to D ; and therefore the number of particles which are ex­erting coheſive forces is ſmaller, and therefore the ſtrength is diminiſhed. Therefore, when we endeavour to proportion the ſtrength of a beam to the ſtrain ariſing from an external force acting obliquely, we make too liberal allowance by increaſing this external force in the ratio of AB to AB. We ac­knowledge our inability to aſſign the proper correction. But this circumſtance is of very great influence. In many ma­chines, and many framings of carpentry, this oblique action of the ſtraining force is unavoidable ; and the moſt enor­mous ſtrains to which materials are expoſed are generally of this kind. In the frames ſet up for carrying the ring- stones of arches, it is hardly poſſible to avoid them : for although the judicious engineer diſpoſes his beams ſo as to ſuſtain only preſſures in the direction of their lengths, tend­ing either to cruſh them or to tear them aſunder, it frequent­ly happens that, by the settling of the work, the pieces come to check and bear on each other tranſverſely, tending to break each other acroſs. This we have remarked upon in the article Roofs, with reſpect to a truſs by Mr Price (ſee Roofs, n⁰ 40, 41, 45). Now when a croſs ſtrain is thus combined with an enormous preſſure in the direction of the length of the bream, it is in the utmoſt danger of ſnapping ſuddenly acroſs. This is one great cauſe of the carrying away of masts. They are compreſſed in the di­rection of their length by the united force of the ſhrouds, and in this ſtate the tranſverſe action of the wind ſoon com­pletes the fracture.

When conſidering the compreſſing ſtrains to which ma­terials are expoſed, we deferred the diſcuſſion of the ſtrain on columns, obſerving that it was not, in the cases which uſually occur, a simple compreſſion, but was combined with a tranſverſe ſtrain, ariſing from the bending of the column. When the column ACB (fig. 20.) reſting on the ground at B, and loaded at top with a weight A, acting in the vertical direction AB, is bent into a curve ACB, ſo that the tangent at C is perpendicular to the horizon, its condition ſomewhat reſembles that of a beam firmly fixed between B and C, and strongly pulled by the end A, ſo as to bend it between C and A. Although we cannot conceive how a force acting on a straight column AB in the direction AB can bend it, we may ſuppoſe that the force acted firſt in the horizontal di­rection A*b,* till it was bent to this degree, and that the rope was then gradually removed from the direction A*b* to the direction AB, increaſing the force as much as is neceſſary for preſerving the ſame quantity of flexure.

The firſt author (we belieye) who conſidered this import­ant ſubject with ſcrupulous attention was the celebrated Euler, who publiſhed in the Berlin Memoirs for 1757 his Theory of the Strength of Columns. The general propoſition establiſhed by this theory is, that the ſtrength of priſmatical co­lumns is in the direct quadruplicate ratio of their diameters and the inverſe duplicate ratio of their lengths. He proſecuted this ſubject in the Peterſburgh Commentaries for 1778, confirming his former theory. We do not find that any other author has beſtowed much attention on it, all ſeeming to acquieſce in the determinations of Euler, and to conſider the ſubject as of very great difficulty, requiring the application of the moſt refined mathematics. Muſchenbroek has compared the theory with experiment ; but the compariſon has been very unſatisfactory, the difference from the theory being ſo enormous as to afford no argument for its juſtneſs. But the experiments do not contradict it, for they are so anomalous as to afford no conclusion or general rule whatever.

To ſay the truth, the theory can be conſidered in no other light than as a ſpecimen of ingenious and very artful algebraic analyſis. Euler was unqueſtionably the firſt analyſt

in Europe for reſource and addreſs. He knew this, and enjoyed his ſuperiority, and without ſcruple admitted any phyſical assumptions which gave him an opportunity of diſplaying his skill. The inconsiſtency of his aſſumptions with the known laws of mechaniſm gave him no concern ; and when his algebraic proceſſes led him to any concluſion which would make his readers ſtare, being contrary to all our uſual notions, he frankly owned the paradox, but went on in his analyſis, saying, “*Sed analysi magis fidendum. "* Mr Robins has given ſome very risible inſtances of this confidence in his analyſis, or rather of his confidence in the indolent ſubmiſſion of his readers. Nay, ſo fond was he of this kind of amuſement, that after having publiſhed an untenable Theory of Light and Colours, he publiſhed ſeveral Memoirs, ex­plaining the aberration of the heavenly bodies, and deducing ſome very wonderful conſequences, fully confirmed by expe­rience, from the Newtonian principles, which were oppoſite and totally inconſiſtent with his own theory, merely becauſe the Newtonian theory gave him “ *occasionem analyſeos promovendae."* We are thus ſevere in our obſervations, becauſe his theory of the ſtrength of columns is one of the ſtrongeſt inſtances of this wanton kind of proceeding, and becauſe his followers in the Academy of St Peterſburgh, ſuch as Mr Fuſs, Lexill, and others, adopt his conclusions, and merely echo his words. Since the death of Dan. Bernoulli no member of that academy has controverted any thing advan­ced by their *Professor ſublimis geometriae,* to whom they had been indebted for their places and for all their knowledge, having been (moſt of them) his amanuenſes, employed by this wonderful man during his blindneſs to make his com­putations and carry on his algebraic inveſtigations. We are not a little ſurpriſed to ſee Mr Emerſon, a conſiderable ma­thematician, and a man of very independent ſpirit, haſtily adopting the ſame theory, of which we doubt not but our readers will eaſily ſee the falſity.

Euler conſiders the column ACB as in a condition preciſely ſimilar to that of an elaſtic rod bent into the curve by a cord AB connecting its extremities.—In this he is not miſtaken.—But he then draws CD perpendicular to AB, and conſiders the ſtrain on the ſection C as equal to the momentum or mechanical energy of the weight A acting in the direction DB upon the lever xcD, moveable round the fulcrum c, and tending to tear aſunder the particle which cohere along the ſection cCx. This is the ſame principle (as Euler admits) employed by James Bernoulli in his inveſtigation of the elaſtic curve ACB. Euler conſiders the ſtrain on the ſection *c*x as the ſame with what it would ſuſtain if the ſame power acted in the horizontal direction EF on a point E as far removed from C as the point D is. We reaſoned in the ſame manner (as has been obſerved) in the article Roofs, where the obliquity of action was inconſiderable. But in the preſent caſe, this ſubſtitution leads to the greateſt miſtakes, and has rendered the whole of this theory falſe and uſeleſs. It would be juſt if the column were of materials which are incompressible. But it is evident, by what has been ſaid above, that by the compreſſion of the parts the real fulcrum of the lever ſhifts away from the point c, ſo much the more as the compreſſion is greater. In the great compreſſions of loaded columns, and the almoſt unmeaſurable compreſſions of the truſs beams in the centres of bridges, and other cases of chief im­portance, the fulcrum is ſhifted far over towards x, ſo that very few fibres reſiſt the fracture by their coheſion ; and theſe few have a very feeble energy or momentum, on ac­count of the ſhort arm of the lever by which they act. This is a moſt important conſideration in carpentry, yet makes no element of Euler’s theory. The conſequence of this is, that a very ſmall degree of curvature is ſufficient to cauſe the co-