal dial with polar gnomon and wide span of the time scale 3–12–9, corresponding to the St Petersburg latitude of 60°.

Fig. 7. Late English double horizontal sundial, ca. 1713, by Benjamin Scott (1690–1751), a London scientific instrument maker, who emigrated to St Petersburg in 1733. Scott held a position of compass maker to the Russian Navy Ministry in 1733–47 and was a scientific instrument maker to the St Petersburg Academy of Sciences. The dial (DH-26) includes a range of geographic locations engraved inside the outer chapter ring. Source: Musée des Arts et Métiers-Cnam/ Michèle Favareille.

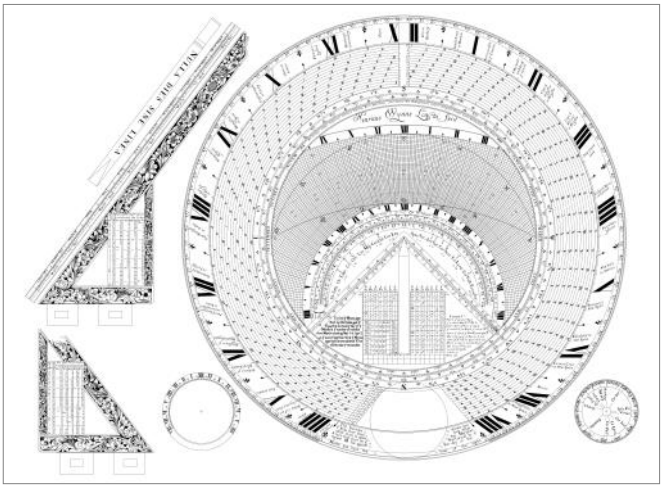


Fig. 8. Drawing of the components of Henry Wynne's double horizontal sundial made in 1685 for Staunton Harold, the home of Earl Ferrers in Leicestershire. It is one of the most complex horizontal sundials ever constructed and an actual 'Pantadeíchnoun'. Besides elements present on the Polotsk sundial it includes: ecliptic arcs, two moondials, nocturnal, perpetual calendar, 32-point compass rose, trigonometric scales, right ascensions of 24 stars, equation of time table, epact tables and user instructions. Note the elongated polar gnomon tail.

Source: Ref. 1.

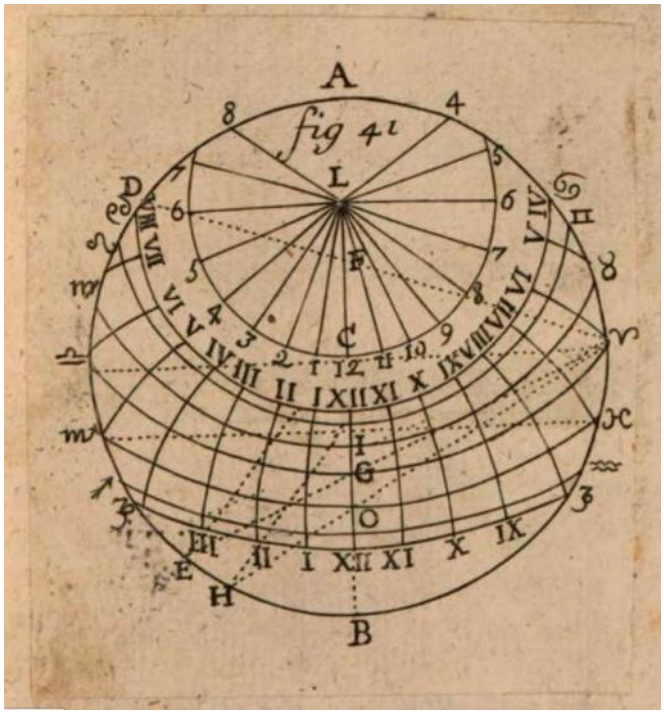


Fig. 9. Jacques Ozanam's pattern of a double horizontal dial, with a horizontal dial's hour lines in the central part. Figure 41 of "Methode Generale ...", note 19.

- length of the night and day throughout the year,
- Babylonian and Italian hours,
- lunar altitude, azimuth and declination,
- instants of noon for given places around the globe and their longitudinal distance from the dial location.

On the last page of the description comes a simplified, geometric drawing of the dial plate, used in the text as a reference to explain the dials' characteristics and use (Fig. 6).

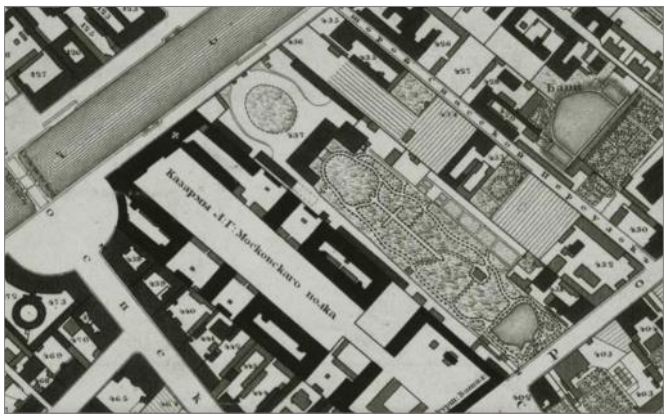


Fig. 10. The estate of Count Alexey Kirillovich Razumovsky by the banks of the Fontanka River from a plan of St Petersburg of 1828. The mansion is located between an ample forecourt with an oval parterre and a large south-oriented informal garden extending to Zagorodny Prospekt. The bay at the apex of the vertical arm of the cross, formed by two intersecting paths, was the most suitable and symbolic place for a sundial. Source: www.retromap.ru

The layout of the dial differs from the known English examples (Figs 7 & 8) in having hour lines and time scales of the horizontal sundial located in the central part of the dial, inside the grid of the stereographic projection. The full hours in this part of the dial were described with Arabic numerals (3-12-9) and repeated in the chapter ring around the perimeter of the dial, marked with Roman numerals. This structure of a horizontal dial with a corresponding simple triangular gnomon (marked with dotted lines between points C, Z, S), lacking the long tail typical of the double horizontal sundials of the English genre, suggests that the design was developed from the pattern published in one of the late 17th century gnomonic treatises by Jacques Ozanam (1640–1717): "*Cours de mathématiques"* or "*Methode Generale pour Tracer des Cadrans …* ,"[19] where this form was briefly described and illustrated with a diagram reproduced here as Fig. 9. The Polotsk Academy sundials seemingly are the only two known historical double horizontal sundials constructed according to Ozanam's pattern. While the pattern is clearly the original of the design, its actual transmission to Gruber was probably indirect – possibly through 18th century textbooks and popular compilations by Central European Jesuit scholars, who used Ozanam's gnomonic treatises as one of their sources.

