PRACTICAL GEOMETRY.

To bisect a straight line—Fig. 29. Let BC be the straight line to be bisected. With any convenient radius greater than AB or AC describe arcs cutting each other at D and E. A line drawn through D and E will bisect or divide the line BC into two equal parts.

To erect a perpendicular line at or near the end of a straight line—Fig. 30. With any convenient radius and at any distance from the line AC, describe an arc

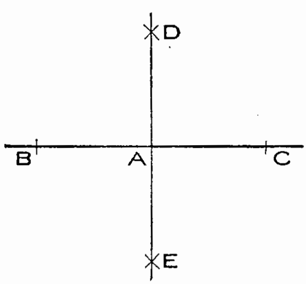

Fig. 29.

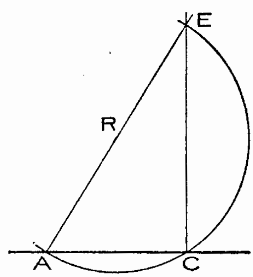

Fig. 30.

of a circle as ACE, cutting the line at A and C. Through the center R of the circle draw the line ARE, cutting the arc at point E. A line drawn from C to E will be the required perpendicular.

To divide a straight line into any number of equal parts—Fig. 31. Let AB be the straight line to be divided into a certain number of equal parts: From the points A and B, draw two parallel lines AD and BC, at any convenient angle with the line AB. Upon AD and BC set off one less than the number of equal parts required, as A-1, 1-2, 2-D, etc. Join C-1, 2-2, 1-D, the line AB will then be divided into the required number of equal parts.

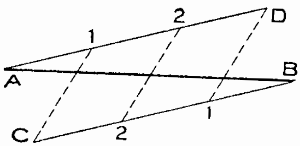

Fig. 31.

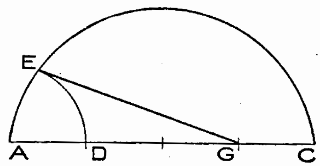

Fig. 32.

To find the length of an arc of a circle—Fig. 32. Divide the chord AC of the arc into four equal parts as shown. With the radius AD equal to one-fourth of the chord of the arc and with A as the center describe the arc DE. Draw the line EG and twice its length will be the length of the arc AEC.

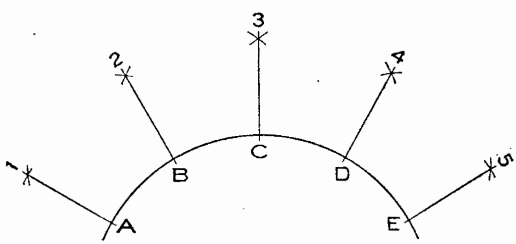

Fig. 33.

To draw radial lines from the circumference of a circle when the center is inaccessible—Fig. 33. Divide the circumference into any desired number of parts as

AB, BC, CD, DE. Then with a radius greater than the length of one part, describe arcs cutting each other as A-2, C-2, B-3, D-3, etc., also B-1, D-5. Describe the end arcs A-1, E-5 with a radius equal to B-2. Lines joining A-1, B-2, C-3, D-4 and E-5 will all be radial.

To inscribe any regular polygon in a circle—Fig. 34. Divide the diameter AB of the circle into as many equal parts as the polygon is to have sides. With the points A and B as centers and radius AB, describe arcs cutting each other at C. Draw the line CE through the second point of division of the diameter of AB, intersecting the circumference of the circle D. A line drawn from B to D is one of the sides of the polygon.

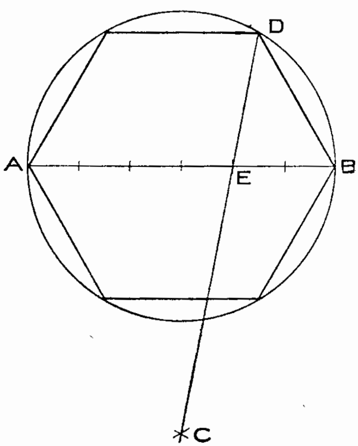

Fig. 34.

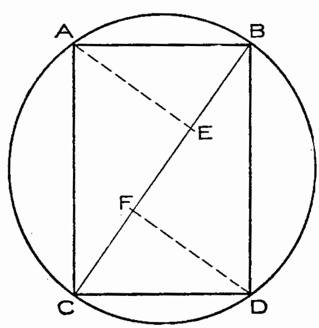

Fig. 35.

To cut a beam of the strongest shape from a circular section—Fig. 35. Divide any diameter CB of the circle into three equal parts as CF, FE and EB. At E and F erect perpendiculars EA and FD on opposite sides of the diameter CB. Join AB, BD, DC and CF. The erect angle ABCD will be the required shape of the beam.

