Let B*b* or *y* be as some power *m* of LB ; that is, let v=xm. Then the contents of LB*b* is ——. The *j m* + 1

momentum of gravity round a horizontal axis at L is *yxdx=xm+2dx,* and the whole momentum round the axis is

——. The distance of the centre of gravity from L is m -f- 2

had by dividing this momentum by the whole weight, which ar'"\*1 TL .∙ . . *x × m* + 1 , x, ,.

is -. The quotient or *g* is — √—, and the dιs-

*nι* -∣- 1 m-∣-2

tance of the centre of gravity from the section B*b* is *x*× *m +* l *x× m4-2—*r×m-l-l *x*

*X* = !!— = ——τr. There­in + 2 *nt* -∣- 2 *nt* -f- 2

fore the strain on the section BZ> is had by multiplying *3-m∖∖ j,* ∙rm÷2

rbv—-—-. The product is — ■■ This *+ 1 ’ + 2 m* + 2 X *m* + 1

must be as the square of the depth, or as *y~.* But *y* is xm, and *y2* as x2m. Therefore we have m + 2 = 2*m*, 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 further 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 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 seem 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 consider 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 forty or fifty 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 twenty 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 nimbleness or agility) must be greater than those of large animals, supposing the force of the muscular 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 ∫ *p* ∙ r2, is as the fourth 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 Roof. 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. 16) 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 ten 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 ten 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 perpendicular 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 DCK∆ 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