

THE UNIVERSAL EAST AND WEST POLAR DIAL

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My attention was brought to this type of dial by a friend who had seen the photograph of one from a private collection and wanted to know what it was and how it worked. It is similar to a dial made by BSS member Harriet James (Fig. 1) but without the EoT corrections. Other closely related dials include the direct East or direct West dials frequently found on churches or as east and west faces of a cube dial. A similar design, a portable cube dial, (Fig. 2) was made by David Beringer, working in Nuremberg c.1725-1776. In the case of all of these cube dials, the directions of north and south are crucial for their correct operation. The fixed ones should have been correctly positioned on their building or on a pillar at the time of installation and the portable ones have an inbuilt compass to align them.

The 'universal East and West polar dial' shown in Fig. 3 is also a portable dial but it does not have a compass, so there has to be some other way of achieving a correct alignment. The dial face is very similar to the east and west faces of the dial by Beringer, but instead of the 'T' gnomon it has a pin gnomon set at the centre of the VI-VI line. The length of the gnomon needs to be set at the exact distance as the VI-VI line is from the IX-III line, a useful indicator in case the gnomon has been lost. Note that the scale on this dial is

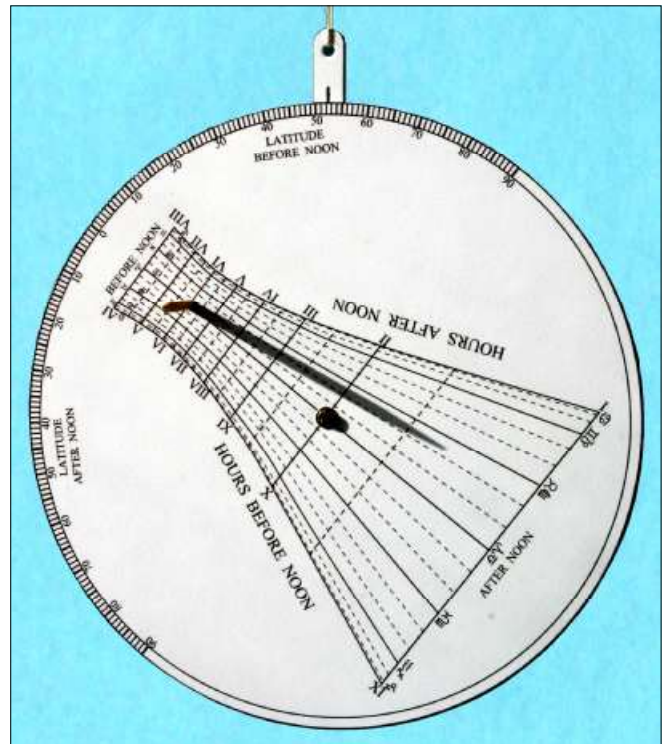


Fig. 3. A model of the 'universal East and West polar dial' made for this study, showing a time of approximately 10:40 'before noon' for Pisces 7° or Libra 23° (equivalent to February 26 or October 16).



Fig. 1. The west face of a double-sided universal East/West polar dial in brass, by BSS member Harriet James.



Fig. 2. Cube dial by David Beringer of Nuremberg with a direct west facing dial on its right face

calibrated lengthwise with the date. This type of dial is universal, capable of being used anywhere between the Equator and the North Pole. To get the correct alignment and find the time, the first step is to set the latitude just below the suspension point, then rotate the dial so that the tip of the gnomon shadow falls on the appropriate date line: this same point will give the current time. As a consequence of this alignment, the dial will automatically be set correctly to face either east or west, depending on whether it is morning or afternoon.

