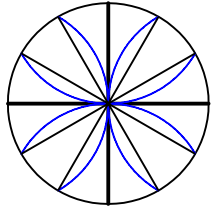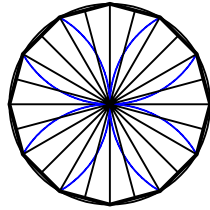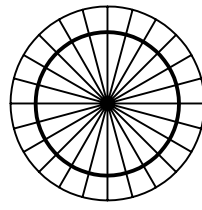# Vitruvius - Ptolemy Alalemma Sundail
from 12 point geometry and orthographic projection

#1:

#2:

#3:
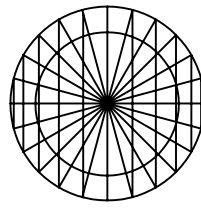
#4:

#5:

Mentioned by the Greek Hipparchus in the 2nd century B.C.,
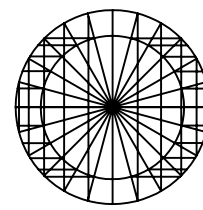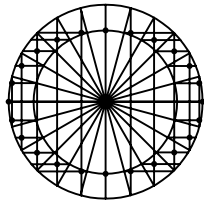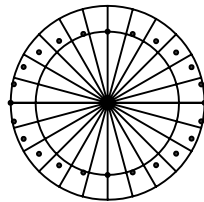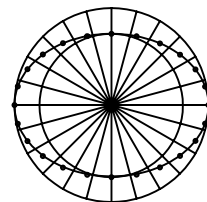the azimuthal orthographic projection
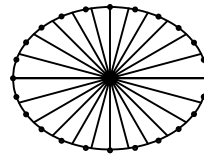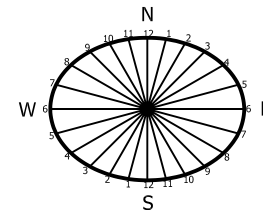was called analemma by Ptolemy and Vitruvius.

#6:

#7:

#8:

#9:

#10:

#1: Draw two perpendicular diameters in a circle, dividing it into four segments.
Set the compass at the end points of each diameter and strike arcs
-- equal to the radius of the circle -- which intersect its perimeter.
Connect all eight intersections to the center. The circle is now divided into 12 equal (30°) triangles.
#2: Spread the compass to the length of a chord segment of the 12 sided polygon and bisect each of the 30° angles.
Connent lines to each of the bisected chords. We now have 24 hour points on the perimter of the circle.
#3: Draw in the latitude circle.
#4: Drop perpendicular lines from the hour points.
#5: Draw in horizontal lines from the latitude circle where the radiating hour lines insect it's permiter.
#6: Mark the intersections of the perpendicular and horizontal lines.
#8 Connect the points to draw the ellipse.
#10: Label sundail hour points on the permiter of the ellipse.