THE FLEET STREET HERITAGE SUNDIAL:
Gnomonic Delineation with Uncertainty

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Last year, Piers Nicholson approached me, asking for help in the design of his Fleet Street Dial. I thought that this would be a straightforward job. I asked for the design parameters:

- Dial size (*about* 10 metres × 10 metres).
- Declination (a *few* degrees north of East).
- Inclination (*about* vertical).
- There was a step in the wall (*about* a third of the way down and *some* centimetres wide).
- Gnomon length and height (*no idea*).
- Gnomon position (*somewhere* near the top left-hand corner of the wall).
- Newspaper names to be drawn between the hour lines (which newspapers – *undecided*).

Nothing was fixed – so the design tool had to be flexible.

Clearly the standard design programs would not provide the flexibility required, so I created a model in a Python-based graphics package that directly produces PDF images. I used a free package named 'PlotDevice'. Therein, I coded the gnomonic heart of the model using the routines of Denis Savoie and Robert Sagot.[1]

These routines trigonometrically calculate the shadow point of any nodus above any plane for any hour angle. They also check if the hour is during daylight and ensures the sun is not behind the plane. The algorithm also provides the location of the dial's origin (the point at which a polar gnomon through the nodus would meet the plane – i.e. the root of the gnomon in a standard dial. At a given hour, connecting the shadow of the nodus to the dial's origin provides the hour line.

Piers' idea was to have the gnomon attached to two vertical legs – with the feet of the legs attaching directly to the vertical wall near the dial's top left-hand corner. The quality of the wall's brickwork was also unknown – so, from a structural point of view, the gnomon length and length of its legs could not be too long.

By a process of graphical iteration, the first tentative designs were made – showing the sun's shadow path at midwinter, equinox and midsummer (Fig. 1). With a taller gnomon, one gets fewer hour lines in a given dial area and vice versa. We were looking for a design that had hour lines that were 'sensible', i.e. give enough space for the newspaper names and represented the time in multiples of 10 or 15 minutes.

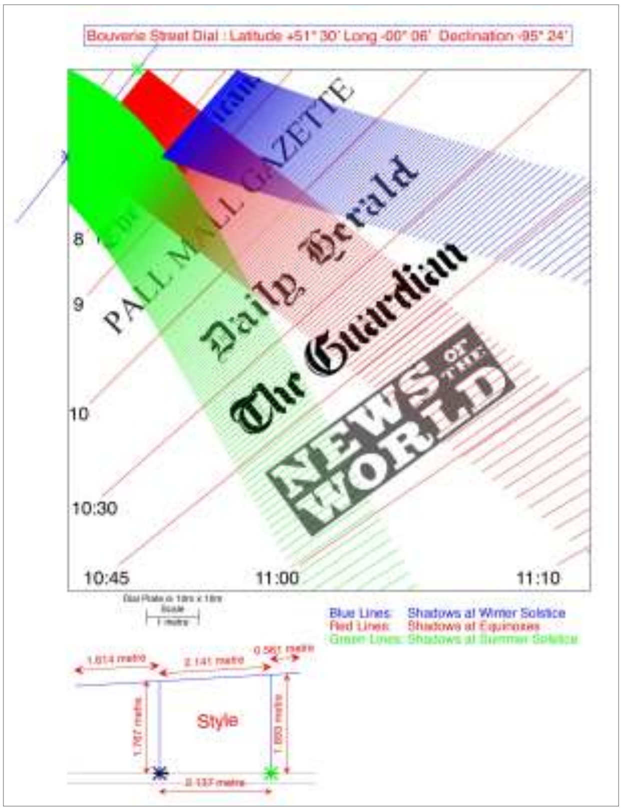

Fig. 1. Showing the shadow path at different times of the year.