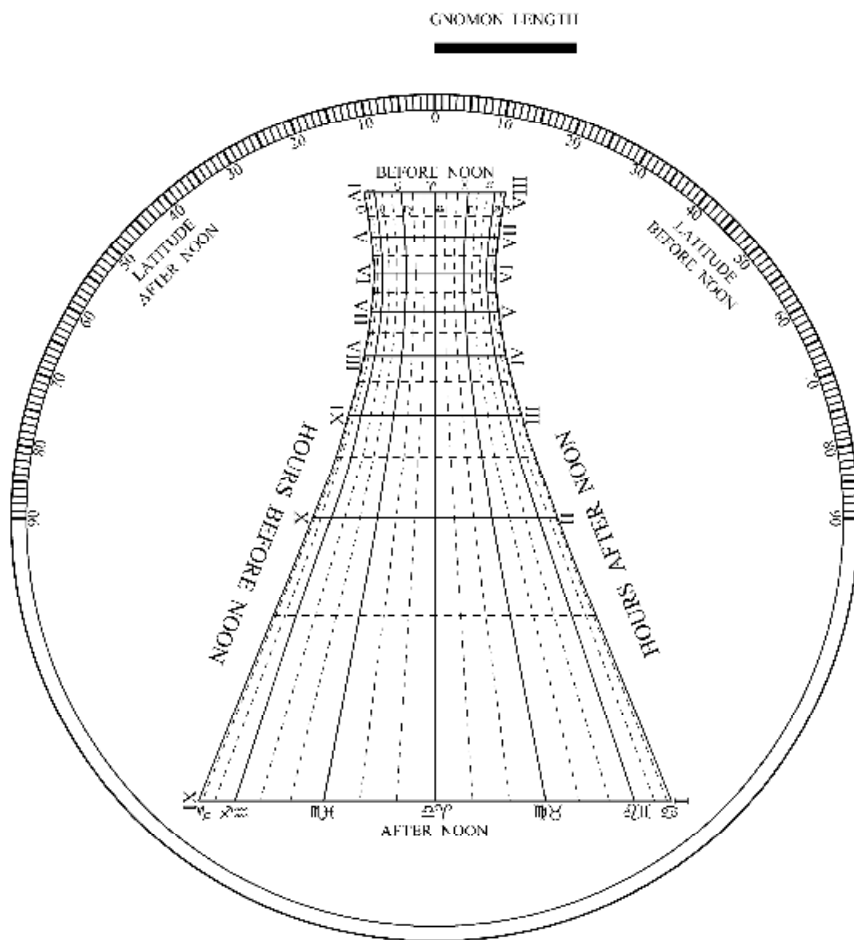
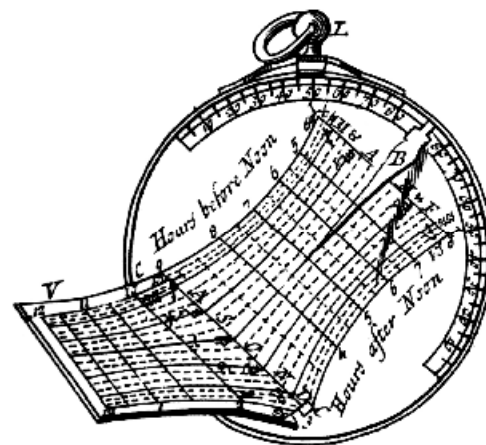


Fig. 4 (left). The 'cooling tower' shaped layout for the universal East and West polar dial.

Fig. 5 (below). The improved version of the dial with its hinged-down flap as illustrated in the book by Bion.



As this is an east *and* west dial it is necessary to reverse the settings between morning and afternoon, (unnecessary on double-sided dials like that by Harriet James). Each of the date lines (signs of the zodiac) are subdivided into three 10° divisions with the dates for morning being shown at the top end of the scale and a reverse sequence for afternoon being shown below the scale. The hour markings for morning are annotated on the left side and those for the afternoon on the right. This at first seems quite complicated and in my first attempts to use the model I got things switched a few times, but once the dial had become familiar, I was pleased to find that it gave consistently good results. Sharp-eyed readers will also have noticed that the dial does not go beyond XI and starts reading again at I, leaving a two-hour gap around noon. This is due to the fact that at noon the shadow actually stretches to infinity so can not be recorded on a vertical dial of this type. This small point can hamper the user and may be the reason why it did not achieve popularity. A further problem with this dial is that the hours around 6am and 6pm are rather cramped and towards XI-I the scale is very spread.

from IX to III on a plate perpendicular to the main dial plate. This solves the problem of loss of readings around noon and also helps to give an expanded scale at other times; the width of the scale is virtually doubled compared with the former type.

I remembered seeing a dial very similar to this in Nicholas Bion's book *The Construction and Uses of Mathematical Instruments*, in the English edition by Edmund Stone, London 1758 (see Fig. 5). Bion's version has an important difference; it has a fold-down section that shows the hours

