loaded point is pulled down, and the ſpace through which it is drawn may be called the deflection. This may be conſidered as the ſubtenſe of the angle of contact, or as the verſed sine of the arch into which the beam is bent, and is therefore as the curvature when the length of the arches is given (the flexure being moderate), and as the ſquare of the length of the arch when the curvature is given. The de­flection therefore is as the curvature and as the ſquare of

*3lιυ* the length of the arch jointly ; that is, as 3lw/fbd3 *× l2,* or as 3l3w/fbd3. The deflection from the primitive ſhape is there­fore as the bending weight and the cube of the length di­rectly, and as the breadth and cube of the depth inverſely.

In beams juſt ready to break, the curvature is as the depth inverſely, and the deflection is as the ſquare of the length divided by the depth ; for the ultimate curvature at the breaking part is the ſame whatever is the length ; and in this caſe the deflection is as the ſquare of the length.

We have been the more particular in our conſideration of this ſubject, becauſe the reſulting theorems afford us the fineſt methods of examining the laws of corpuſcular action, that is, for diſcovering the variation of the force of cohesion by a change of distance. It is true it is not the atomical law, or Hylarchic Principle as it may justly be called, which is thus made acceſſible, but the ſpecific law of the particles of the ſubſtance or kind of matter under examina­tion. But even this is a very great point ; and coinciden­ces in this reſpect among the different kinds of matter are of great moment. We may thus learn the nature of the corpuſcular action of different ſubſtances, and perhaps ap­proach to a diſcovery of the *mechaniſm* of chemical affini­ties. For that chemical actions are inſenſible caſes of local motion is undeniable, and local motion is the province of mechanical diſcuſſion ; nay, we see that theſe hidden changes are produced by mechanical forces in many impor­tant caſes, for we see them promoted or prevented by means purely mechanical. The converſion of bodies into elastic vapour by heat can at all times be prevented by a *ſufficient* external preſſure. A ſtrong ſolution of Glauber’s ſalt will congeal in an inſtant by agitation, giving out its latent beat ; and it will remain fluid for ever, and return its latent heat in a cloſe veſſel which it completely fills. Even wa­ter will by ſuch treatment freeze in an inſtant by agitation, or remain fluid for ever by confinement. We know that heat is produced or extricated by friction, that certain compounds of gold or ſilver with ſaline matters explode with irreſiſtible violence by the ſmalleſt preſſure or agita­tion. Such facts ſhould rouſe the mathematical philosopher, and excite him to follow out the conjectures of the illuſtrious Newton, encouraged by the ingenious attempts of Boſcovich ; and the proper beginning of this ſtudy is to attend to the laws of attraction and repulſion exerted by the particles of cohering bodies, diſcoverable by experiments made on their actual extensions and compreſſions. The ex­periments of ſimple extenſions and compreſſions are quite inſufficient, becauſe the total ſtretching of a wire is ſo small a quantity, that the miſtake of the 1000th part of an inch occasions an irregularity which deranges any progreſſion ſo as to make it uſeleſs. But by the bending of bodies, a diſtenſion of 1/100th of an inch may be easily magnified in the deflection of the ſpring ten thouſand times. We know that the inveſtigation is intricate and difficult, but not beyond the reach of our preſent mathematical attainments ; and it will give very fine opportunities of employing all the addreſs of analyſis. In the laſt century and the beginning of the preſent this was a sufficient excitement to the firſt geniuſes of Europe. The cycloid, the tenana, the elaſtic curve, the velaria, the cauſtics, were reckoned an abundant recompenſe for much ſtudy ; and James Bernoulli requeſted, as an honourable monument, that the logarithmic ſpiral might be inſcribed on his tombſtone. The reward for the ſtudy to which we now preſume to incite the mathemati­cians is the almoſt unlimited extenſion of natural ſcience, important in every particular branch. To go no further than our preſent ſubject, a great deal of important practi­cal knowledge reſpecting the ſtrength of bodies is derived from the single obſervation, that in the moderate extenſions which happen before the parts are overſtrained the forces are neatly in the proportion of the extenſions or ſeparations of the particles. To return to our ſubject.

James Bernoulli in his ſecound dissertation on the elaſtic curve, calls in queſtion this law, and accommodates his in­veſtigation to any hypothesis concerning the relation of the forces and extenſions. He relates ſome experiments of lute ſtrings where the relation was considerably different. Strings of three feet long,

Stretched by **2,** 4, 6, 8, 10 pds.

Were lengthened 9, 17, 23, 27, 30 lines.

But this is a moſt exceptionable form of the experiment. The ſtrings were twiſted, and the mechaniſm of the extenſions is here exceedingly complicated, combined with compreſſions and with tranſverſe twiſts, &c. We made experiments on fine slips of the gum caoutchouc, and on the juice of the berries of the white bryony, of which a single grain will draw to a thread of two feet long, and again return into a perfectly round ſphere. We meaſured the diameter of the thread by a microſcope with a micrometer, and thus could tell in every ſtate of extenſion the proportional number of particles in the ſections. We found, that though the whole range in which the diſtance of the particles was changed in the proportion of 13 to I, the extenſions did not *ſenſibly* deviate from the pro­portion of the forces. The ſame thing was obſerved in the caoutchouc as long as it perfectly recovered its firſt dimensions. And it is on the authority of theſe experiments that we preſume to announce this as a law of nature.

Dr Robert Hooke was undoubtedly the firſt who attend­ed to this ſubject, and affirmed this as a law of nature. Mariotte indeed was the firſt who expreſsly uſed it for de­termining the ſtrength of beams : this he did about the 1679, correcting the ſimple theory of Galileo. Leibnitz indeed, in his diſſertation in the *Aeta Eruditorum* 1684 *de Resistentia Solidorum,* introduces this conſideration, and wiſhes to be conſidered as the diſcoverer ; and he is always acknowledged as ſuch by the Bernoullis and others who adhe­red to his peculiar doctrines. But Marriottè had publiſhed the doctrine in the moſt expreſs terms long before ; and Bulfinger, in the *Comment. Petropol.* 1729, completely vindicates his claim. But Hooke was unqueſtionably the diſcoverer of this law. It made the foundation of his theory of springs, announ­ced to the Royal Society about the year 1661, and read in 1666. On this occasion he mentions 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 Marriotte, the me­chaniſm of tranſverſe ſtrain is not fully nor juſtly explain­ed. The force acting in the direction BP (fig. 4. n⁰ 1.), and bending the body ABCD, not only ſtretches the fibres on the wide oppoſite to the axis of fracture, but compreſſes the side AB, which becomes concave by the ſtrain. Indeed it cannot do the one without doing the other: For in order.