fibre, such as fir, will be less impaired by any load which is not sufficient to break them immediately.

According to Mr Emerson, the load which may be safely suspended to an inch square is as follows :

Iron 76,400

Brass 35,600

Hempen rope 19,600

Ivory ...15,700

Oak, box, yew, plum-tree 7,850

Elm, ash, beech, 6,070

Walnut, plum 5,360

Red fir, holly, elder, plane, crab 5,000

Cherry, hazel 4,760

Alder, asp, birch, willow 4,290

Lead 430

Freestone 914

He gives us a practical rule, that a cylinder whose diame­ter is *d* inches, loaded to one fourth of its absolute strength, will carry as follows :

Iron 135

Good rope 22

Oak..... 14

Fir 9 } cwt.

The rank which the different woods hold in this list of Mr Emerson's is very different from what we find in Mus- chenbroeck’s. But precise measures must not be expected in this matter. It is wonderful, that in a matter of such un­questionable importance the public has not enabled some persons of judgment to make proper trials. They are be­yond the abilities of private persons.

II.—BODIES MAY BE CRUSHED.

It is of equal, perhaps greater, importance to know the strain which may be laid on solid bodies without danger of crushing them. Pillars and posts of all kinds are exposed to this strain in its simplest form ; and there are cases where the strain is enormous, viz. where it arises from the oblique position of the parts, as in the struts, braces, and trusses, which occur very frequently in our great works. It is therefore most desirable to have some general know­ledge of the principle which determines the strength of bodies, in opposition to this kind of strain. But, unfortu­nately, we are much more at a loss in this than in the last case. The mechanism of nature is, in the present case, much more complicated. It must be in some circuitous way that compression can have any tendency to tear asunder the parts of a solid body, and it is very difficult to trace the steps.

If we suppose the particles insuperably hard and in con­tact, and disposed in lines which are in the direction of the external pressures, it does not appear how any pressure can disunite the particles ; but this is a gratuitous supposition. There are infinite odds against this precise arrangement of the lines of particles ; and the compressibility of all kinds of matter in some degree shows that the particles are in a situation equivalent to distance. This being the case, and the particles, with their intervals, or what is equivalent to in­tervals, being in situations that are oblique with respect to the pressures, it must follow, that by squeezing them together in one direction, they are made to bulge out or separate in other directions. This may proceed so far that some may be thus pushed laterally beyond their limits of cohesion. The moment that this happens the resistance to compres­sion is diminished, and the body will now be crushed to­gether. We may form some notion of this by supposing a number of spherules, like small shot, sticking together by means of a cement. Compressing this in some particular direction causes the spherules to act among each other like so many wedges, each tending to penetrate through between the three which lie below it : and this is the simplest, and perhaps the only distinct, notion we can have of the matter. We have reason to think that the constitution of very homo­geneous bodies, such as glass, is not very different from this.

If this be the constitution of bodies, it appears probable that the strength, or the resistance which they are capable of making to an attempt to crush them to pieces, is propor­tional to the area of the section whose plane is perpendicu­lar to the external force ; for each particle being similarly and equally acted on and resisted, the whole resistance must be as their number, that is, as the extent of the section.

Accordingly this principle is assumed by the few writers who have considered the subject ; but we confess that it appears to us very doubtful. Suppose a number of brittle or friable balls lying on a table uniformly arranged, but not cohering nor in contact, and that a board is laid over them and loaded with a weight ; we have no hesitation in saying that the weight necessary to crush the whole collection is proportional to their number or to the area of the section. But when they are in contact, and still more if they cohere, we imagine that the case is materially altered. Any indi­vidual ball is crushed only in consequence of its being bul­ged outwards in the direction perpendicular to the pressure employed. If this could be prevented by a hoop put round the ball like an equator, we cannot see how any force can crush it. Any thing therefore which makes this bulging outwards more difficult, makes a greater force necessary. Now this effect will be produced by the mere contact of the balls before the pressure is applied ; for the central ball cannot swell outward laterally without pushing away the balls on all sides of it. This is prevented by the friction on the table and upper board, which is at least equal to one third of the pressure. Thus any interior ball be­comes stronger by the mere vicinity of the others ; and if we further suppose them to cohere laterally, we think that its strength will be still more increased.

The analogy between these balls and the cohering par­ticles of a friable body is very perfect. We should there­fore expect that the strength by which it resists being crush­ed will increase in a greater ratio than that of the section, or the square of the diameter of similar sections ; and that a square inch of any matter will bear a greater weight in proportion as it makes a part of a greater section. Ac­cordingly this appears in many experiments, as will after­wards be noticed. Muschenbroeck, Euler, and some others, have supposed the strength of columns to be as the biqua­drates of their diameters. Euler deduced this from for­mulae which occurred to him in the course of his algebraic analysis ; and he boldly adopts it as a principle, without looking tor its foundation in the physical assumptions which he had made in the beginning of his investigation. But some of his original assumptions were as paradoxical, or at least as gratuitous, as these results ; and those, in particular, from which this proportion of the strength of columns «as deduced, were almost foreign to the case ; and therefore the inference was of no value. Yet it was received as a prin­ciple by Muschenbroeck and by the academicians of St Petersburg. We make these very few observations, be­cause the subject is of great practical importance ; and it is a great obstacle to improvements when deference to a great name, joined to incapacity or indolence, causes authors to adopt his careless reveries as principles from which they are afterwards to draw important consequences. It must be acknowledged that we have not as yet established, on solid mechanical principles, the relation between the dimensions and the strength of a pillar. Experience plainly contradicts the general opinion, that the strength is proportional to the area of the section ; but it is still more inconsistent with the opinion, that it is in the quadruplicate ratio of the dia­meters of similar sections. It would seem that the ratio depends much on the internal structure of the body ; and experiment seems the only method for ascertaining its ge­neral laws.