



dialing. In 2008, he came across a sketch of a stereographic dial in an anonymous manuscript notebook in the Bayerische Staatsbibliothek (*Astronomische Zeichnungen* - BSB Cod. icon. 182, Vienna, 1508 – 1520. See the sketch at <http://tr.im/En3b>). Given that the notebook has been dated to the period 1508-1520, it appears to predate Finé's work. It shows construction lines on the dial, thus giving some indication of a technique for laying it out. However, all we have is a sketch; there is no associated text. Severino produced an article on this find (*L'orologio solare di Oughtred un secolo prima di Oughtred!* See <http://tr.im/EmRB>), but he did not stop looking for other traces of early publications of the dial. His next find, from Andreas Schöner's 1562 *Gnomonice*, proved more fruitful.

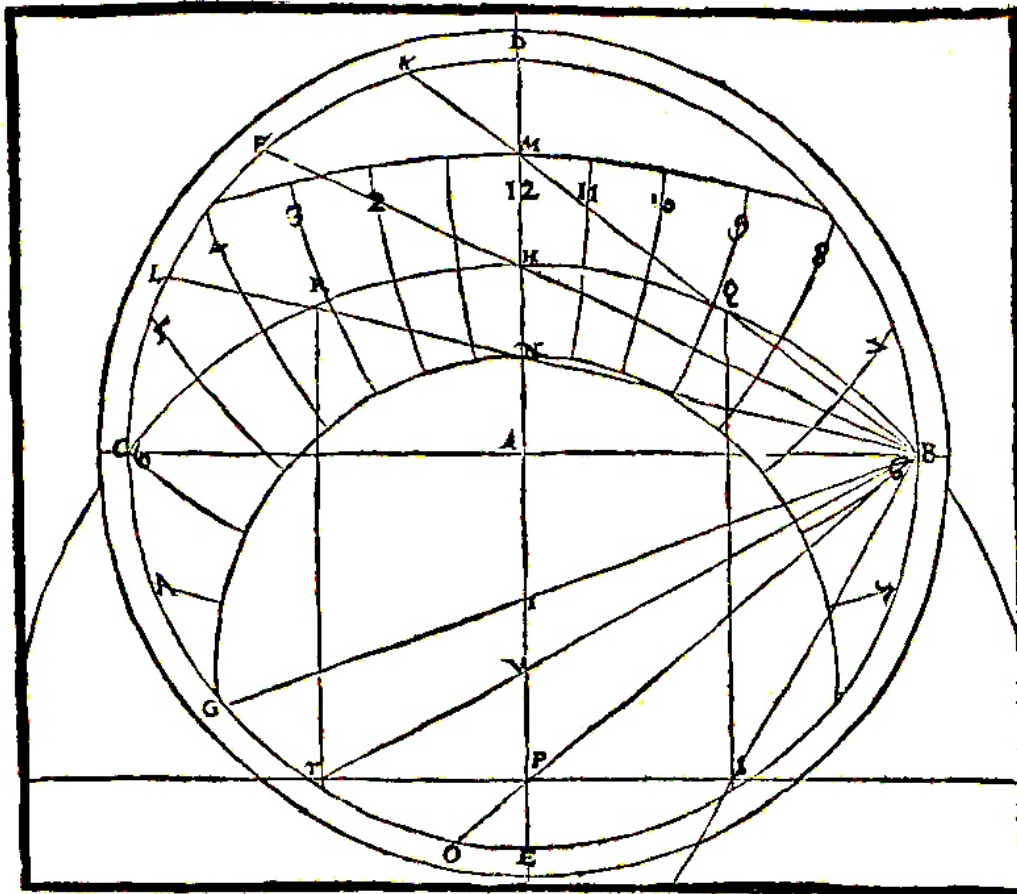


Fig. 2 Illustration from Andreas Schöner's 1562 *Gnomonice*, p. 85v

Andreas Schöner (1528-1590) was the son of the famous Nuremberg mathematician Johannes Schöner. The younger Schöner worked as astronomer to Landgrave Wilhelm IV and in 1562 published *Gnomonice*, his major work on gnomonics. The first two books of this volume dealt with sundials on flat and curved surfaces, respectively. The third dealt with other varieties such as quadrants, and cylindrical and ring dials. The text also included brief works on a method of determining the noon line and a technique for drawing an astrolabe.