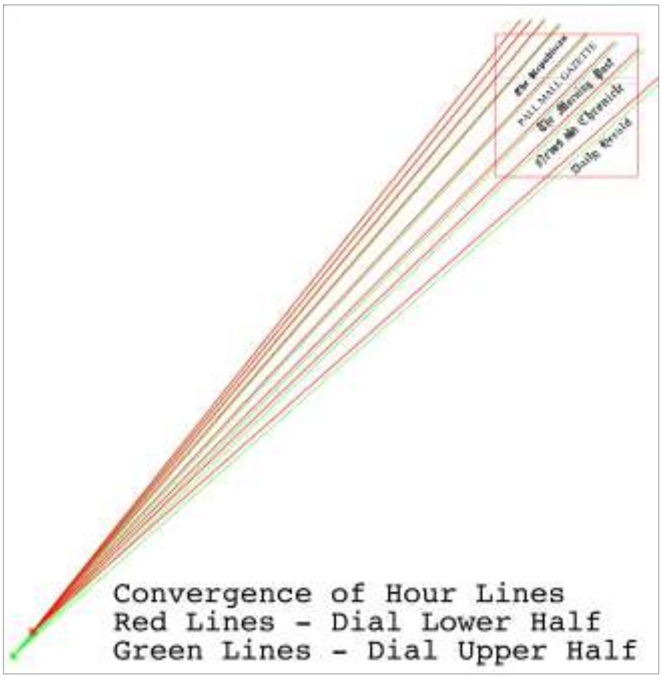

Fig. 2. Showing how the gnomon origin moves with the imposition of the step in the wall.

Fig. 3. Fitting the newspaper names across the step.

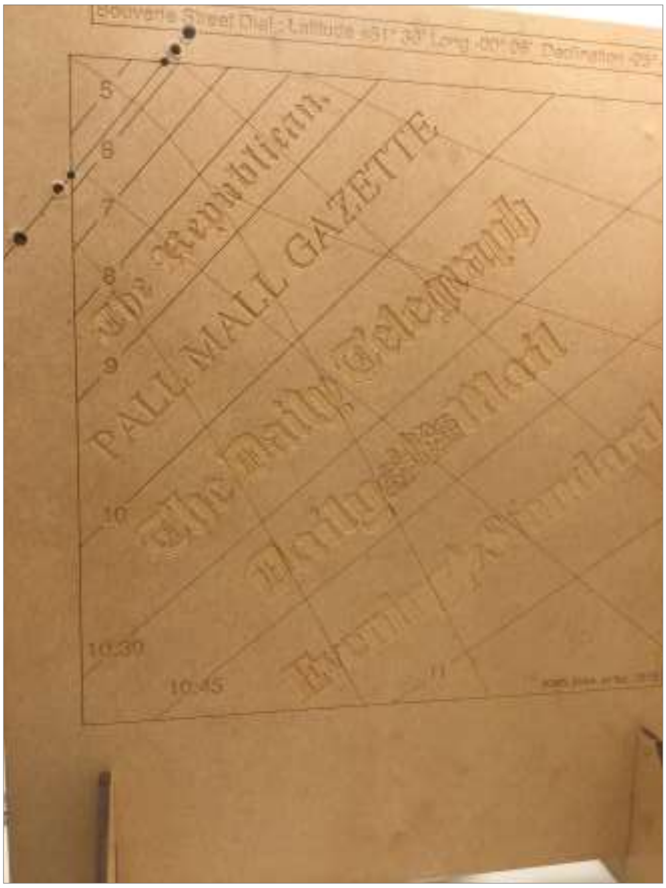

Fig. 4. An initial laser-cut model, used to help acquire both funding and approval.

Next it was necessary to account for the step in the wall. An outward step of x cm effectively means that the nodus height is reduced by x cm. Thus the dial's origin changes and hour lines are no longer parallel in the upper and lower halves of the dial (see Fig. 2). Note how far the dial origin is from the dial itself with a wall declination a few degrees off East.

Still with basic measurement uncertainty, the newspaper names (themselves uncertain) had to be ordered and fitted in so that the step passed in a gap between the words (see Fig. 3). Some consideration was given to shifting the upper parts of the names to be central between the hour lines when viewed full on, but this was abandoned on visual grounds. This seems to have been justified by the final result.

Piers was still seeking both financing of the dial and approval from the City of London authorities. To aid this the model was used to generate an 1:100 scale image that I used to laser-cut a model of the dial, as seen in Fig. 4, without its gnomon.