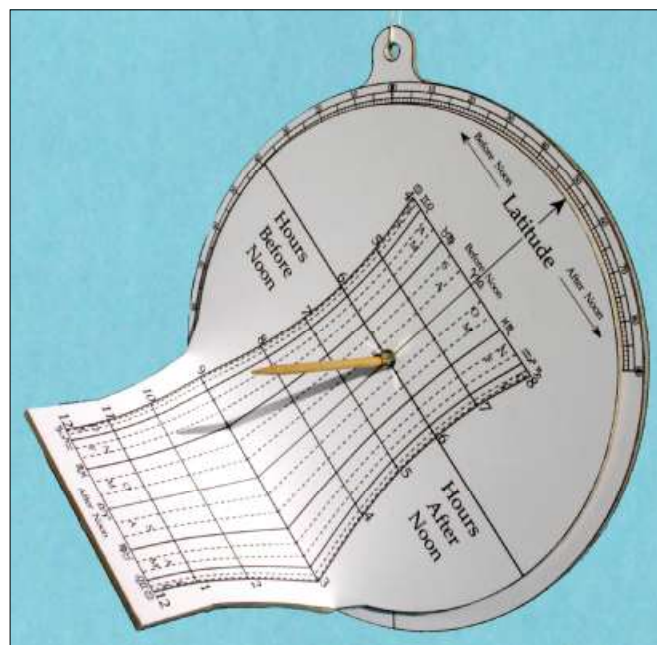


Fig. 6. Model of East and West dial similar to that given by Bion, showing a time of 2:10 'after noon' at Scorpio 9° or Aquarius 21° (equivalent to 2 November or 10 February).

A model of this dial was also constructed (Fig. 6) to enable me to get a good feel of how it would perform. The gnomon was positioned so that it came from the centre of rotation (purely for convenience of manufacture) but could equally well have come from any point, such as that in Bion's drawing which comes from the top, because it is only the shadow of the tip of the gnomon that is used to tell the time. His design will simply fold flat whereas mine needs to have the gnomon removed first.

The initial results with this dial were disappointing until I realised that the weight of the hinged-down flap and, to some lesser extent, the gnomon to one side of the disc, were causing a serious imbalance: the dial was no longer hanging vertically or correctly at my latitude setting of 52°! This problem could be solved with a counterweight but this would also need to be rotated as the latitude and the morning/afternoon settings were changed. Bion does not show such a device, probably because his flap is much lighter in proportion to the dial's weight than the one that I used.

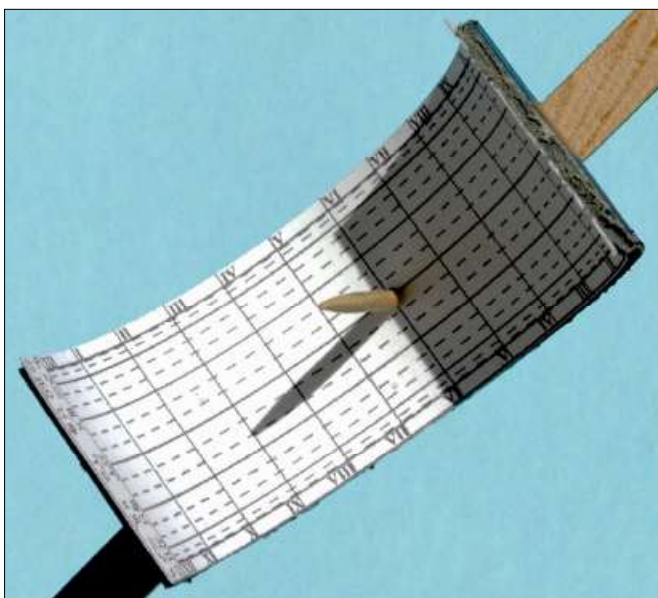


Fig. 7. A model of an East and West dial but made inside a half cylinder. It is rather bulky and therefore not very suitable as a portable dial. It is showing a time of 3:00 'after noon' at Aries 20° or Virgo 10° (equivalent to 10 April or 3 September).

My next attempt, Fig. 7, was to make a further improvement on the design of Bion by placing the hour scale on the inside of a cylinder, thereby making all of the hour spacings exactly 15° with the scale at a constant distance from the gnomon tip. The gnomon, of course, could have been of any form, but a pin type was used as all that was necessary was for the tip to be at the centre of the dial scale's arc. The dial now produced was half of an equatorial dial. Due to the width of the ring, which must also be rigid, the dial can no longer fold flat for transit, being much bulkier than the two former designs.



Fig. 8. A double crescent dial from Johannes Martin of Augsburg, c.1700.

At this stage it then became obvious that, in order to achieve a compact design, the gnomon has to be moved in order to agree with the date lines. This then allows the ring to be of minimal width. A dial to this design had already been made prior to 1700. It was the 'double crescent dial', made in Augsburg (mostly from the workshop of Johannes Martin – see Fig. 8). It usually has two separate semi-circular dials, one for morning and the other for afternoon, mounted back-to-back with a double gnomon like a pair of horns mounted so that they can be moved to correspond to the correct date setting, the tips of the 'horns' forming the shadow on the appropriate equatorial ring.

The dials described above are therefore all closely related. They are all 'universal', being capable of operation at any latitude and are all self-aligning, not requiring a compass at all. They are fully portable, all but one folding neatly for transit in a pouch or pocket.

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A Butterfield dial by P Le Maire, seen in the Kirschgarten Museum, Basel, during the BSS Alsace tour.