In fig. 4, A is the knife-edge or fulcrum, P the weight moveable along $A\,B$: C, the point whence the substance, whose weight W is required, is suspended.

$C\,A\,B$ being horizontal, let O be the point on the other side of A where P would keep the Steelyard at rest when the weight W is away. The moment of the weight of the Steelyard about A is therefore equal to $P.\,A\,O$.

Now let the weight W be attached, and let M be the place of P when equilibrium is obtained. Then, taking moments about A,

$$\begin{aligned} W.\,AC &= P.\,AM + \text{moment of weight of Steelyard} \\ &= P.\,AM + P.\,AO \\ &= P.\,OM \end{aligned}$$

Hence, $W = \dfrac{P}{AC}\,OM$,

And, since P and AC are invariable, W is proportional to OM: O therefore is the point from which the graduation must be made. Thus, if P be at B_1 when W is 1 lb, and we take $O\,B_1 = B_1\,B_2 = B_2\,B_3 = \ldots$; then when P is at B_2, B_3, ... W will be 2, 3, ... lbs.

62. The preceding cases of the lever are only special applications of the general investigation in Chap. III. In fact, any body moveable about a fixed point and acted on by forces in the plane of that point may be considered a *lever*, and the principle of § 38 is often quoted as the *principle of the lever*. "Principle of the lever."

63. *The Wheel and Axle.*

Wheel and axle Fig. 5.

This machine consists of a circular drum or wheel, which is attached to a cylinder or axle, its centre lying in the axis of the cylinder and its plane being perpendicular to this axis. The whole system runs freely on this axis, which is fixed; and the power P acts by a string coiled round the wheel, and supports a weight W which hangs from a string coiled round the axle. The strings being perpendicular to the axis, and also to the radii of the wheel and axle respectively at the points where they become uncoiled, we have for the condition of equilibrium, by § 39, taking moments about the axis,

$$P \times \text{radius of wheel} - W \times \text{radius of axle} = 0,$$