tervals, 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. The particles are certainly arranged ſymmetrically in the angles of ſome regular ſolids. It is only ſuch an ar­rangement that is conſiſtent with tranſparency, and with the free paſſage of light in *every* direction.

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 refilled, 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 this 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 farther 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 be no­ticed afterwards. Muſchenbroek, Euler, and ſome others, have ſupposed the ſtrength of columns to be as the biqua­drates of their diameters. But 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 for 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 was deduced, were almoſt foreign to the case ; and therefore the inference was of no value. Yet it was recei­ved as a principle by Muſchenbroek and by the academicians of St Peterſburgh. 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 the re­lation between the dimenſions and the ſtrength of a pillar on ſolid mechanical principles. 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.

If we ſuppoſe the body to be of a fibrous texture, having the fibres situated in the direction of the preſſure, and ſlightly adhering to each other by ſome kind of cement, ſuch a body will fail only by the bending of the fibres, by which they will break the cement and be detached from each other. Some­thing like this may be ſuppoſed in wooden pillars. In ſuch. caſes, too, it would appear that the reſiſtance muſt be as the number of equally reſiſting fibres, and as their mutual ſupport, jointly ; and, therefore, as ſome function of the area of the ſection. The ſame thing muſt happen if the fibres are naturally crooked or undulated, as is obſerved in many woods, &c. provided we suppoſe ſome similarity in their form. Similarity of ſome kind muſt always be ſuppoſed, otherwiſe we need never aim at any general inferences.

In all caſes therefore we can hardly refuſe admitting that the ſtrength in opposition to compreſſion is proportional to a function of the area of the ſection.

As the whole length of a cylinder or priſm is equally preſſed, it does not appear that the ſtrength of a pillar is at all affected by its length. If indeed it be ſuppoſed to bend under the preſſure, the caſe is greatly changed, becauſe it is then expoſed to a tranſverſe ſtrain ; and this increaſes with the length of the pillar. But this will be conſidered with due attention under the next claſs of ſtrains.

Few experiments have been made on this ſpecies of ſtrength and ſtrain. Mr Petit ſays, that his experiments, and thoſe of Mr Parent, ſhow that the force neceſſary for cruſhing a body is nearly equal to that which will tear it aſunder. He ſays that it requires ſomething more than 60 pounds on every ſquare line to cruſh a piece of ſound oak. But the rule is by no means general : Glaſs, for inſtance, will carry a hundred times as much as oak in this way, that is, reſting on if; but will not *ſuſpend,* above four or five times as much. Oak will ſulpend a great deal more than fir ; but fir will carry twice as much as a pillar. Woods of a ſoft texture, although confiding of very tenacious fibres, are more easily cruſhed by their load. This ſoftneſs of texture is chiefly owing to their fibres not being ſtraight but undulated, and there being conſiderable vacuities between them, ſo that they are easily bent laterally and cruſhed. When a poll is overſtrained by its load, it is obſerved to ſwell. ſensibly in diameter. Increasing the load cauſes lon­gitudinal cracks or ſhivers to appear, and it preſently after gives way. This is called *crippling.*

In all caſes where the fibres lie oblique to the ſtrain the ſtrength is greatly diminiſhed, because the parts can then be