The sundial drawn in the description corresponds to the latitude of 60° i.e. "*Petersburg's horizon*". Thus it represents the dial constructed at the Academy and presented to the Count Razumowsky,[20] the Tsar's Minister of Enlightenment. The scheme is much simplified from what one would expect the actual sundial to look like based on the description although it exhibits at least some primary features that were present on the original:

- stereographic grid, here reduced to 10 degrees and 1 hour intervals,
- dotted circles of the equal altitudes or "*parallels of altitude (Almicantharat)*", i.e. almucantars,
- calendar scale along the horizon, marked with zodiac sigils,
- azimuth scale around the perimeter, split into two chapter rings, each divided into four quadrants,
- the obliquity value of 23° 28′.

Based on the description in the article, the dial must also have included a calendar scale in days. It is unclear whether it used the Gregorian calendar – practised by the Roman Catholic Church – or a Julian one, used in Russia and by the Orthodox Church.

The most unusual feature, not present in any of the double horizontal dials known to the author, is the extension of the stereographic grid beyond the horizon circle in order to mark the twilight circles and the circle of 0.5° below the horizon – corresponding to the instants of apparent sunrise and sunset, effects resulting from atmospheric refraction – or, in the original wording of the description "breaking of the light". The twilight circles on the sundial include one for 'civil twilight' with the Sun's elevation 6.5° below horizon; for 'nautical twilight' with elevation value of –11° and for 'astronomical twilight' at –18°. In Fig. 6 the –18° circle is the one on the inner side of the perimeter time chapter ring, while the –11° and –6.5° circles border the external azimuth scale. Because of the scale of the drawing the –0.5° circle was omitted as it would have merged with the horizon circle.

The use of the twilight arcs was primarily for educational purposes, but with the help of moonlight or the position of stars, one could actually make practical use of them to determine dusk during nighttime. Twilight arcs are found on historical astrolabes and it seems likely that this was the actual source of inspiration for Gruber, who, as a former director of Navigation Headquarters (1772–1781) in Ljubljana and teacher of marine engineering, was proficient in astronomy, navigation and the history of scientific instruments.

The article promoting construction of similar dials suggests that two additional chapter rings (listing towns and geographical locations) can be added between the twilight circles with the first marked with longitude differences from the sundial's design location, and the second with the moments of their noon shown by the gnomon's shadow. This feature – a 'geographical ring' – is often found on more sophisticated horizontal dials of the 17th and 18th centuries and, though not expressed directly by the author, could have been an element of both dials. According to the preserved accounting books, it was also included in Edward Hatton's double horizontal sundial for the Middle Temple in London, the supposed dial of a similar design that Condrau recalls having seen in a London public park.[16]

The date given on the drawing, "Ano Dni 1818", refers to the publication year of the article in *Polotsk Monthly*, rather than the date of the sundial's construction. The first of the two dials must have been completed under Gruber's direc-

torship, between 1785 and 1800. The other, being its analogue for the St Petersburg latitude, was made between 1810 and 1816, after Gruber's death, when Alexey Kirillovich Razumovsky (1748–1822), to whom it was dedicated, held the post of the Tsar's Minister of Enlightenment.

Alexey Razumovsky had a special interest in astronomy and held the quality of the mathematical education at Polotsk Academy in high esteem. It was he who advised Tsar Alexander I to promote the College to the rank of an Academy, which took place in 1812.[9] In this light the dial can be regarded as a sophisticated gift that expressed Polotsk Academy's gratitude to its supporter. On 10 April 1810 Razumovsky purchased an estate on the embankment of the Fontanka river[21] in St Petersburg, which is thought to be the site for which the sundial was designed. It comprised a two-storey mansion, separated from the Fontanka embankment by a large front yard and a vast informal garden that stretched behind the southern façade of the house, reaching the Zagorodny Prospekt. The detailed city plan from the year 1828, drawn twelve years after Razumovsky moved from St Petersburg to Moscow and Gorenka in 1816, indicates the general appearance and composition of the garden (Fig. 10). Other than two straight paths that cross at right angles in its central section, reminiscent of a Latin cross, the overall layout was informal with a pavilion and a pond at a southern end and no obvious sign of a sundial, which could have been omitted due to the scale of the map. The cross feature in the layout of the garden might not have been for purely aesthetic reasons but also a symbolic one. Count Aleksei Kirillovich Razumovsky, a member of the Masonic lodge, was strongly influenced by the Jesuits and by Count Joseph de Mestra, a key figure of Counter-Enlightenment philosophy. So the sundial could have been an element of this symbolic composition.

During the course of the 19th century both the house and the once magnificent garden fell into decline. The mansion was demolished between 1909 and 1912 and Borodinskaya Street, commemorating the centennial anniversary of victory over Napoleon, was laid in place of it and a former garden.[22] No further information on the whereabouts of the Razumovsky sundial is known.

As for the other sundial, its most astonishing historical episode started thirteen years after the publication of the article in *Polotsk Monthly*, when political circumstances had dramatically changed in Russia for the Jesuit order. Tsar Alexander I dissolved the order in the Russian Empire with a decree (*ukaz*) dated 13 March 1820. The Polotsk Academy, teaching some 700 pupils, and 21 provincial houses were instantly closed. Jesuits were expelled and a government commission conducted a survey of the Academy's estate and movables.

The Piarist Brothers were allowed to move in and take over the estate with the remaining equipment of the former Academy; they resided there until 1830, when they were similarly expelled and the estate was granted to the newly formed Cadet Corps. The authorities broke up the Academy's library with an estimated 40 to 60 thousand volumes which were subsequently dispersed among different institutions.

The scientific equipment, collections and other belongings of the Academy were distributed by the director of the Department for Enlightenment, Vasily Popov, who received special instructions from Tsar Nicholas I in relation to the Polotsk sundial. They stated that the "aforementioned sundial shall be packed with proper care and sent to St Petersburg with the transport of books, as it is notable for its rarity".[9] The sundial was accordingly removed from the plinth, packed into three large crates and transported to St Petersburg. We find the report of this and the following events in the day entries of the Annals of St Petersburg Kunstkamera (*Letopis*) for the year 1831:[23]

27 April
S.S. Uvarov said that the imperator Nicholas I ordered the transfer to the Academy of some objects from the former Jesuit Museum in Polotsk.
The Conference expressed gratitude.