At the end of the third book, Severino found an image (Fig. 2) which clearly appeared to be a stereographic projection. He passed it on to me to evaluate as another precursor of Oughtred. I found that the image had a number of interesting elements: it showed construction lines, suggesting a

*Finding Schöner's Gnomonice*

Go to the website of the *Istituto e museo di Storia della Scienza di Firenze*: <http://fermi.imss.fi.it/rd/bd>. Click on *English* in the upper right corner. Enter *Schoner Gnomonice* and click on *Search*. When the record appears, click on *Download* to obtain a copy of the entire text as a 41MB pdf file (see pp. 195-198), or click on *See* to review the text online (see the last 4 pages of Liber Tertius).

procedure different from that embodied in the *Astronomische Zeichnungen* sketch; for some initially unclear (but no doubt interesting) reason, it showed the hours progressing counterclockwise around the dial instead of the usual clockwise orientation for a horizontal dial in the northern hemisphere; and it was associated with an explanatory text. The only drawback was that the associated passages were in a rather dense Latin.

In order to make good progress with the necessary translation, I sent the *Gnomonice* extract to John Schilke. John is a retired physician who now occupies his time with a variety of activities including dialing and teaching Latin. John took on the challenge and was able to convert the essential parts of Schöner's text into English. He then passed it back to me with the challenge to make sense of the English! It took a while, but in the end it became clear that Schöner had indeed described an interesting variant of the stereographic dial. He did so with no great fanfare – with no suggestion that he was describing a new dial; rather he merely presented it as an interesting and useful instrument different in function than the traditional gnomonic projection dial.

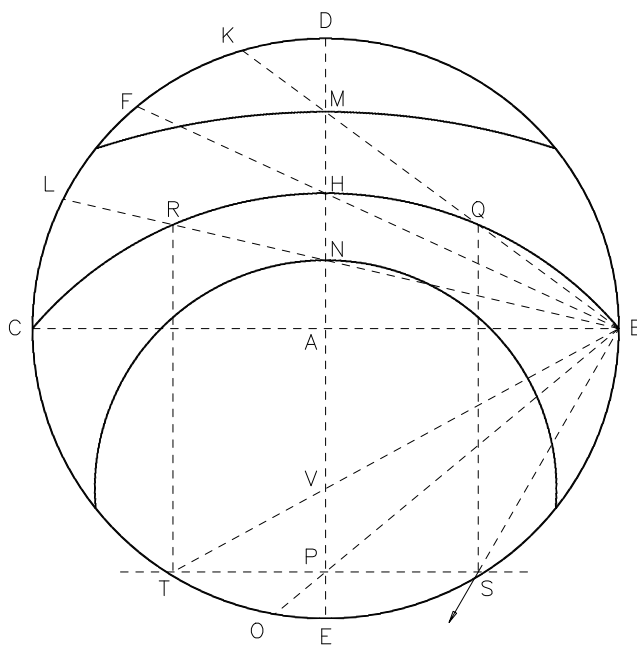


Figure 3

### Schöner's Design

Schöner begins his discussion: *We propose an instrument on which the time is given... by an upright gnomon. Its construction is as follows....* He then proceeds to outline in detail a technique which we summarize here. Begin with a circle representing the horizon and having perpendicular diameters  $CAB$  and  $DAE$  as in Figure 3. Set off arc  $BO$  from  $B$  towards  $E$  equal to twice the latitude at which the dial is to be used and draw line  $BO$ . This is equivalent to setting  $\angle CBO = 90^\circ - \phi$ . Let  $P$  be the intersection of  $BO$  and  $DE$ ;  $P$  will be the center of the circular arc representing the equinoxes.

Set off arc  $CF$  from  $C$  towards  $D$  equal to the latitude, and draw line  $BF$ . This is equivalent to setting  $\angle CBF = \phi/2$ . Let  $H$  be the intersection of  $BF$  with  $DE$ . Now draw the arc  $CHB$  passing through  $H$  with center at  $P$ ;  $CHB$  will serve as the equatorial arc for this dial. [Note – it is easy

*to show that the arc through  $H$  will always pass through  $C$  and  $B$ .]*

Set off arcs  $FL$  and  $FK$  as shown, and on  $CHB$  arcs  $HR$  and  $HQ$ , all four equal to  $23.5^\circ$  each. Draw lines  $BL$  and  $BK$ , intersecting  $DE$  at points  $N$  and  $M$ , respectively.

Draw line  $TPS$  perpendicular to  $DE$  and passing through  $P$ . Draw lines  $RT$  and  $QS$  parallel to  $DE$  and intersecting  $TPS$  at  $T$  and  $S$  as shown. Draw line  $BT$ , intersecting  $DE$  at  $V$ . Draw the summer solstice arc (from horizon to horizon) through  $N$  with center at  $V$ .

Draw  $BS$  and extend the line until it intersects  $DE$  [not shown here or in Schöner's image to conserve space]. Using the point of intersection as center, draw the winter solstice arc (again, from horizon to horizon) through point  $M$ .

An actual dial will need to have several more declination arcs drawn if it is to be useful. Although we do not draw them here, this procedure can be used to draw as many arcs as one wishes. Simply continue with arcs drawn from  $F$  and  $H$  as before equal in size to the declination whose arc is to be drawn, and repeat the procedure we have just outlined.

