FORUM

A Standard-Time Sundial

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As is generally known to navigators (though the statement surprises most laymen) the Sun is a poor timekeeper; rated against its own average behaviour, it is over 14 minutes slow in mid-February, over 16 minutes fast in early November, and more than 5 minutes wrong, one way or the other, on more than half of all the days in the year. The 'errors' are however very nearly the same from year to year; the principal variation is a slight oscillation in phase due to the incidence of leap-years and the effect of this is too small to be detected on a sundial, where the accuracy is limited to about the nearest minute by the Sun's apparent diameter however large or small the dial may be. It is thus possible to make a table of the 'errors' (i.e. of the 'Equation of Time'), say for every tenth day and to the nearest minute only, and to engrave it permanently on the dial, leaving the observer to interpolate to the actual date and add or subtract the correction. Provided the table includes also the allowance for the longitude-difference from the standard meridian of the zone, the result (if the observer does his arithmetic correctly) will be standard time for that zone. But it is quite possible to save the observer this labour. It was shown in a note in this *Journal* (15, 454) that one need only mount the complete sundial on a polar axis, so that it can be rotated about a line parallel to the slanting gnomon-edge. A rotation through θ degrees will then change all readings by 4θ minutes, whatever the date or the time of day. This may surprise some viewers who see that the angles between successive hour-lines on the dial are not equal; but of course the dihedral angles between successive hour-planes *are* equal, that being how the lines on the dial were computed in the first place.

A sundial has now been constructed on this principle and installed on the Indiana University Campus at Bloomington, Indiana, as a tribute to a distinguished alumnus. The rotation is controlled by a cam on one end of a brass cylinder which has dates cut uniformly all round the other end. The cylinder is rotated by a handwheel and any observer can adjust the dial to the correct tilt for the day by merely setting the drum to the date. No tables or astronomical knowledge are involved at all. The longitude difference from the 75th meridian to Bloomington is about 11½ degrees (46·1 minutes). This could of course be included in all the tilts but the effect would be rather unsightly, and would make the Sun go below the plane of the dial from half an hour to an hour before it actually set. The times for the various hour-lines have therefore all been decreased by 45 minutes, before computing their positions on the dial, leaving only 1·1 minutes to be dealt with by a trivial permanent addition to all the tilts. The box containing the drum and gears is decorated on three sides by representations of the three reasons why a simple sundial cannot show standard time: on the east is a diagram showing the tilt of the ecliptic to the equator, on the south is an ellipse showing the law of areas, and on the west is a sketch-map of the U.S.A. from Indiana to New Jersey, with the 75th, 80th, and 85th meridians. The sundial was unveiled on 28 October 1977.