5 May
The Conference of the Academy of Sciences reported S.S. Uvarov that the Academy was deposited with items from the former Jesuit Museum in Polotsk (see the entry of April 27):
1) the Turkish seal in a gilded silver frame;
2) four palm leaves with Malabar inscriptions;
3) an iron medal found in "Tatar graves";
4) a crucifix made of amber;
5) a sundial.
The first three subjects were transferred to the Asian Museum.
The crucifix from amber came to the Kunstkamera.

The sundial of "special device" imperator Nicholas I ordered to place on the square between the buildings of the Academy of Sciences and the Twelve Colleges.
It was found that the sundial was designed for geographical position of the city of Polotsk and that in St. Petersburg can only be a subject for curiosity. For this reason, the dial could be given to storage in the Observatory. At the request of the emperor, it was possible to make a similar dial for St. Petersburg and put it in the place chosen by him.

10 June
K.A. Lieven notified S.S. Uvarov about the decision of the imperator Nicholas I to return the sundial (see entry of May 5) to Polotsk Cadet Corps.

An early 20th-century book on the history of the Cadet Corps includes a transcript of a record from its archives, confirming that by February 1836 the sundial, returned and reinstalled in Polotsk, was brought back to its full functionality. The relevant paragraph in the book also recalls its St Petersburg episode and includes its simplified description, by Tovstonog – 7th class officer – providing information on the materials used for its construction:[24]

> *The dial consists of a lead disk, upon which different curved lines are drawn, with a copper arrow set perpendicular in the middle of the disk.*

Fig. 11. Panoramic view of the square between Twelve Colleges, Academy of Sciences and the Kunstkamera in St Petersburg – the location ordered by Tsar Nicholas I for the Polotsk sundial. The central pavilion originally housed a famous 3.1 metre Gottorp globe. View by John A. Atkinson, ca. 1802–1805. Source: US Library of Congress.

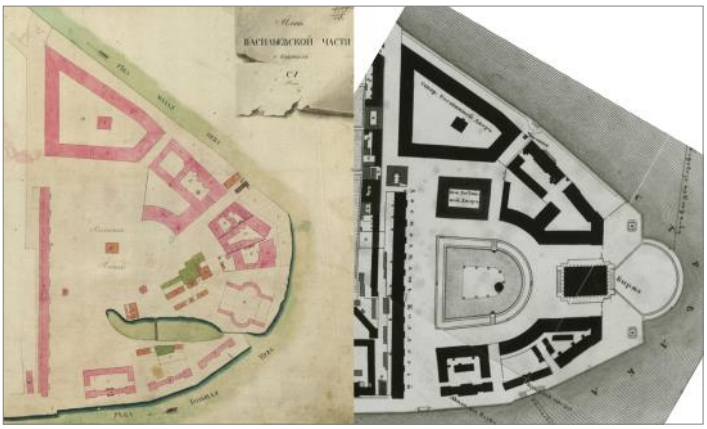


Fig. 12. The square between Twelve Colleges and the Kunstkamera in the 1798 atlas of St Petersburg and on F.F. Schubert's plan of 1828. In the first three decades of the 19th century the area underwent significant reconstruction, including a New Stock Exchange and buildings forming a symmetrical horseshoe enclosure of the internal square – named College Square. Source: Государственный реестр уникальных документов Архивного фонда Российской Федерации, www.retromap.ru

It is to be noted that the site originally envisioned by Tsar Nicholas I for the sundial in St Petersburg – *the square between the buildings of the Academy of Sciences and the Twelve Colleges* – had a significant gnomonic past shortly before the events discussed here. According to V.L. Chenakal[25] a meridian line accompanied by a sundial existed in this square almost continuously between 1774 and 1828, with a gap of an undefined period prior to 1790. However, none of the highly detailed contemporary plans and panoramas of St Petersburg (Figs 11 & 12) depicts either the sundial or the meridian line in the square.

Properties of the Polotsk Sundials

For the purpose of this study a graphic reconstruction of the Polotsk double horizontal sundials was developed (Figs 13-16) showing more detail than the simplified geometrical scheme published in the 1818 *Polotsk Monthly* article. This gives a glimpse of how they might have appeared and allows study some of their unique properties. It also provides the basis for a possible future reconstruction. The dials were drafted using AutoCAD software.

The geographical coordinates of the sundials were chosen based on their most probable locations, discussed earlier in this study – 55.485356° (55° 29′ 07″) N, 28.763975° (28° 45′ 50″) E for Polotsk and 59.925256° (59° 55′ 31″) N, 30.332698° (30° 19′ 58″) E for St Petersburg. The size of the dials was set at 16 inches – following the value given in the description in *Polotsk Monthly.* The obliquity of the ecliptic was set at the modern value of 23° 26′ (23.44°) compared to 23° 28′ [23.46(6)°] drawn on the diagram, due to the intention of a possible future physical reconstruction.

A number of assumptions had to be made, including the precision of the scales, calendar, and the language of the inscriptions. The precision was chosen by the author based on the criterion of overall intelligibility of the dials, given their size. Owing to lack of information on the aesthetic code of the originals, the dials were given a modern look, emphasizing their scientific aspect.

The reconstructed dial for the Polotsk Academy was described in Polish and Latin – the actual languages of the Academy at that time, and with a Gregorian calendar. On the St Petersburg sundial, crafted in the Academy for the Minister of Enlightenment, Russian and Latin together with the Julian calendar were used. These are subjective choices by the author as no historical detail is available. The question of the original choices for the respective dials is an interesting one considering the complex political context – cosmopolitan, but predominantly Polish Jesuit Academy in the Orthodox Russian Empire in the period of the Napoleonic wars. One can be sure that it must have been a thoughtful, if not political, decision by the maker.

As the reconstruction progressed, some obstacles emerged. Firstly, the unique extension of the stereographic grid beyond the horizon circle overlaps in the perimeter area of the dial plate with different graduated scales. To maintain legibility in this area it was decided not use any additional border lines for the calendar, azimuth and longitude scales and to enhance civil, nautical and astronomical twilight rings with background colours for printing.

