

## Geometrical Drawing — IV.

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The problems here given for grade VIII, although few in number, contain sufficient principles on which to base plenty of exercises to cover the year's work. Many of these may be found in the publication mentioned last month, and in past examination papers. If further practice is required, good exercises may be given in copying, enlarging and reducing given figures, using all kinds of scales.

FIG. 1. *The diagonal scale*, its construction and use. To explain the construction of this most useful scale, let AB in the first diagram be a short line which is to be divided into twelve equal parts. Draw AC any length, stepping off on it twelve equal divisions. Join CB and from the divisions on AC draw lines  $a_1, b_2$ , etc., parallel to AB.

Since Af is half AC, f6 will be half AB; and since Ci is one-fourth of AC, i9 will be one-fourth of AB. Similarly k11 is one-twelfth of AB, and e5 seven-twelfths, and so on. This method of division is extremely useful when AB is a very short line. In the second diagram we have a true diagonal scale in which the inch is divided into 120 parts, giving a scale of 10 feet to the inch from which we can measure feet and inches.

To construct it draw AB any required length marking off each inch. Divide the first one AE into 10 equal parts. Draw AC at right angles to AB and on it mark off twelve equal divisions. Through each one draw a line parallel to AB. Draw EF, GH, etc. parallel to AC. Divide CF into ten equal parts. Join Fa, 1b, 2c, etc. These lines are diagonals and divide each tenth of AE into twelve equal parts.

Suppose we wish to measure off a line 26 feet 7 inches long. From K to 6 on the bottom line represents 26 feet. By going up the line 6g to the parallel marked 7, we add seven-twelfths of another foot, so that the distance xo represents 26 ft. 7 in.

By using ten parallels instead of twelve we divide the inch into 100 equal parts, and can obtain fractions of the inch to two decimal places.

FIG. 2. *The scale of chords*, its construction and use. With any convenient radius describe a quadrant AB. With the same radius trisect the arc. By trial divide each of these thirds again into three giving nine divisions, each representing ten degrees. With A as centre and radius Aa draw the arc a10. Similarly draw b20, c30, etc.

This divided line AC is the scale of chords. The second part of the figure shows its use. It is re-

quired to make an angle of  $37^\circ$  with DE. With D as centre and radius A60 on the scale describe the arc EF. With radius A37 and centre E, cut off point F. Join DF. Then EDF contains 37 degrees.

FIG. 3. *To construct an irregular polygon*, having given lengths of sides and sizes of angles. Draw AB and make it the given length. By means of protractor or scale of chords make the angle ABC the given size. Cut off BC the required length and proceed in a similar manner with each side and angle until the figure is complete.

NOTE.—In this and the succeeding figures which have dimensions, the scale used is 100 yards to the inch. This is an easy scale, and can be worked with great accuracy from a diagonal scale.

FIG. 4. *The same as Fig. 3*, having given the lengths of sides and diagonals. Make the triangle ABC according to dimensions given (by Ex. 4 grade VII.) Then on CA make the triangle CDA by the same method. Next construct the triangle DEA on DA and the figure will be complete.

FIG. 5. *The same as Fig. 3*, having given two sides, lengths of lines radiating from one corner, and the angles between them.

Draw BA its given length. Make the angles BAC, CAD, and DAE of the given number of degrees. Cut off AC, AD and AE the given lengths, and join BC, CD and DE.

FIG. 6. *The same as Fig. 3*, having given lengths of radii from a point within the figure, and the angles between them. Draw BO the given length. Make the angles BOC, COD, DOE, and EOA of the required number of degrees. Next set off the lengths of the radii, and join their extremities.

FIG. 7. *The same as Fig. 3*, by means of ordinates from one side, or the side produced. Draw any line fh and set off fA, Ag, gE, and Eh their respective lengths. At f, g, and h erect perpendiculars (called ordinates) and cut them off to required lengths. Join AB, BC, CD, and DE.

FIG. 8. *The same as Fig. 3*, by means of ordinates from a diagonal. Draw the diagonal AB and mark off the different divisions from the table. Erect the ordinates and cut them to lengths. Join the extremities.

FIG. 9. *To construct an irregular figure from dimensions given as in land surveying*. The right hand portion of the figure represents a page from a surveyor's Field-book, which should be read from the bottom upwards.

Draw AB rising  $11\frac{1}{4}^\circ$  from the horizontal (each