There followed many iterations of a design (rather than gnomonic) nature. Finally, all the measurement uncertainties were resolved by Chris Lusby Taylor's laser survey (see pages 13-16 of this issue of the *Bulletin*). This provided all the basic measurements – the wall size, the declination, the wall inclination (effectively vertical), the position and size of the step. The laser survey did reveal unevenness in the surface of the wall. This could have been included in the design but this was abandoned since it would have led to (slightly) wavy hour lines and substantial marking difficulties for the painter.

Public vote and instructions from the City of London authorities fixed the newspaper names and a final design could be produced (Fig. 5).

Fig. 5. Final approved design.

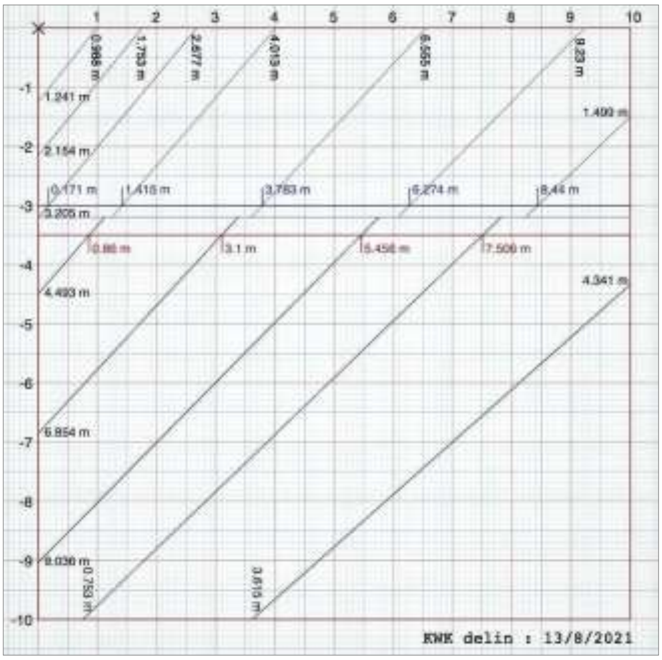

Fig. 6. Painter's instructions.

The final use for the computer model was to produce the painter's instruction (see Fig. 6). The red and blue lines were produced a few centimetres above and below the step to ease the painter's marking out.

All that was left was to produce the graphics for the roadside ceramic plaque (Fig. 7), which attempts to educate the public why the sundial seldom provides the same reading as their watch…

Postscript

I cannot overemphasize either the utility or the pleasure of using a graphical computer-based model. A change of any parameter (e.g. declination) requires a one-line change in the code and produces an instantaneous result. Python is an exceptionally easy language to learn. I also strongly recommend that gnomonists become familiar with the routines of Savoie and Sagot. By including the equation of time and longitude into the hour angle, one can easily calculate an analemma.

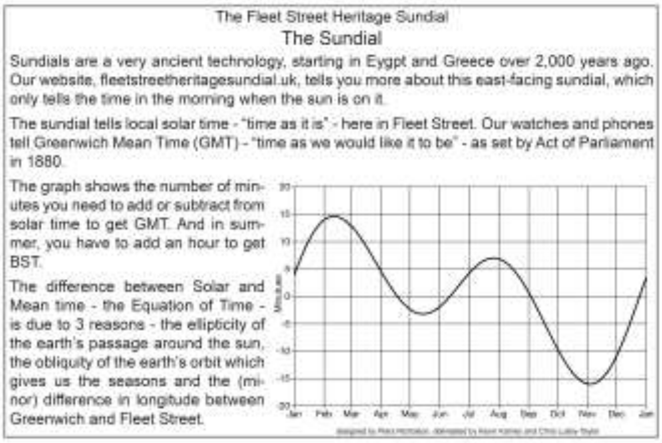

Fig. 7. The explanatory plaque.

REFERENCE

1. Jean Meeus: 'Calculation of a Planar Sundial', ch. 58 in *Astronomical Algorithms*, 2nd ed., Willman-Bell, Inc., Richmond (1998), pp. 401-8.

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