Also, an obvious practical drawback of the Ozanam pattern was revealed. It was noticed that by the summer solstice

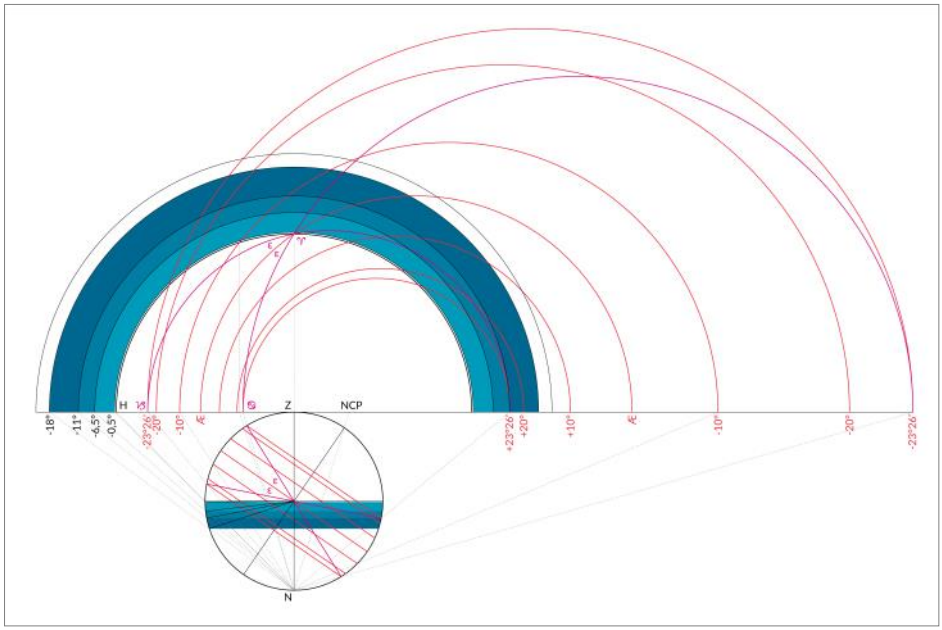


Fig. 13. Construction of solar declination arcs (red), ecliptic arcs (purple) and equal altitude circles (almucantars) of a stereographic projection. Only altitude circles for civil, nautical and astronomical twilight below the horizon are drawn and highlighted with blue shading.

near noon the shadow of the triangular gnomon barely reaches the azimuth chapter ring, not to mention other potential scales beyond it. Scaling the gnomon to counteract this would consume the limited space between the gnomon's foot and the horizon circle on the south side of the dial, normally utilized for pre-6 am and post-6 pm time divisions of the central horizontal dial. For the St Petersburg latitude the original scheme was deemed acceptable, but the problem in the Ozanam scheme intensifies at lower latitudes.

It is not clear whether this issue was recognized and addressed by the designer in the case of the Polotsk sundial. Tovstonog's description of the gnomon: "*a copper arrow set perpendicular in the middle of the disk*", suggests that it was of simple triangular form, as in the Ozanam design. Actually, the only alternative the designer could have implemented was to enlarge the gnomon in the southern direction, utilizing the space between the horizon circle and summer solstice declination arc for delineation of the horizontal dial's morning and evening hours – but this would significantly affect the aesthetics and educational aspect of the dial. For the purpose of the reconstruction, the most historically probable form was used, in line with the scheme published in *Polotsk Monthly* and the St Petersburg sundial; however, in the case of a physical construction of a similar dial a short tail to the polar gnomon is advisable (Fig. 16) or other non-orthodox solutions such as a longer, simple blade polar gnomon and vertical rod beneath.

The list of the cities and geographical places around the globe with their local noon times marked on the dial together with their longitude differences (Figs 14 & 15) were placed between the twilight circles – as stipulated by the *Polotsk Monthly* description. The places chosen are a subjective selection by the author. They include, among others, major European and Russian Empire cities, places related with Christianity (*Jerusalem, Rome, Constantinople*), and those which commonly appear on geographic rings of period sundials (*Goa, Isfahan, Barbados*).

The sundials drawn for Polotsk and St Petersburg reveal the highly informative potential of the twilight circles, beautifully highlighting the phenomena of 'white nights' and other features of northern latitudes. It is clearly seen on the dial that at the summer solstice in Polotsk (Fig. 14) the Sun sinks to ca. –11°, the border between *nautical* and *astronomical twilight*, while in the St Petersburg dial (Fig. 15) it reaches just ca. –6.5° below the horizon, merely the border between *civil* and *nautical twilight.* The part of the grid below the horizon also nicely shows the changing rate at which the Sun dips below the horizon. One can read from the dial that in Polotsk, at the winter solstice, it takes the Sun 1.5 hours to sink –11° below the horizon, while at the summer solstice it takes almost 3.5 hours.

Comparing the two sundials, another interesting phenomenon is to be noted – of the latitude-dependent time interval difference between Sun-centred apparent and geometric sunrise/sunset. With the help of a circle drawn 0.5° below the horizon, one can estimate the interval for Polotsk to be at ca. 5 minutes, while for St Petersburg it is ca. 7 minutes.

According to the description in *Polotsk Monthly***,** it was possible to read the value of the ecliptic longitude from the dial, but there was no information as to whether ecliptic arcs were actually present on it. To facilitate such readings on the reconstructed dial, the ecliptic arcs, a standard feature on English 17th century double horizontal dials, were added to the design, graduated to 1°. Historically, two ecliptic arcs were used, corresponding to summer and winter solstice positions of the ecliptic at noon – jointly representing the entire annual path of the Sun across the heavens. In the case of the Polotsk sundials, with the stereographic grid extending below the horizon, the entire ecliptic actually could have been represented as a single, complete circle at the winter solstice noon position, but it was decided to preserve the other arc on the dial as well, to facilitate readings. Thus a partial doubling of the ecliptic

