

this ratio may be either equal to, greater, or less than unity; but in Case II. it is always greater, and in Case III. less: hence, advantage is always gained in the second case and lost in the third, but may be either gained or lost in the first.

Lever supposed heavy.

59. If the weight of the lever (w) be taken into account, it may be supposed collected at the centre of gravity G (which will be the middle point if the lever be uniform).

Let the vertical through G meet the horizontal $A b c$ in g .

Then, by the vanishing of moments about A ,

$$P. Ab + w. Ag - W. Ac = 0$$

but by similar triangles,

$$\frac{AB}{Ab} = \frac{AG}{Ag} = \frac{AC}{Ac}, \text{ and therefore}$$

$$P. AB + w. AG - W. AC = 0$$

or,

$$P. AB + w. AG = W. AC$$

Similarly, in Cases II. and III. we should find

$$P. AB = W. AC + w. AG.$$

Here also the lever will balance in all positions about the fulcrum.

Common Balance.

60. In the common Balance, which consists of a heavy beam, having scale pans suspended at its ends, and balancing about a horizontal knife edge, the pans and arms of the beams are made perfectly equal and similar on each side of the edge, but the centre of gravity of the beam is made to fall vertically below the knife-edge when the beam is horizontal. The beam will therefore rest in a horizontal position only when the pans are loaded with equal weights; and if then disturbed from this position, the moment of its own weight brings it back, so that the equilibrium is *stable*.

Roman Steelyard. Fig. 4.

61. In the common or Roman Steelyard, a heavy beam has attached to it a knife-edge which is supported as a fulcrum; a weight runs along the upper straight edge of the beam on the longer arm, and the substance to be weighed is attached at a fixed point to the shorter arm by a hook or scale-pan. The longer arm is graduated, and the weight of the substance is known from the graduation at the point where the moveable weight is, when the beam is at rest.