the centre of gravity from L is had by dividing this momentum by the whole weight, which is (xm + 2)/(m + 1).

The quotient or *g* is (x × (m + 1))/(m + 2). And the diſtance of the centre of gravity from the ſection B*b* is x - (x × m + 1)/(m + 2), = ((x + (m + 2) - x × (m + 1))/(m + 2), = x/(m + 2). Therefore the ſtrain on the ſection B*b* is had by multiplying (xm + 1)/(m + 1) by x/(m + 2). The product is (xm + 2)/((m + 2) × (m + 1)). This muſt be as the ſquare of the depth, or as y2. But y is as xm, and y2 as *x2m.* Therefore we have m + 2 = 2m*,* and m = 2 ; that is, the depth muſt be as the ſquare of the diſtance from the extremity, and the curve L*b*A is a parabola touching the horizontal line in L.

It is eaſy to ſee that a conoid formed by the rotation of this figure round DL will alſo be equally able in every ſec­tion to bear its own weight.

We need not proſecute this farther. When the figure of the piece is given, there is no difficulty in finding the ſtrain ; and the circumſtance of equal ſtrength to resiſt this ſtrain is chiefly a matter of curiosity.

It is evident, from what has been already ſaid, that a pro­jecting beam becomes leſs able to bear its own weight, as it projects farther. Whatever may be the ſtrength of the ſection DA, the length may be ſuch that it will break by its own weight. If we ſuppoſe two beams A and B of the ſame ſubſtance and ſimilar ſhapes, that is, having their lengths and diameters in the ſame proportion; and farther ſuppoſe that the ſhorter can just bear its own weight ; then the longer beam will not be able to do the ſame : For the ſtrengths of the ſections are as the cubes of the diameters, while the ſtrains are as the biquadrates of the diameters ; becauſe the weights are as the cubes, and the levers by which theſe weights act in producing the ſtrain are as the lengths or as the diameters.

Theſe conſiderations show us, that in all caſes where the ſtrain is affected by the weight of the parts of the machine or ſtructure of any kind, the ſmaller bodies are more able to withſtand it than the greater ; and there ſeems to be bounds ſet by nature to the ſize of machines conſtructed of any given materials. Even when the weight of the parts of the machine is not taken into the account, we cannot enlarge them in the ſame proportion in all their parts. Thus a steam-engine cannot be doubled in all its parts, ſo as to be ſtill efficient. The pressure on the piſton is qua­drupled. If the lift of the pump be alſo doubled in height while it is doubled in diameter, the load will be increaſed eight times, and will therefore exceed the power. The depth of lift, therefore, muſt remain unchanged; and in this caſe the machine will be of the ſame relative ſtrength as be­fore, independent of its own weight. For the beam being doubled in all its dimenſions, its momentum of coheſion is eight times greater, which is again a balance for a qua­druple load acting by a double lever.—But if we now conider the increaſe of the weight of the machine itſelf, which muſt be ſupported, and which muſt be put in motion by the intervention of its coheſion, we ſee that the large ma­chine is weaker and leſs efficient than the ſmall one.

There is a ſimilar limit ſet by nature to the size of plants and animals formed of the ſame matter. The coheſion of an herb could not ſupport it if it were increaſed to the ſize of a tree, nor could an oak ſupport itſelf if 40 or 50 times bigger, nor could an animal of the make of a long-legged ſpider be increaſed to the ſize of a man ; the articulations of its legs could not ſupport it.

Hence may be underſtood the prodigious ſuperiority of the ſmall animals both in ſtrength and agility. A man by falling twice his own height may break his firmeſt bones. A mouſe may fall 20 times its height without risk ; and even the tender mite or wood-louſe may fall unhurt from the top of a ſteeple. But their greateſt ſuperiority is in reſpect of nimbleneſs and agility. A flea can leap above 500 times its own length, while the ſtrength of the human muſcles could not raiſe the trunk from the ground on limbs of the ſame conſtruction.

The angular motions of ſmall animals (in which conſiſts their nimbſeneſs or agility) muſt be greater than thoſe of large animals, ſuppoſing the force of the mucſular fibre to be the ſame in both. For ſuppoſing them ſimilar, the num­ber of equal fibres will be as the ſquare of their linear di­menſions ; and the levers by which they act are as their linear dimenſions. The energy therefore of the moving force is as the cube of theſe dimenſions. But the momen­tum of inertia, or Sp. r2 is as the 4th power : Therefore the angular velocity of the greater animals is ſmaller. The number of ſtrokes which a fly makes with its wings in a ſe­cond is aſtonishingly great ; yet, being voluntary, they are the effects of its agility.

We have hitherto confined our attention to the ſimpleſt form in which this tranſverſe ſtrain can be produced. This was quite ſufficient for showing us the mechaniſm of nature by which the ſtrain is resiſted ; and a very slight attention is ſufficient for enabling us to reduce to this every other way in which the ſtrain can be produced. We ſhall not take up the reader’s time with the application of the ſame principles to other caſes of this ſtrain, but refer him to what has been ſaid in the article Roofs. In that article we have shown the analogy between the ſtrain on the ſection of a beam pro­jecting from a wall and loaded at the extremity, and the ſtrain on the ſame ſection of a beam ſimply reſting on ſupports at the ends, and loaded at ſome intermediate point or points. The ſtrain on the middle C of a beam AB (fig. 19.) ſo ſupported, arising from a weight laid on there, is the ſame with the ſtrain which half that weight hanging at B would produce on the ſame ſection C if the other end of the beam were fixed in a wall. If therefore 1000 pounds hung on the end of a beam projecting 10 feet from a wall will just break it at the wall, it will require 4000 pounds on its middle to break the ſame beam reſting on two props 10 feet aſunder. We have alſo ſhown in that article the additional ſtrength which will be given to this beam by ex­tending both ends beyond the props, and there framing it firmly into other pillars or ſupports. We can hardly add any thing to what has been ſaid in that article, except a few obſervations on the effects of the obliquity of the ex­ternal force. We have hitherto ſuppoſed it to act in the direction BP (fig. 6.) perpendicular to the length of the beam. Suppoſe it to act in the direction BP, oblique to BA. In the article Roof we ſuppoſed the ſtrain to be the ſame as if the force *p* acted at the diſtance AB', but ſtill perpendidicular to AB : ſo it is. But the ſtrength of the ſection A∆ is not the ſame in both caſes ; for by the obliquity of the action the piece DCKδ is pressed to the other. We are not ſufficiently acquainted with the corpuſcular forces to ſay preciſely what will be the effect of the pressure arising from this obliquity ; but we can clearly see, in general, that the point A, which in the inſtant of fracture is neither ſtretched nor compressed muſt now be farther up, or nearer