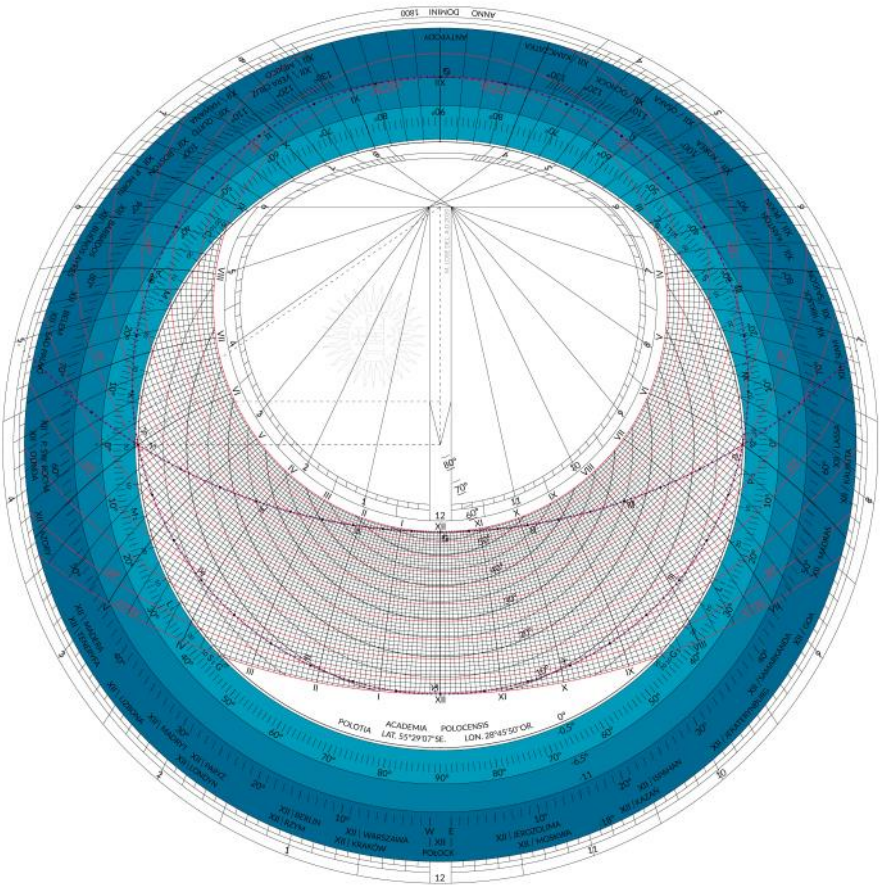


Fig. 14. A geometric reconstruction of the Polotsk Academy double horizontal sundial. Periods of civil, nautical and astronomical twilight are highlighted with blue shading.

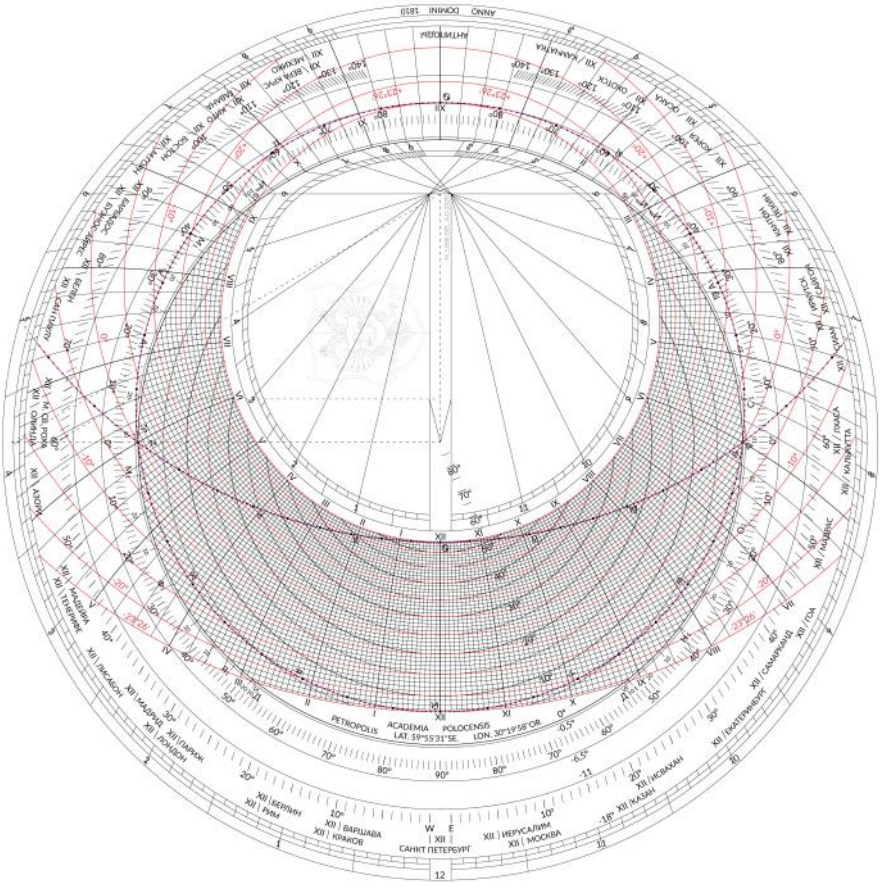


Fig. 15. A geometric reconstruction of the double horizontal sundial for the St Petersburg residence of Count Alexey Kirillovich Razumovsky, the Tsar's Minister of Enlightenment, constructed at the Polotsk Academy.

