

PRACTICAL GEOMETRY—APPLIED.

BY J. MANGNALL.

THE CONSTRUCTION OF SCALES.

SCALES.—The scale is so called from a Greek word, which signifies a wooden measure of length, and is a mathematical instrument consisting of various lines drawn on wood, ivory, brass, &c., variously divided according to the purpose it is intended to serve, and is used for measuring straight lines, and laying down distances. Scales are denominated, according to their uses, as the plain scale, diagonal scale, plotting scale, vernier scale, &c.

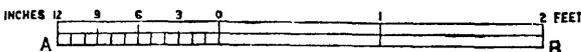
The most useful scales for mechanical drawing are the plain scale and diagonal scale, and to the construction of these scales we confine ourselves in this part of the series.

PLAIN SCALES.—Plain scales consist of any number of equal divisions and subdivisions, laid down with such accuracy that any drawing constructed by them shall be in exact proportion in all its details.

In the construction of scales, the subdivisions should be carried to as low a denomination as is likely to be required. Thus, for a drawing of limited extent, the subdivisions may be inches, and the primaries feet, but, for a drawing of large area, these subdivisions may each represent one mile, or one chain, or one foot, &c.; and the primaries so many tens of miles, or of chains, or of feet, &c. Therefore, the graduation of the scale must be determined by the natural size or extent of the object or area, and the space or surface to be occupied by the delineation.

NOTE.—In copying plans and drawings, it is often requisite to transfer a series of different lengths on one straight line, from the one plan to the other. This may be easily done with the compasses or scale, but, in practice, the following more expeditious and convenient method is preferred:—Place a thin strip of paper—with one edge cut accurately straight, and of sufficient length—along the line to be copied, and mark upon it the several divisions with a finely-pointed pencil; then, by placing the same upon the other line, the divisions may be transferred with great facility, and with sufficient accuracy for most practical purposes.

PROBLEM 104.—TO MAKE A SCALE OF ONE FOOT TO AN INCH TO SHOW FEET AND INCHES.

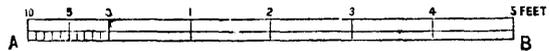


- 1.—Draw a straight line, **A B**, of any convenient length, suitable for the required drawing.
- 2.—From the point **A**, set off, on **A B**, equal distances of one inch in length, and, to make the points of division more conspicuous, raise small perpendiculars from each of them: these divisions each represent one foot, and are called the primary divisions; mark these divisions with figures, commencing at the second division, **1, 2, &c.**, according to the length of the scale, and mark the first **A 0**.
- 3.—Divide the first division, **A 0**, into twelve equal parts, for inches (see Prob. 8), and figure every third division or inch as **3, 6, 9, 12**, counting the opposite way from **0**, to that of the feet. These divisions are called subdivisions.

To take a measurement of 2 feet 6 inches, from this scale, place one leg of the compasses on **2 B**, and the other on **6** (the sixth subdivision). Other dimensions are taken in a similar manner.

NOTE.—In subdividing a line, the operation may be performed with the greatest accuracy and least trouble, by using a sort of compasses called Hair-dividers; but, in cases where the divisions are so very small (as in the above case), a sort of dividers called Spring-compasses are preferable. This instrument has, from its principle of construction, a steadiness and firmness which cannot be surpassed, and its points can be adjusted to the smallest portion of space with an ease and nicety unattainable by any other form of compasses.

PROBLEM 105.—TO MAKE A SCALE OF TWO FEET TO AN INCH TO SHOW FEET AND INCHES.



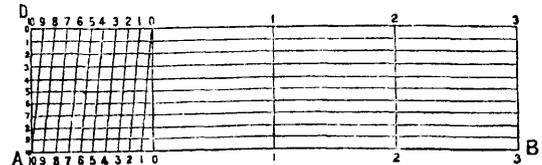
- 1.—Draw the straight line **A B**, as before, and on it set off the required number of distances, each equal to half an inch in length.
- 2.—Figure these points or divisions, commencing at the second division, **1, 2, 3, &c.**, according to the length of the scale, and mark the first **A 0**.
- 3.—Divide the first division, **A 0**, into ten equal parts, to represent tenths of feet, and figure the fifth and tenth division, counting the opposite from **0** to that of feet.

To take a measurement of 3.5, or 3 feet 5 tenths, place one leg of the compasses on **3**, in the larger or primary divisions, and the other on **5**, in the smaller or subdivisions.

DIAGONAL SCALE.—More minute subdivisions are frequently required than those obtained from a simply-divided scale, which give only two denominations—primaries and tenths or twelfths—so that any distance which is less than a tenth of a primary division cannot be accurately taken from them; but by means of a diagonal scale, the parts of any distance, which are the hundredths of the primary division, are correctly attained.

A diagonal scale consists of a number of primary divisions, one which is divided into tenths, and subdivided into hundredths, by diagonal lines.

PROBLEM 106.—TO MAKE A DIAGONAL SCALE OF THREE-FOURTHS OF AN INCH TO THE FOOT, TO SHOW FEET, TENTHS OF FEET, AND HUNDREDTHS OF FEET.



- 1.—Draw eleven parallel equidistant lines.
- 2.—Set off, on **A B**, the lower of these lines, a number of equal distances, each three-fourths of an inch long, for feet.
- 3.—Through each of these divisions draw perpendicular lines, cutting all the eleven parallels, and number these **1, 2, 3, &c.**, beginning from the second division, and mark the first **A 0**.
- 4.—Subdivide the first of these primary divisions, **A 0**, into ten equal parts, both upon the upper and lower of the eleven parallel lines, for tenths; figure these subdivisions, **1, 2, 3, 4, &c.**, counting the opposite way from **0** to that of feet.
- 5.—Draw the diagonal lines from the ninth subdivision above to the tenth below; from the eighth above to the ninth below, and so on. These lines divide each tenth again into ten equal parts at points in the horizontal lines, or one-hundredths of the extent of a primary division.

To take a measurement of 2.68—that is, 2 feet, 6 tenths, 8 hundredths—place one leg of the compasses on the primary **2**, and carry it down to the ninth parallel line, and then extend the other leg of the compasses to the intersection of the diagonal, which falls from the subdivision **6**, with the parallel that measures the eighth-hundredth part; or, on the parallel indicated by the third figure, measure from the diagonal indicated by the second figure to the vertical indicated by the first.