STRENGTH of materials, in mechanics, is a ſubject of ſo much importance, that in a nation ſo emi­nent as this for invention and ingenuity in all ſpecies of manufactures, and in particular ſo diſtinguiſhed for its improvements in machinery of every kind, it is ſomewhat singular that no writer has treated it in the detail which its importance and difficulty demands. The man of ſcience who viſits our great manufactures is delighted with the ingenuity which he obſerves in every part, the in­numerable inventions which come even from individual artiſans, and the determined purpoſe of improvement and re­finement which he ſees in every workſhop. Every cotton mill appears an academy of mechanical ſcience ; and mecha­nical invention is ſpreading from theſe fountains over the whole kingdom : But the philoſopher is mortified to see this ardent ſpirit ſo cramped by ignorance of principle, and many of theſe original and brilliant thoughts obſcured and clogged with needleſs and even hurtful additions, and a com­plication of machinery which checks improvement even by its appearance of ingenuity. There is nothing in which this want of ſcientific education, this ignorance of principle, is ſo frequently obſerved as in the injudicious proportion of the parts of machines and other mechanical ſtructures ; pro­portions and forms of parts in which the ſtrength and poſition are nowiſe regulated by the ſtrains to which they are expoſed, and where repeated failures have been the only lessons.

It cannot be otherwiſe. We have no means of inſtruction, except two very ſhort and abſtracted treatiſes of the late Mr Emerſon on the ſtrength of materials. We do not recollect a performance in our language from which our artiſts can get information. Treatiſes written expreſsly on different branches of mechanical arts are totally silent on this, which is the basis and *only principle* of their perform­ances. Who would imagine that Price’s British Car­penter, the work of the firſt reputation in this country, and of which the sole aim is to teach the carpenter to erect solid and durable ſtructures, does not contain one propor­tion or one reaſon by which one form of a thing can be ſhown to be ſtronger or weaker than another ? We doubt very much if one carpenter in an hundred can give a reaſon to convince his own mind that a joiſt is ſtronger when laid on its edge than when laid on its broad side. We ſpeak in this ſtrong manner in hopes of exciting ſome man of ſcience to publiſh a ſyſtem of inſtruction on this ſubject. The li­mits of our Work will not admit of a detail : but we think it neceſſary to point out the leading principles, and to give the traces of that ſyſtematic connection by which all the knowledge already poſſeſſed of this ſubject may be brought together and properly arranged. This we ſhall now attempt in as brief a manner as we are able.

The ſtrength of materials ariſes immediately of ultimate­ly from the cohesion of the parts of bodies. Our examination of this property of tangible matter has as yet been very partial and imperfect, and by no means enables us to apply mathematical calculations with preciſion and success. The various modifications of cohesion, in its different appear­ances of perfect ſoftneſs, plaſticity, ductility, elaſticity, hardneſs, have a mighty influence on the ſtrength of bodies, but are hardly ſuſceptible of meaſurement. Their texture also, whether uniform like glaſs and ductile metals, cryſtallized or granulated like other metals and freeſtone, or fibrous like timber, is a circumſtance no leſs important ; yet even here, although we derive ſome advantage from remarking to which of theſe forms of aggregation a ſubſtance belongs, the aid is but ſmall. All we can do in this want of general principles is to make experiments on every claſs of bodies. Accord­ingly philoſophers have endeavoured to inſtruct the public in this particular. The Royal Society of London at its very firſt inſtitution made many experiments at their meet­ings, as may be ſeen in the firſt registers of the Society @@\*. Several individuals have added their experiments. The most numerous collection in detail is by Muſchenbroek, profeſſor of natural philoſophy at Leyden. Part of it was publiſhed by himſelf in his Es*ſais de Physique,* in 2 vols 4t0 ; but the full collection is to be found in his Syſtem of Natural Philoſo­phy, publiſhed after his death by Lulofs, in 3 vols 4to. This was tranſlated from the Low Dutch into French by Sigaud de la Fond, and publiſhed at Paris in 1760, and is a prodigious collection of physical knowledge of all kinds, and may almoſt ſuffice for a library of natural philoſophy. But this collection of experiments on the coheſion of bodies is not of that value which one expects. We preſume that they were carefully made and faithfully narrated ; but they were made on ſuch ſmall ſpecimens that the unavoidable natural inequa­lities of growth or texture produced irregularities in the reſults which bore too great a proportion to the whole quan­tities obſerved. We may make the same remark on the experiments of Couplet, Pitot, De la Hire, Du Hamel, and others of the French academy. In ſhort, if we except the experiments of Buffon on the ſtrength of timber, made at the public expence on a large ſcale, there is nothing to be met with from which we can obtain abſolute meaſures which may be employed with confidence ; and there is nothing in the Engliſh language except a ſimple list by Emerſen, which is merely a ſet of affirmations, without any narration of circumſtances, to enable us to judge of the validity oſ his conclusions : but the character of Mr Emerſon, as a man of knowledge and of integrity, gives even to theſe aſſertions **a** conſiderable value.

But to make uſe of any experiments, there muſt be employed ſome general principle by which we can generalize their reſults. They will otherwiſe be only narrations of detached facts. We muſt have ſome notion of that intermedium, by the intervention of which an external force applied to one part of a lever, joiſt, or pillar, occaſions a ſtrain on a diſtant part. This can be nothing but the coheſion between the

@@@\* See Birche's History, and Hooke's Mathematical Collections.