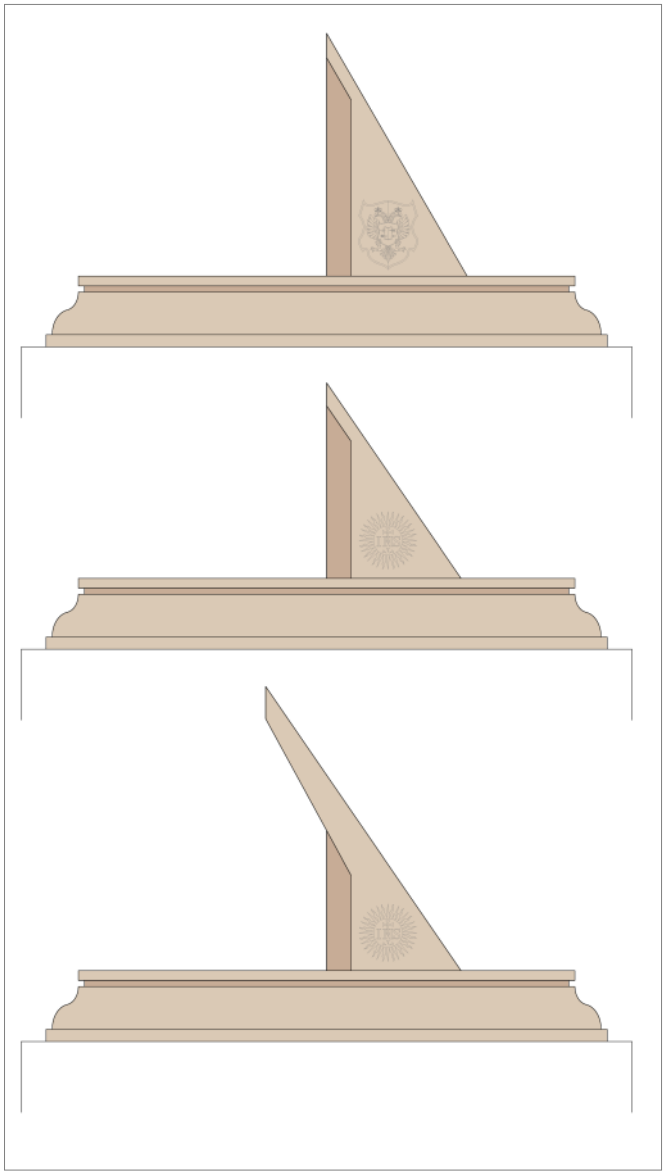


Fig. 16. A side view of the reconstructed St Petersburg dial (top) and Polotsk dial (centre). The gnomon of the Polotsk dial was embellished with the emblem of the Jesuit order and, for the St Petersburg dial, with the Razumowsky family's coat of arms. The bottom view represents the recommended gnomon shape for double horizontal sundials constructed along Ozanam's principles for latitudes below 60°, which use additional scales along the perimeter read by the gnomon shadow.

and zodiac sigils can be noted on the dials (Figs 14 & 15).

Pantadeíchnoun – Deus ex Machina?

Whilst writing the conclusion of this article, another Belarusian source was accessed, thanks to Polotsk archaeologist Aleksandr Solovev. The brief, half-page article by W.I. Shaikov[26] on the Polotsk sundial records that in 1845 Tsar Nicolas I visited Polotsk Cadet Corps, in the grounds of the former Academy. On the 10th anniversary of the inauguration of the Cadet Corps, established in 1835, he granted orders to the large group of teachers and expressed his interest in the fate of the sundial that he had ordered to be returned to Polotsk some fourteen years earlier. The article also states that the sundial, whilst in St Petersburg, was set in the square between the Twelve Colleges and Academy of Sciences buildings, where it attracted crowds of St Petersburg citizens. This is also supported by the information that it was moved to Polotsk only in 1835, four years after the Tsar's order of 10 June 1831.[27] The delay in execution of the Tsar's order was caused by prolonged preparations by the Cadet Corps establishment. The location in the square that was initially planned to be permanent, before the Tsar's consultations with the Academy of Sciences, was chosen as a temporary location for a four-year period. Thus it is likely that between 1831 and 1835 St Petersburg hosted two double horizontal sundials crafted in the Polotsk Academy, one in College Square near the Academy of Sciences and the other at Alexey Kirillovich Razumowsky's estate.

МИНИСТЕРСТВО КУЛЬТУРЫ РОССИЙСКОЙ ФЕДЕРАЦИИ

ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ БЮДЖЕТНОЕ УЧРЕЖДЕНИЕ КУЛЬТУРЫ

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28.01.2020 № 81

На № _____ от _____

Уважаемый господин Macej Lose!

В ответ на Ваше письмо от 24 января 2020 г. на тему «Редкие солнечные часы из собрания Музея Религии» сообщаем, что в учетной документации ФГБУК «Государственный музей истории религии» данный предмет не числиться. Приложение со статьей Шайкова «Полацкі сонечны гадзіннік», в Вашем письме, к сожалению, отсутствовало.

Если в Вашем распоряжении имеются какие-то дополнительные уточняющие сведения об этих часах, просим сообщить нам эти данные, чтобы мы смогли возобновить поиски.

Директор ГМИР Мусиенко Л.А.

Исполнители: Виноградова Т.Н. tnvkhran@gmail.com
Цеховская Я.С. tsekhanovskayayana@mail.ru

Fig. 17. A letter from the National Museum of Religion in St Petersburg. Note an aesthetic resemblance of the ministerial stamp with the composition of reconstructed sundials (!).

Another and crucial note by Shaikov is that he had personally seen the Polotsk sundial, or a St Petersburg dial for Minister Razumowsky, in the St Petersburg Museum of Atheism in 1990s! This was a revelation both for the author and for Valery Dmitriev, who conducted a large part of the St Petersburg studies for this research. In the following days we approached personally and via electronic means the director and staff members of the State Museum of the History of Religion – the current name of the Atheism Museum, rebranded after the collapse of the Soviet Union. To our great dissatisfaction, Museum staff could not confirm Shaikov's revelations – as there is no trace of a sundial

in the inventory database. A formal response to our enquiry was issued, bearing an official stamp of the Ministry of Culture of the Russian Federation (Fig. 17). Most intriguingly the stamp bears an aesthetic similarity to the formal composition of the reconstructed Polotsk Academy sundials – with location of the eagle's wings corresponding to the stereographic projection, and multiple rings of text culminating at the perimeter with one filled with blue!

The Museum of the History of Religion's response closes the Polotsk sundials search for now. History shows that artefacts considered lost can sometimes resurface. I hope that Shaikov was not wrong and that this will also be the case for one of the Polotsk sundials.

CONCLUSION

Two double horizontal sundials, constructed in the short-lived, turbulent but otherwise flourishing existence of the Polotsk Jesuit College (1772–1812) and Academy (1812–1820) under the Russian Empire, have a historical importance extending beyond the art and science of gnomonics. They are unusual examples of the transmission of scientific knowledge from centre to periphery and reviving it, at times when it was already forsaken in its place of origin.

The transmission of the original, early 17th-century concepts by English mathematician William Oughtred followed through treatises originally published in Paris by Jacques Ozanam in the late 17th century and then the further distribution of knowledge in the course of the next centuries among Central European Jesuit scholars through manuscripts and gnomonic compilations. This concluded with a practical revival of double horizontal sundials at the Polotsk Academy at the turn of the 19th century.

The inclusion of the twilight circles on the Polotsk sundials, as well as an altitude circle, corresponding to the moments of apparent sunrise and sunset, was an innovative and educational addition to the furniture typically found on double horizontal sundials, enriching the broad spectrum of its functions as *Pantadeíchnoun – The one that shows everything*.

