ved ; and a little reflection will ſhow it to be impoſſible, in conſistency with the equality of action and reaction.

Since all parts are thus equally ſtretched, it follows, that the ſtrain in any tranſverſe lection is the ſame, as alſo in every point of that ſection. If therefore the body be suppoſed of a homogeneous texture, the coheſion of the parts is equable ; and ſince every part is equally ſtretched, the particles are drawn to equal diſtances from their quieſcent poſitions, and the forces which are thus excited, and now exerted in opposition to the ſtraining force, are equal. This external force may be increaſed by degrees, which will gra­dually ſeparate the part of the body more and more from each other, and the connecting forces increaſe with this increaſe of diſtance, till at laſt the coheſion of ſome particles is overcome. This must be immediately followed by a rupture, becauſe the remaining forces are now weaker than before.

It is the united force of coheſion, immediately before the diſunion of the firſt particles, that we call the strength of the ſection. It may alſo be properly called its absolute strength, being exerted in the ſimpleſt form, and not mo­dified by any relation to other circumſtances.

If the external force has not produced any permanent change on the body, and it therefore recovers its former dimenſions when the force is withdrawn, it is plain that this ſtrain may be repeated as often as we pleaſe, and the body which withſtands it once will always withſtand it. It is evident that this ſhould be attended to in all conſtructions, and that in all our inveſtigations on this ſubject this ſhould be kept ſtrictly in view. When we treat a piece of ſoft clay in this manner, and with this precaution, the force em­ployed muſt be very ſmall. If we exceed this, we produce **a** permanent change. The rod of clay is not indeed torn aſunder ; but it has become ſomewhat more ſlender : the number of particles in a croſs ſection is now smaller ; and therefore, although it will again, in this new form, ſuffer, or allow an endleſs repetition of a *certain* ſtrain without any far­ther permanent change, this ſtrain is ſmaller than the former.

Something of the ſame kind happens in all bodies which receive a sett by the ſtrain to which they are expoſed. All ductile bodies are of this kind. But there are many bodies which are not ductile. Such bodies break completely when­ever they are ſtretched beyond the limit of their perfect elaſticity. Bodies of a fibrous ſtructure exhibit very great varieties in their coheſion. In ſome the fibres have no la­teral coheſion, as in the caſe of a rope. The only way in which all the fibres can be made to unite their ſtrength is, to twiſt them together. This cauſes them to bind each other ſo faſt, that any one of them will break before it can be drawn out of the bundle. In other fibrous bodies, ſuch as timber, the fibres are held together by ſome cement or glu­ten. This is ſeldom as ſtrong as the fibre. Accordingly timber is much eaſier pulled aſunder in a direction tranſverſe to the fibres. There is, however, every poſſible variety in this particular.

In ſtretching and breaking fibrous bodies, the viſible extenſion is frequently very conſiderable. This is not solely the increaſing of the diſtance of the particles of the cohe­ring fibre : the greateſt part chiefly ariſes from drawing the crooked fibre ſtraight. In this, too, there is great diverſity ; and it is accompanied with important differences in their power of withſtanding a ſtrain. In ſome woods, ſuch as fir, the fibres on which the ſtrength most depends are very ſtraight. Such woods are commonly very elaſtic, do not take a sett, and break abruptly when overſtrained : others, ſuch as oak and birch, have their reſiſting fibres very undu­lating and crooked, and ſtretch very senſibly by a ſtrain. They are very liable to take a ſet, and they do not break ſo ſuddenly, but give warning by *complaining,* as the carpenters call it ; that is, by giving viſible ſigns of a derangement of texture. Hard bodies of an uniform glaſſy ſtructure, or granulated like ſtones, are elaſtic through the whole extent of their coheſion, and take no ſett, but break at once when overloaded.

Notwithſtanding the immenſe variety which nature exhi­bits in the ſtructure and coheſion of bodies, there are cer­tain general facts of which we may now avail ourselves with advantage. In particular,

The abſolute coheſion is proportional to the area of the ſection. This muſt be the caſe where the texture is perfectly uniform, as we have reaſon to think it is in glaſs and the ductile metals. The coheſion of each particle being alike, the whole coheſion muſt be proportional to their number, that is, to the area of the ſection. The ſame muſt be admitted with reſpect to bodies of a granula­ted texture, where the granulation is regular and uniform. The ſame muſt be admitted of fibrous bodies, if we ſuppoſe their fibres equally ſtrong, equally dense, and similarly diſpoſed through the whole ſection ; and this we muſt either ſuppoſe, or muſt ſtate the diverſity, and meaſure the cohesion accordingly.

We may therefore aſſert, as a general propoſition on this ſubject, that the abſolute ſtrength in any part of a body by which it reſiſts being pulled aſunder, or the force which muſt be employed to tear it aſunder *in that part,* is propor­tional to the area of the ſection perpendicular to the ex­tending force.

Therefore all cylindrical or priſmatical rods are equally ſtrong in every part, and will break alike in any part ; and bodies which have unequal ſections will always break in the ſlendereſt part. The length of the cylinder or priſm has no effect on the ſtrength ; and the vulgar notion, that it is eaſier to break a very long rope than a ſhort one, is a very great miſtake. Alſo the abſolute ſtrengths of bodies which have ſimilar ſections are proportional to the ſquares of their diameters or homologous ſides of the ſection.

The weight of the body itſelf may be employed to ſtrain it and to break it. It is evident, that a rope may be ſo long as to break by its own weight. When the rope is hanging perpendicularly, although it is equally ſtrong in every part, it will break towards the upper end, becauſe the ſtrain on any part is the weight of all that is below it. Its relative strength in any part, or power of withſtanding the ſtrain which is actually laid on it, is inverſely as the quantity below that part.

When the rope is ſtretched horizontally, as in towing **a** ſhip, the ſtrain ariſing from its weight often bears a very ſenſible proportion to its whole ſtrength.

Let AEB (fig. 3.) be any portion of ſuch a rope, and AC, BC be tangents to the curve into which its gravity bends it. Complete the parallelogram ACBD It is well known that the curve is a catenaria, and that DC is per­pendicular to the horizon ; and that DC is to AC as the weight of the rope AEB to the ſtrain at A.

In order that a suſpended heavy body may be equally able in every part to carry its own weight, the ſection in that part muſt be proportional to the ſolid contents of all that is below it. Suppoſe it a conoidal ſpindle, formed by the revolution of the curve A *a e* (fig. 4.) round the axis CE. We muſt have AC2 : ac2 = AEB ſol. : a E *b* ſol. This condition requires the logarithmic curve for A *a e,* of which C *c* is the axis.

Theſe are the chief general rules which can be ſafely de­duced from our cleareſt notions of the coheſion of bodies. In order to make any practical uſe of them, it is proper to have ſome meaſures of the coheſion of ſuch bodies as arc