To divide any triangle into two parts of equal area—Fig. 36. Let ABC be the given triangle: Bisect one of its sides AB at D and describe the semicircle AEB. At D erect the perpendicular DE and with center B and radius BE describe the arc EF which intersects the line AB at F. At F draw the line AG parallel at AC, this divides the triangle into two parts of equal area.

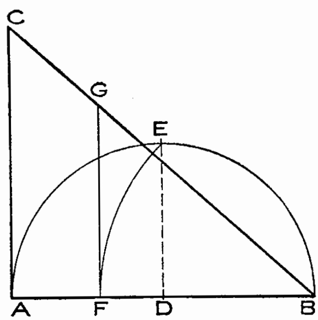

Fig. 36.

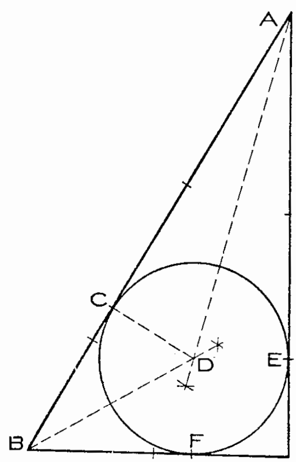

Fig. 37.

To inscribe a circle of the greatest possible diameter in a given triangle—Fig. 37. Bisect the angles A and B, and draw the lines, AD, BD which intersect each other at D. From D draw the line CD perpendicular to AB. Then CB will be the radius of the required circle CEF.

To construct a square equal in area to a given circle —Fig. 38. Let ACBD be the given circle: Draw the diameters AB and CD at right angles to each other, then bisect the half diameter or radius DB at E and draw the line FL, parallel to BA. At the points C and F erect the perpendiculars CH and FG, equal in length to CF. Join HG, then CFGH is the required square. The dotted line FL is equal to one-fourth the circle ACBD.

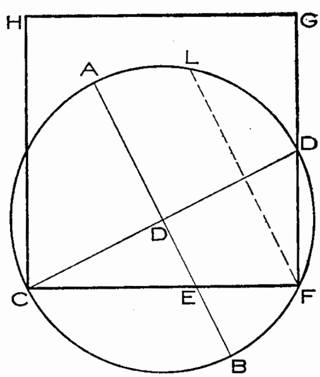

Fig. 38.

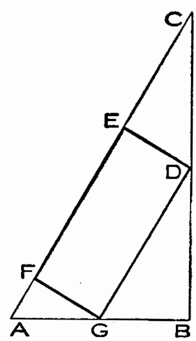

Fig. 39.

To construct a rectangle of the greatest possible area in a given triangle—Fig. 39. Let ABC be the given triangle: Bisect the sides AB and BC at G and F. Draw the line GD and from the points G and D, draw the lines GF and DE perpendicular to GD, then EFGD is the required rectangle.

To construct a rectangle equal in area to a given triangle—Fig. 40. Let ABC be the given triangle:

Bisect the base AB of the triangle at D and erect the perpendiculars DE and BF at D and B. Through C

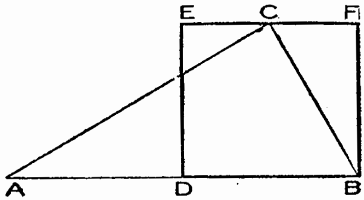

Fig. 40.

draw the line ECF intersecting the perpendiculars DE and B at E and F. Then BDEF is the required rectangle.

To construct a triangle equal in area to a given parallelogram—Fig 41. Let ABCD be the given parallelogram: Produce the line AB at B and make BE

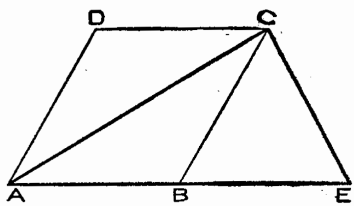

Fig. 41.

equal to AB. Joint the points A and C and ACE will be the triangle required.

To inscribe a square within a given circle—Fig. 42. Let ADBC be the given circle: Draw the diameters AB and CD at right angles to each other. Join AD, DB and CA, then ACBD is the inscribed square.

To describe a square without a given circle—Fig. 43. Draw the diameters AB and CD at right angles to each other. Through A and B draw the lines EF and GH,

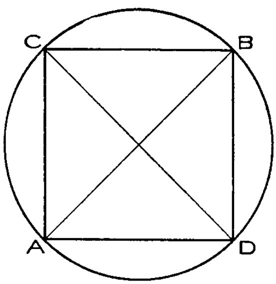

Fig. 42.

