proper place. Now since we nad fd1/2d = pl, we have p = (fd1/2d)/l for the meaſure of the ſtrength of the ſection DA, in relation to the power applied at B.

If the ſolid is a rectangular beam, whoſe breadth is *b,* it is plain that all the vertical ſections are equal, and that AG or 1/2d is the same in all. Therefore the equation expreſſmg the equilibrium between the momentum of the external force and the accumulated momenta of coheſion will be *pl = fdb* × 1/2*d.*

The product *db* evidently expreſſes the area of the ſec­tion of fracture, which we may call s, and we may expreſs the equilibrium thus, *pl = fs1/2d,* and ***2****l : d = fs : p.*

Now f*s* is a proper expreſſion of the abſolute coheſion of the ſection of fracture, and p is a proper meaſure of its ſtrength in relation to a power applied at B. We may therefore ſay, that *twice the length of a rectangular beam is to the depth as the abſolute coheſion to the relative strength.*

Since the action of equable coheſion is ſimilar to the ac­tion of equal gravity, it follows, that whatever is the figure of the ſection, the relative ſtrength will be the ſame as if the abſolute coheſion of all the fibres were acting at the centre of gravity of the ſection. Let *g* be the diſtance between the centre of gravity of the ſection and the axis of fracture, we ſhall have *pl = fsg,* and l : *g = fs : p.* It will be very uſeful to recollect this analogy in words : “ *The length of a prſmatic beam of any ſhape is to the height of the centre of gravity above the lower ſide, as the abſolute coheſion to the strength relative to this length.”*

Becauſe the relative ſtrength of a rectangular beam is (fdb1/2d)/l or fdb2/2l, it follows that the relative ſtrengths of different beams are proportional to the abſolute coheſion of the particles, to the breadth, and to the ſquare of the depth directly, and to the length inverſely ; alſo in priſms whole ſections are ſimilar, the ſtrengths are as the cubes of the dia­meters.

Such are the more general reſults of the mechaniſm of this tranſverſe ſtrain, in the hypotheſis that all the particles are exerting equal forces in the inſtant of fracture. We are indebted for this doctrine to the celebrated Galileo ; and it was one of the firſt ſpecimens of the application of mathe­matics to the ſcience of nature.

We have not included in the preceding inveſtigation that action of the external force by which the ſolid is drawn ſidewiſe, or tends to slide along the ſurface of fracture. We have ſupposed a particle E to be pulled only in the direction E e?, perpendicular to the ſection of fracture, by the action of the crooked lever BAE. But it is alſo pulled in the di­rection EA; and its reaction is in fame direction ε E, com­pounded of ε*f* by which it reſiſts being pulled outwards ; and εe, by which it reſiſts being pulled downwards. We are but imperfectly acquainted with the force εe, and only know that their accumulated ſum is equal to the force p.· but in all important caaes which occur in practice, it is unneceſſary to attend to this force ; becauſe it is ſo small in companion of the forces in the direction E *e,* as we eaſily conclude from the uſual ſmallneſs of AD in compariſon of AB.

The hypotheſis of equal coheſion, exerted by all the par­ticles in the inſtant of fracture, is not conformable to nature: for we know, that when a force is applied tranſverſely at B, the beam is bent downwards, becoming convex on the up­per side ; that side is therefore on the ſtretch. The par­ticles at D are farther removed ſrom each other than thoſe at E, and are therefore *actually exerting* greater cohesive for­ces, We cannot ſay with certainty and preciſion in what proportion each fibre is extended. It ſeems most probable that the extenſions are proportional to the diſtances from A. We ſhall ſuppoſe this to be really the case. Now recollect the general law which we formerly ſaid was *obſerved* in all moderate extenſions, viz. that the attractive forces exerted by the dilated particles were proportional to their dilata­tions. Suppoſe now that the beam is so much bent that the particles at D are exerting their utmoſt force, and that this fibre is juſt ready to break or actually breaks. It is plain that a total fracture must immediately enſue ; becauſe the force which was ſuperior to the full coheſion of the par­ticle at D, and a certain portion of the coheſion of all the reſt, will be more than superior to the full coheſion of the particle next within D, and a ſmaller portion of the cohe­ſion of the remainder.

Now let F repreſent, as before, the full force of the ex­terior fibre D, which is exerted by it in the inſtant of its breaking, and then the force exerted at the ſame inſtant by the fibre E will be had by this analogy AD : AE, or d : x = f : fx/d*,* and the force really exerted by the fibre E is f × x/d.

The force exerted by a fibre whoſe thickneſs is *x* is therefore fxx/d, but this force reſiſts the ſtrain by acting

by means of the lever EA or *x.* Its energy or momentum is therefore fx2x/d, and the accumulated momenta of all the fibres in the line AE will be f × sum of x2x/d.

This, when *x* is taken equal to *d,* will expreſs the momen­tum of the whole fibres in the line AD. This, therefore, is f(1/3d3/d), or f×1/3d2, or fd × 1/3d. Now f*d* expreſſes the ab­ſolute coheſion of the whole line AD. The accumulated momentum is therefore the ſame as if the abſolute coheſion of the whole line were exerted at 1/3d of AD from A.

From these premiſes it follows that the equation expreſsing the equilibrium of the ſtrain and coheſion is *pl = fd* × 1/3*d ;* and hence we deduce the analogy, “ As *thrice the length is to the depth, ſo is the abſolute coheſion to the relative strength."*

This equation and this proportion will equally apply to rectangular beams whoſe breadth *is b ;* for we ſhall then have pl = fbd × 1/3d.

We alſo ſee that the relative ſtrength is proportional to the abſolute coheſion of the partcles, to the breadth, and to the ſquare of the depth directly, and to the length in­verſely : for p is the meaſure of the force with which it isreſiſted, and *p = (fbd1/3d)/l, = fbd2/3l.* In this reſpect there­fore this hypotheſis agrees with the Galilean; but it aſſigns to every beam a ſmaller proportion of the absolute coheſions of the ſection of fracture, in the proportion of 3 to 2. In the Galilean hypotheſis this ſection has a momentum equal to 1/2 of its abſolute ſtrength, but in the other hypotheſis it is only 1/3d. In beams of a different form the proportion may be different.

As this is a moſt important propoſition, and the founda­tion of many practical maxims, we are anxious to have it clearly comprehended, and its evidence perceived by all. Our better informed readers will therefore indulge us while we endeavour to preſent it in another point of view, where it will be better ſeen by thoſe who are not familiarly acquainted with the fluxionary calculus,