The Compass Sundial

Most sundials in the northern hemisphere have a slanted rod as a shadow caster, the gnomon, pointing to the celestial north pole. Time is measured by the direction of the Sun's shadow. However, would a sundial with a vertical gnomon also be possible?

The Greek astronomer Ptolemy (c. AD 100-160) already solved this problem: The rod must be moved along a date scale, the so-called analemma, which reflects the different levels of the sun's height over the course of a year.

However, as such sundials are difficult to calculate, they had been nearly forgotten. In the 18th century the principle was rediscovered by French sundial makers. They combined an analemmatic sundial with a conventional horizontal one. When the vertical gnomon is set to the correct date and the instrument is turned until both sundials show the same time, it is correctly aligned. All that without a compass!

These sundials were manufactured individually for specific geographical latitudes. If they were used further south or north they became increasingly inaccurate. This Compass Sundial can be adjusted to all northern latitudes between 26° and 65°.

Building instructions: Please read each step before commencing.

What you need:

- A sharp knife (craft knife)
- Good scissors, possibly nail scissors for the round parts
- A ruler and a blunt knife or a folding bone to fold the groove lines
- A good all-purpose glue. Solvent based glue is better than water based glue because it does not warp the cardboard.

Tips for assembly:

Tip 1: *Each part is marked with a part number, e.g.* A1, A2, B1, B2, *etc. as well as with its name. The letter of the part number denotes the chapter in which the part is needed. Only cut out the parts as you need them. Places needing glue are marked in grey and carry symbols like* B3 . *They mean that the part in question (here:* B3 *) is glued in this place.*

Tip 2: *To make a fold, a groove is pressed into the cardboard. This is easier if the part has not yet been cut out. "Folding backwards" means: fold along the groove away from you, "Folding forwards": fold towards you. To ensure that a fold forms a straight edge, fold it over completely and push it down using the back of the your thumb nail or a folding bone.*

Tip 3: *How to dry glued joints faster: Apply glue to one side, press the parts together and pull them apart again. Blow a couple of times over the glue and press the parts together tightly - they will stick immediately.*

Chapter A: The Housing

The housing is an open case which carries the movable dial in its axle bearings. Instructions for use can be found on the front and inside the case.

Step 1: Cut out the housing base [A1] and fold all grooves and glue tags backwards.

Step 2: Cut out the two side walls of the housing [A2] and [A3].

Step 3: Glue the two side walls onto the glue tabs of the base. The housing now has the shape of an open top box.

Chapter B: The Twin Dial

Step 4: Cut out the twin dial [B1]. With a sharp knife, cut out the two hatched 0.8 mm wide slots in the middle of the two dials. Fold the top and bottom side walls with the latitude scales backwards and pull them over an edge so that they curve slightly. Also fold the narrow rounded flaps at the end of the curved sides backwards.

Step 5: Cut out the side wall of the dial [B2], the axis [B3], and the cover disk [B4], and glue the axis exactly on the centre of the round grey area in the middle of the side wall. Make sure that the whole surface is covered with glue, but also that none squeezes out at the sides. After drying, coat the axis with glue and place the cover disk in the middle of the axis. No glue should leak here either. Allow to dry well.

Step 6: Repeat the last step with the other side wall [B5], axis [B6], and cover disk [B7].

The side walls are only glued to the dial after the gnomons have been installed.

Chapter C: The vertical, mobile gnomon

The two gnomons are made from cardboard surfaces on which a straight edge serves as the shadow caster. Both have supports so that they are always at right angles to their dial. The triangular gnomon is glued to the top of the dial and the vertical one remains movable.

Step 7: Cut out the two halves of the vertical gnomon [C1] and [C2] and fold the tabs on the feet forwards. Glue the parts together and make sure that the edges are flush.

Step 8: Cut out the two parts of the left support [C3] and [C4], fold both forwards and glue them together as indicated on their backs. Repeat the above with the parts of the right support [C5] and [C6]. After drying, glue the supports to the left and right side of the gnomon, flush to the rounded edge.

Step 9: Cut out the rectangular cover plate [C7]. Insert the foot tabs of the vertical gnomon from above through the slot of the lower dial (the one with the dates of the year). The straight, vertical edge points to the north, the round handle to the south, as shown by the printed compass rose. Apply glue to the cover plate as indicated and glue it under the dial so that the gnomon can no longer fall out, but remains movable.

Chapter D: The vertical, fixed gnomon

Step 10: Cut out the two halves of the angled gnomon [D1] and [D2], fold the foot tabs and the two small support tags forwards and glue the two halves flush together.

Step 11: Insert the foot tabs from above through the slot of the upper dial. The slanted edge of the shadow pointer must start from the centre of the golden star. Glue the foot tabs under the dial.

Step 12: Cut out the support [D3] and fold it forwards along the groove line. Glue it to the support tags of the gnomon and to the dial.

Now the side walls can be glued to the dial:

Step 13: Fold back the long flaps and the small teeth like tags on the side walls [B2] and [B5]. Try sliding the side walls onto the sides of the housing so that the side wall lies inside the housing and the axis slides into its bearing. Check that they rotate easily.

Step 14: Glue both side panels under the dial. The tooth tags are placed behind the curved sides with the latitude scales. The result is a box open at the bottom with two convex curved side walls.

Step 15: Insert the dial into the case with the cover plates of the two axles on the outside. The dial can then be swivelled up and down like a rocker. The correct latitude can be read from the edges of the case.

Congratulations! Your Compass Sundial is now finished.

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