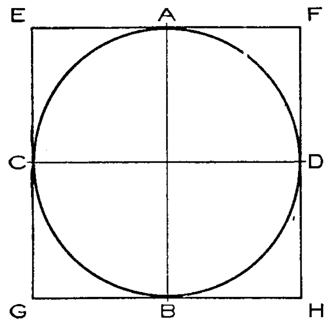

Fig. 43.

parallel to CD, also draw the lines EG and FH through the points C and D and parallel to AB, this completes the required square EFGH.

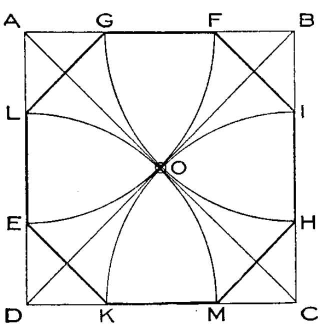

Fig. 44.

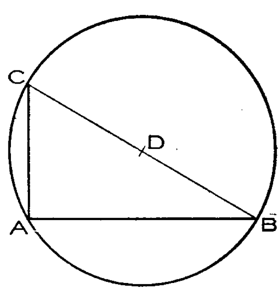

Fig. 45.

To construct an octagon in a given square—Fig. 44. Let ABCD be the given square: Draw the diagonal lines AC and BD, which intersect each other at the

To describe a square without a given circle—Fig. 43. Draw the diameters AB and CD at right angles to each other. Through A and B draw the lines EF and GH,

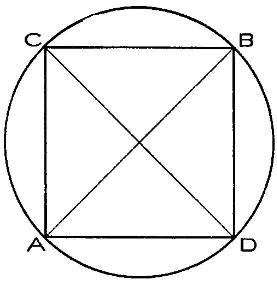

Fig. 42.

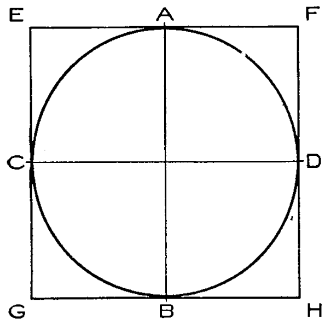

Fig. 43.

parallel to CD, also draw the lines EG and FH through the points C and D and parallel to AB, this completes the required square EFGH.

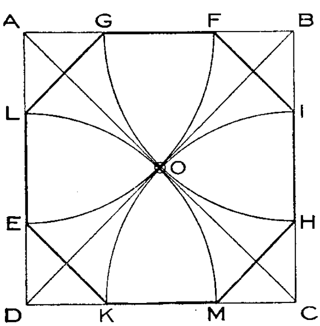

Fig. 44.

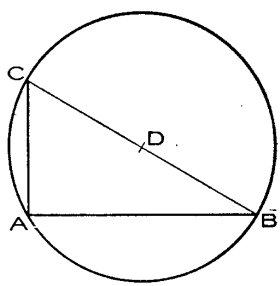

Fig. 45.

To construct an octagon in a given square—Fig. 44. Let ABCD be the given square: Draw the diagonal lines AC and BD, which intersect each other at the point O. With a radius equal to AO or OC, describe the arcs EF, GH, IK and LM. Connect the points EK, LG, FI and HM, then GFIHMKEL is the required octagon.

To construct a circle equal in area to two given circles—Fig. 45. Let AB and AC equal the diameters of the given circles: Erect AC at A and at right angles to AB. Connect B and C, then bisect the line BC at D and describe the circle ACB which is the circle required and is equal in area to the two given circles.

To describe an octagon about a given circle—Fig. 46. Let ACBD be the given circle: Draw the diameters AB and CD at right angles to each other. With

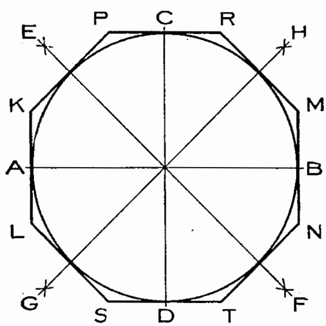

Fig. 46.

any convenient radius and centers A, C, B and D describe arcs intersecting each other at E, H, F and G. Join EF and GH which form two additional diameters. At the points AB and CD draw the lines KL, PR, MN and ST, parallel with the diameters CD and AB respectively. At the points of intersection of the circumference of the circle by the lines EF and GH, draw the lines KP, RM, NT and SL parallel with the lines EF and HG respectively, then PRMNTSLK is the required octagon.

