many things on the strength of bodies as quite familiar to his thoughts, which are immediate deductions from this prin­ciple ; and among these *all* the facts which John Bernoulli so vauntingly adduces in support of Leibnitz’s finical dog­mas about the force of bodies in motion ; a doctrine which Hooke might have claimed as his own, had he not perceived its frivolous inanity.

But even with this first correction of Mariotte, the me­chanism of transverse strain is not fully nor justly explain­ed. The force acting in the direction BW (fig 3), and bending the body ABCD, not only stretches the fibres on the side opposite to the axis of fracture, but compresses the side CD, which becomes concave by the strain. Indeed it cannot do the one without doing the other ; for, in order to stretch the fibres at D, there must be some fulcrum, some support, on which the virtual lever BAD may press, that it may tear asunder the stretched fibres. This fulcrum must sustain both tile pressure arising from the cohesion of the distended fibres, and also the action of the external force, which immediately tends to cause the prominent part of the beam to slide along the section EF.

This is fully verified by experiment. If we attempt to break a long slip of cork, or any such very compressible body, we always observe it to bulge out on the concave side before it cracks on the other side. If it is a body of fibrous or foliated texture, it seldom fails splintering off on the con­cave side ; and in many cases this splintering is very deep, even reaching half way through the piece. In hard and granulated bodies, such as a piece of freestone, chalk, dry clay, sugar, and the like, we generally see a considerable splinter or shiver fly off from the hollow side. If the frac­ture be slowly made by a force at B gradually augmented, the formation of the splinter is very distinctly seen. It forms a triangular piece, which generally breaks in the middle.

Let us see what consequences result from this state of the case respecting the strength of bodies. Let D∆KC (fig. 6) represent a vertical section of a prism of compres­sible materials, such as a piece of timber. Suppose it load­ed with a weight P hung at its extremity. Suppose it of such a constitution that all the fibres in AD are in a state of dilatation, while those in A∆ are in a state of compres­sion. In the instant of fracture the particles at D and E are withheld by forces DJ, Ee, and the particles at ∆ and E repel, resist, or support, with forces ∆3, Fι.

Some line, such as *de*A*εδ*, will limit all these ordinates, which represent the forces actually exerted in the instant of fracture. If the forces be as the extensions and compres­sions, as we have great reason to believe, *deA* and Aεδ will be two straight lines.. They will form *one* straight line *dAδ,* if the forces which resist a certain dilatation are equal to the forces which resist an equal compression. But this is

quite accidental, and is not strictly true in any body. In most bodies which have any considerable firmness, the com­pressions made by any external force are not so great as the dilatations which the same force would produce ; that is, the repulsions which are excited by any supposed degree of compression are greater than the attractions excited by the same degree of dilatation. Hence it will generally fol­low, that the angle dAD is less than the angle δA∆, and the ordinates Dd, Ee, &c. are less than the corresponding ordinates ∆δ, Eε, &c.

But whatever be the nature of the line *dAi,* we are cer­tain of this, that the whole area AD*d* is equal to the whole area A*∆δ* ; for as the force at B is gradually increased, and the parts between A and D are more extended, and greater cohesive forces are excited, there is always such a degree of repulsive forces excited in the particles between A and Δ that the one set precisely balances the other. The force at B, acting perpendicularly to AB, has no tendency to push the whole piece closer on the part next the wall, or to pull it away. The sum of the attractive and repulsive forces actually excited must therefore be equal. These sums are represented by the two triangular areas, which are there­fore equal.

The greater we suppose the repulsive forces correspond­ing to any degree of compression, in comparison with the attractive forces corresponding to the same degree of ex­tension, the smaller will A∆ be in comparison of AD. In a piece of cork or sponge, A∆ may chance to be equal to AD, or even to exceed it ; but in a piece of marble, A∆ will perhaps be very small in comparison of AD.

Now it is evident that the repulsive forces excited between A and Δ have no share in preventing the fracture. They rather contribute to it, by furnishing a fulcrum to the lever by whose energy the cohesion of the particles in AD is overcome. Hence we see an important consequence of the compressibility of the body. Its power of resisting this transverse strain is diminished by it, and so much the more diminished as the stuff is more compressible.

This is fully verified by some very curious experiments made by Duhamel. He took sixteen bars of willow two feet long and half an inch square, and supporting them by props under the ends, he broke them by weights hung on the middle. He broke four of them by weights of 40, 41, 47, and 52 pounds : the mean is 45. He then cut four of them one third through on the upper side, and filled up the cut with a thin piece of harder wood stuck in pretty tight These were broken by 48, 54, 50, and 52 pounds ; the mean of which is 51. He cut other four half through, and they were broken by 47, 49, 50, 46 ; the mean of which is 48. The remaining four were cut two thirds, and their mean strength was 42.

Another set of his experiments is still more remarkable.

Six battens of willow thirty-six inches long and one and a half square were broken by 525 pounds at a medium.

Six bars were cut one third through, and the cut filled with a wedge of hard wood stuck in with a little force: these broke with 551.

Six bars were cut half through, and the cut was filled in the same manner : they broke with 542.

Six bars were cut three fourths through : these broke with 530.

A batten cut three fourths through, and loaded till near­ly broken, was unloaded, and the wedge taken out of the cut. A thicker wedge was put in tight, so as to make the batten straight again by filling up the space left by the com­pression of the wood : this batten broke with 577 pounds.

From this it is plain that more than two thirds of the thickness (perhaps nearly three fourths) contributed nothing to the strength.

The point A is the centre of fracture in this case ; and in order to estimate the strength of the piece, we may sup-