Geometrical Drawing.

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The exercises presented this month are designed for grade VI. It will be noticed that the new principles introduced are not many in number, as those given for grade V are constantly recurring, and also a certain space is given to exercises in which extreme accuracy is necessary. As several of the exercises have reference to angles and degrees, it is advisable to introduce the protractor at this stage. It need not be used so much for construction as to prove the truth of the angles made by compass methods.

For the benefit of teachers in grades VI, VII, or VIII, it should be stated that if they wish to commence work along these lines without any having been done in grade V, they should commence at the beginning, and take up the main principles. Also in response to some enquiries already made, it would be well to mention here, that this is not intended to supplement freehand or ruler drawing, but to be taught in conjunction with both.

FIG. 1. *To construct an angle equal to a given angle.*—Let CDE be the given angle, and A the point at which it is required to make a similar angle. From A draw the line AB. With C as centre and any convenient radius, describe the arc DE. With A as centre and the same radius, describe the arc FG. Measure DE with the compasses and cut off FG equal to it. Join AG. Then GAB is the required angle.

For an exercise let the children make an angle equal to a given one, but making the legs twice as long as the original. This will give an opportunity for showing that angles are not measured by the lengths of the sides, and therefore a good introduction to a lesson on *degrees* and the protractor.

FIG. 2. *To bisect an angle.*—Let BAC be the given angle. With A as centre and any radius described the arc BC. With B as centre and any radius more than half BC describe an arc. With C as centre and the same radius described another arc cutting the first in D. Join AD. This line bisects the angle.

Exercise.—The two lines forming the angle represent two of the fences bounding a piece of ground. The owner wishes to make a path across the land beginning at B and keeping equidistant from the two fences. Lay out the path.

FIG. 3. *The same as Fig. 2.*—Set square method. Mark off a point on each leg equidistant from B. Place the set square with one edge on BC, and the corner at E and draw the line EG. Similarly from D draw DH. Join B to the point of intersection F.

FIG. 4. *To trisect a right angle.*—From A as centre and with any radius describe arc BC. From B and C as centres and the same radius describe arcs cutting the first in E and D. Join AD and AE. Most children will solve this exercise without any instruction. If not, a few questions on degrees will have the desired effect.

FIG. 5. *To construct angles of* 15°, 30°, 45°, 60°, 75°, or 105°. Draw the right angle BAC. Mark off D and E as in the previous exercise. Bisect CE for 15°. CB or ED for 45° and DB for 75°. For 105° mark off BK equal to BL.

This is simply a combination of exercises 2 and 4, and can also be solved by the children without assistance.

FIG. 6. *To divide a straight line into any number of equal parts.*—Let AB be the given line. It is required to divide it into 7 equal parts. Draw AC at any angle with AB. Make the angle ABF equal to the angle BAC (Ex. 1). Step off 7 equal divisions of any convenient length on AC and BF. Join A to 7, 1 to 6 and so on as shown in the diagram. These lines will divide AB into 7 equal parts.

This exercise may be varied in form, such as:—Cut off 1-5 of AB; or, AB represents the length of a piece of land owned by two persons. One owns 2-5 and the other the balance. Show their portions.

FIG. 7. *The same as Fig.* 6.—Set square method. Draw AC at any angle. Step off seven equal divisions on AC. Place the set square in a position to join B 7. Before moving the set square, place the ruler under it as shewn. By sliding the square along the ruler, parallels can be drawn through 6, 5, 4, 3, 2 and 1, dividing AB into 7 equal parts.

FIG. 8. *To construct an equilateral triangle on a given base.*—With A and B as centres and radius AB describe arcs cutting at C. Join AC and BC.

By applying the set square shew that the triangle is also equiangular, and that the three angles are together equal to 180°.

FIG. 9. *To inscribe an equilateral triangle in a circle.*—Draw any diameter AB. With B as centre and radius BO describe arc COD. Join AC, CD, and DA.

This exercise may be made the basis of several designs. For example, if the working be repeated starting from A as centre, we get a six pointed star, a favorite shape for flower garden plots.