It is to be noted that since the construction of the Polotsk Academy's sundials on the threshold of the 19th century no further examples of this most attractive and high-profile gnomonic typology have been crafted in the countries of Gabriel Gruber's heritage – today's Slovenia, Russia, Poland and Belarus. As the year 2020 marks the bicentennial anniversary of the dissolution of the Polotsk Academy, the author's wish is to encourage scientific and educational institutions of the aforementioned countries to commemorate the achievements of the former Academy and its famous director with the reconstruction of the *Pantadeíchnoun* sundials in Polotsk, St Petersburg, Ljubljana and possibly Warsaw, where today's Jesuit *Collegium Bobolanum* continues the academic traditions of the Polotsk Academy. Gabriel Gruber's sundials, now uncovered from the past, still have great potential in terms of science, art and history to be exploited by the public and young people.

ACKNOWLEDGEMENTS

I thank all who have contributed to this paper, but firstly Darek Oczki, who brought Polotsk sundials to my attention. The historical part of this article concerning Polotsk Academy was largely based on extensive studies by Irena Kadulska. Valery Dmitriev provided information on locations of both sundials in St Petersburg and their historical and spatial context, Aleksandr Solovev shared Belarusian sources concerning the Polotsk dial, John Davis provided information on the London Middle Temple sundial, Yevgenia Lupanova of St Petersburg Kunstkamera shared references to the Polotsk dial in *Letopis Kunstkamery*, Kirill Maslennikov of Pulkovo Observatory kindly surveyed for traces of sundial there, Anthony Ayiomamitis helped in resolving ambiguities of the Greek term for Polotsk sundial, Stanislav Juznic provided sources on Gabriel Gruber and his Slovenian period, Anton Budas and Michał Goncerzewicz provided technical assistance with the drawings and text.

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1. J. Davis, M. Lowne: *The Double Horizontal Dial*, BSS Monograph No. 5, BSS, London 2009.
2. Newly recorded Elias Allen double horizontal dials:
   (i) DH-80, Sworders, 3 December 2019, Lot 283 (octagonal, 22 cm across, broken gnomon).
   (ii) DH-78, Bonhams, 19 September 2018, Lot 77 (octagonal, 18 cm across, lacks gnomon).
   (iii) DH-68, Christie's, 25 April 2012, Lot 72 (octagonal, 32 cm across, gnomon possibly replaced).
3. DH-67, Unfinished double horizontal dial signed "*Elias Allen fecit*" but incompletely delineated, possibly a contemporary forgery (octagonal, 33 cm across, later and inappropriate polar gnomon). Sold by Charles Miller Ltd, 25 April 2012, Lot 175 Currently for sale at, now without a gnomon, by Dreweatts.
4. Newly recorded John Allen double horizontal dial (DH-75) octagonal, 35.2 cm across flats, original gnomon, currently exhibited at the Mathematical Tower of Wrocław University, Poland*: http://mbd.muzeum.uni.wroc.pl/kolekcje-uniwersyteckie/zegary-sloneczne/26*
5. Nathaniel Witham's double horizontal dial (DH-70) was offered to members of the British Sundial Society by Mr John Forward in 2015 via the Society's *Newsletter*.
6. Circular, heavily eroded dial without gnomon, offered 21 October 2015, auction house and dial dimensions not archived by the author.
7. Dieppe diptych by Charles Bloud with stereographic projection offered by Tajan Auction house, 4 April 2014, while the other example was found on the Internet.
8. Unsigned dial with stereographic projection, with polar gnomon only, 30.5 cm square, gilded, possibly English, offered in 2018 by Raphael Bedos Antiques, Paris.
9. Kadulska Irena: *Zegar słoneczny Akademii Połockiej i jego podróż do Petersburga*, in: *Poezja i Astronomia*, ed. B. Burdziej, G. Halkiewicz-Sojak, UMK Toruń (2006), and private correspondence in 2013.
10. X.I.C.: *Opisanie rzadkiego Kompasu zwanego (Παντα δείχνουν).* Miesięcznik Połocki. Tom III. Rok 1818, pp. 214-232. A modern Greek transcription of the term used to describe the sundial would be: "*Τα Πάντα δείχνουν*". Translation by courtesy of Anthony Ayiomamitis. The word "*kompas"* in old Polish has two meanings: *compass/sundial* and comes from old German.
11. Jakub Condrau entry in Jesuit Science Network: *http://jesuitscience.net/p/1008/*

12. Józef Cytowicz entry in Jesuit Science Network: *http://jesuitscience.net/p/978/*
13. Ignacy Z. Siemion: *Wokół nauczania chemii w Akademii Połockiej,* Analecta 10/2(20), pp. 67-79 (2001).
14. Jakub Condrau: *Elementa geometriae theoreticae et practicae*, Polociae, typis Acad. Soc. Jesu, 1818, in: Estreicher, poz. 16621.
15. Jakub Condrau: *Trigonometria plana et sphaerica,* Polociae, typis Acad. Soc. Jesu, 1818, in: Estreicher, poz. 16622.
16. The suggestion by John Davis is that the sundial referred to in the article might possibly be the non-extant double horizontal dial, designed by Edward Hatton for the Middle Temple in London. The dial has the DH-23 entry in BSS Monograph No. 5 (Ref. 1).
17. i.e. "*sundials*" in old Polish (see Ref. 10).
18. i.e. "*Petersburg latitude*" in old Polish.
19. Jacques Ozanam: *Cours de mathématiques, Paris, 1693; Méthode générale pour tracer des cadrans sur toute sorte de plans*, Paris 1697.
20. Alexey Kirillovich Razumovsky (1748-1822), member of Razumowsky noble Russian family, son of Count Kirill Grigoryevich Razumovsky, and grandfather of A.K. Tolstoy. The surname comes from a word "*razum/rozum*", which in Slavic languages means *mind, intellect* – most appropriate surname for an Enlightenment Minister.
21. Russian biographical dictionary, St Petersburg (1910), p. 438.
22. The information on the history of A.K. Razumovsky's estate is based on: I.A. Soboleva: *Lost Petersburg*, St Petersburg (2012), p. 220; and P.Ya. Kann: *Walks in St Petersburg. Along The Moyka, Fontanka, Sadovaya,* St Petersburg (1994), p. 93.
23. *Letopis Kunstkamery. 1714–1836* / Avt.-sost. M.F. Khartanovich, M.V. Khartanovich. Otv. N.P. Kopaneva (ed.), YU.K. Chistov. — SPb.: MAE RAN, 2014. *http://lib.kunstkamera.ru/files/lib/978-5-88431-262-3/978-5-88431-262-3.pdf*
24. В.П. Викентьевт: *Полоцкій Кадетскій Корпусъ. Исторический очеркъ*, Полоцкъ (1910). The three archival sources used are listed in the book.
25. V.L. Chenakal: *Petersburg Meridian. Historical and astronomical studies*, vol. 2 (1956), pp. 153-170.
26. В.І. Шайкоў: *Полацкі сонечны гадзіннік*, in: Г.П. Папкоў (ed.): *Памяць. Гіст. дакум. хроніка Полацка*, Минск (2002), pp. 292–293.
27. The information about positioning the sundial in front of the building of the Academy of Sciences is also included in the essay by Irena Kadulska (note 9), p. 206, with a reference to a manuscript in Vilnius University Library: VUB F2 – KC 608, f. 80v.

