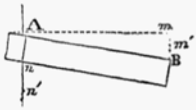
but the quantity of angular motion around the point of support to which the deflection is proportioned is also inversely as the depth, as may be seen by reference to the figure; in which, if $A\,n$ becomes $A\,n' = 2\,A\,n$, the deflection will become $m\,m' = \frac{1}{2}\,B\,m$, since, if the leverage of the resistance be doubled, the effect will be reduced one-half. Hence, it follows that the deflection will be inversely as the cube of the depth.

FIG. 4.



Combining all these results, it follows that the whole deflection will be directly as the weight and the cube of the length, and inversely as the breadth and the cube of the depth—and will be expressed by $\frac{W\,l^3}{b\,d^3}$.

If different timbers be required to fulfil the condition, that the deflection shall be equal whatever be the length, we have only to make this expression constant, and determine its value by direct experiment upon the particular kind of timber to be used.

The condition of equal stiffness, however, does not require that the deflection should be equal for every length, but allows it to be in proportion to the length: for example, a beam of 20 feet may be allowed to bend twice as much as one of 10 feet, and the expression modified to suit this case will be $\frac{w\,l^2}{b\,d^3}$, a constant quantity for beams of equal stiffness.

By introducing a suitable number for the constant, the equation which expresses its value will determine any one of the four quantities, w, l, b, or d, when the other three are known.

Beams supported at both ends.

When a beam rests on two points of support, and is loaded with a weight applied in the middle, the general circumstances of the case are involved in that which we have considered.