To draw a straight line equal in length to a given portion of the circumference of a circle—Fig. 47. Let ACBD be the given circle: Draw the diameters AB and CD at right angles with each other. Divide the radius RB into four equal parts. Produce the diameter AB and B and make BE equal to three of the four parts of RB. At A draw the line AF parallel to CD

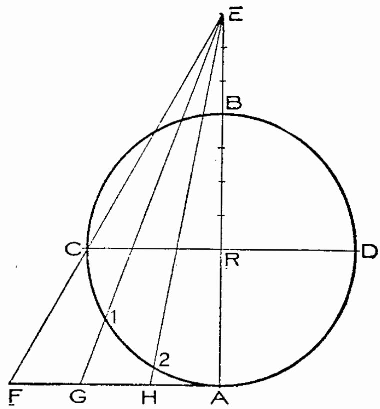

Fig. 47.

and then draw the line ECF which is to one-fourth of the circumference of the circle ACBD. If lines be drawn from E through points in the circumference of the circle as 1 and 2, meeting the line AF and G and H, then C-1, 1-2 and 2-A will equal FG, GH and HA respectively.

To construct a square equal in area to two given squares—Fig. 48. Let AC and AD be the length of the sides of the given squares: Make AD perpendicular to AC and connect DC, then DC is one of the sides of the square DCEG which is equal to the two given squares.

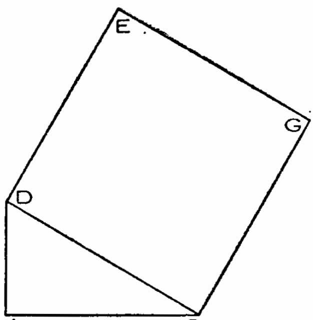

Fig. 48.

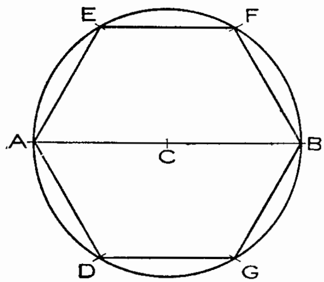

Fig. 49.

To inscribe a hexagon in a given circle—Fig. 49. Draw a diameter of the circle as AB: With centers A and B and radius AC or BG, describe arcs cutting the circumference of the circle at D, E, F and G. Join EF, FB, BG, GD, DA and AE, this gives the required hexagon.

To describe a cycloid, the diameter of the generating circle being given—Fig. 50. Let BD be the generating circle: Draw the line ABC equal in length to the circumference of the generating circle. Divide the circumference of the generating circle into 12 parts as shown. Draw lines from the points of division 1, 2, 3, etc., of the circumference of the generating circle parallel to the line ABC and on both sides of the circle. Lay off one division of the generating circle on the lines 5 and 7, two divisions on the lines 4 and 8, three

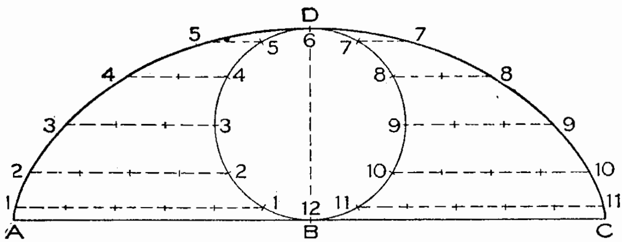

Fig. 50.

divisions on the lines 3 and 9, four divisions on the lines 2 and 10, and five divisions on the lines 1 and 11. A line traced through the points thus obtained will be the cycloid curve required.

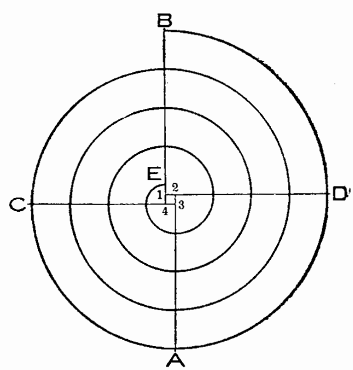

Fig. 51.

To develop a spiral with uniform spacing—Fig. 51. Divide the line BE into as many equal parts as there are required turns in the spiral. Then subdivide one of these spaces into four equal parts. Produce the line BE to 4, making the extension E-4 equal to two of the subdivisions. At 1 draw the line 1-D, lay off 1-2 equal to one of the subdivisions. At 2 draw 2-A perpendicular to 1-D and at 3 in 2-A draw 3-C, etc. With center 1 and radius 1-B describe the arc BD with center 2 and radius 2-D describe the arc DA, with center 3 and radius 3-A, etc. until the spiral is completed. If carefully laid out the spiral should terminate at E as shown in the drawing.