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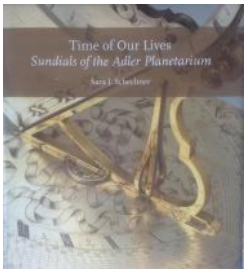
NEW BOOKS

Time of Our Lives: Sundials of the Adler Planetarium by Sara J. Schechner. Chicago, The Adler Planetarium, 2019. 29 x 26 cm, hardback + dust jacket, pp. xiv + 474, copiously illustrated in full colour. ISBN 978-0-578-49710-5. $40.



Members who attended the BSS Conference in Norwich in 2018 will have heard Sara Schechner give the Andrew Somerville Lecture in which she previewed this long-awaited book. It is a catalogue of the Planetarium's superlative collection of sundials, which Sara curated for a considerable period, and is a must-have for anyone seriously studying the history of the subject or even just as a coffee-table book. It is very reasonably priced plus members of NASS can buy it at half price but beware of the significant cost of postage to the UK for this heavy tome. (The Editor bought several copies to spread the charge and has one left at cost-price.)

The collection consists of nearly 500 sundials, mainly from Europe and the 268 which are covered here (a second volume is promised with more) are organised in technical groups. In addition to the actual catalogue, there are several essays on a variety of sundial topics including, for the first time, a taxonomy of compass needles which will surely find a use at some stage for identifying an unsigned dial or working out the suppliers of compasses to dial makers.

Reviewers like to find errors in books to prove that they have actually read it and know at least as much as the author but here, let it simply be said that even if there may be a minor infelicity or two, they certainly do not detract from what is clearly a major work by someone who loves the subject.

Mathematical Instruments in the Collections of the Bibliothèque Nationale de France by Anthony Turner with Silke Ackermann and Tara Yasin Arslan. BnF Éditions/ Brepols, Turnhout/London. pp. 336, 156 x 234 mm, 2018. ISBN 978-2503568058. hardback + dust jacket, large colour illustrations throughout. Price 150 Euro (net).

Medieval libraries had collections of scientific instruments as well as books and manuscripts which they could lend to their users – mainly monks or university scholars. Traces of this tradition have been preserved by the French national library (the BnF) which has a small but fine collection of instruments with an eclectic mix of types and periods – they are no longer available for loan, though. They are little known to modern students of the history of science but this is corrected here with a comprehensive catalogue which includes full details of 138 instruments, complete with generously-sized photographs. Amazingly, for the catalogue of a French institution, the book is solely in English with the exception of the Preface which is in dual French/English. Sundial lovers will make their way to Chapter V with five sundials and nocturnals ranging from a Roman direct East/West stone disc dial to an 18th-century universal equinoctial ring via the earliest known (AD 1163/4) portable vertical dial. Many other chapters are of interest including nine astrolabes and quadrants from both Islamic and Latin sources (with their scales fully transcribed) and others on globes, 'cosmographical instruments', compasses and so on.

JD

A Freshly-excavated Sundial From Antiquity Found in Turkey

John Davis

Dan-George Uza has recently alerted the sundial community to a news item reporting the excavation in March this year of a marble sundial in the ancient city of Laodikeia, near Turkey's Aegean city of Denizli and some 600 kilometres (373 miles) to the south of Istanbul. The report[1] said that the dial was found in one piece and it was described by Celal Şimşek, the chief archaeologist at Denizli's Pamukkale University, as from the Hellenistic era, c. 2000 years old. He called it "unique" but although dials of this type are not common, they are of the 'hemicyclium' form.[2] It is a little difficult to see the geometry clearly from the available photographs but it is formed from a part-hemisphere with the front face cut obliquely to suit the local latitude. The 'gnomon', presumably originally of bronze, which would have supported the nodus at the centre of the sphere is missing but otherwise the dial is in fairly good condition.

The hour lines of the dial are drawn to meet at a level somewhat above that of the nodus height and although unnumbered they would have been designed to show seasonal (temporary) hours.

There are rows of Greek capital letters along each of the three declination arcs, interspersed with the hour lines. Some are missing where the stone corners of the dial have broken away but the others can, with some difficulty, be read as

[ΤΡΟΠΗ] ΧΕ[Ι]ΜΕΡΙΝΗ

ΙΣΗΜΕΡΙΝΗ

[ΤΡΟΠΗ] ΘΕΡΙΝΗ

where the square brackets indicate that letters are missing. The first person to work on these was Janet Wilson (wife of our Librarian and Mass Dial Recorder, John). She suggested that the top line means 'of winter', i.e. the winter solstice, the middle line is for 'by the day' (or night), i.e. the equinoxes, and the third line is thus for the summer solstice.

Karlheinz Schaldach, an accepted expert on sundials from Antiquity who knows more on the subject than any archaeologist, also made the same interpretations of the inscriptions[3] but disagreed with the dating of the dial, believing that it was from the somewhat later Roman era, AD 200-400. He came to this conclusion by comparisons with other known examples and by the missing 'I' in the middle of ΧΕ[Ι]ΜΕΡΙΝΗ (or χειμερινή in lower case). The jury is still out at the moment.

Built in the third century BC, Laodikeia is the second-largest ancient city in modern Turkey and has been on the UNESCO Tentative List of World Heritage Sites since 2013 as it has one of the seven churches named in the Book of Revelations. Although Laodikeia was a place of high prosperity in the Hellenistic era (as part of the Kingdom of Pergamon in the second) century BC) it fell under Roman control in 133 BC. Among the rare, largely preserved buildings in the city are the largest ancient stadium in Turkey, a theatre and a sacred agora.

Photos courtesy of the Daily Sabah, German Press Agency.

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2. Sharon L. Gibbs: *Greek and Roman Sundials*, Yale University Press (1976). See e.g. p.17 and frontispiece.
3. Posting to the Sundial Mailing List, 10 April 2020.

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