parts. It is this connecting force which is brought into action, or, as we more ſhortly expreſs it, excited. This ac­tion is modified in every part by the laws of mechanics. It is this action which is what we call the st*rength* of that part, and its effect is the ſtrain on the adjoining parts ; and thus it is the same force, differently viewed, that conſtitutes both the ſtrain and the ſtrength. When we conſider it in the light of a resiſtance to fracture, we call it st*rength.*

We call every thing a *force* which we obſerve to be ever accompanied by a change of motion ; or, more ſtrictly ſpeaking, we infer the preſence and agency of a force where­ver we obſerve the ſtate of things in reſpect of motion dif­ferent from what we know to be the reſult of the action of all the forces which we know to act on the body. Thus when we obſerve a rope prevent a body from falling, we in­fer a moving force inherent in the rope with as much confi­dence as when we obſerve it drag the body along the ground. The *immediate* action of this force is undoubtedly exerted between the immediately adjoining parts of the rope. The immediate effect is the keeping the particles of the rope to­gether. They ought to ſeparate by any external force drawing the ends of the rope contrarywiſe ; and we aſcribe their not doing ſo to a mechanical force really oppoſing this external force. When desired to give it a name, we name it from what we conceive to be its effect, and therefore its characteriſtic, and we call it cohesion. This is merely a name for the fact ; but it is the same thing in all our deno­minations. We know nothing of the cauſes but in the ef­fects ; and our name for the cauſe is in fact the name of the effect, which is cohesion. We mean nothing elſe by gra­vitation or magnetiſm. What do we mean when we say that Newton underſtood thoroughly the nature of gravita­tion, of the force of gravitation ; or that Franklin underſtood the nature of the electric force? Nothing but this: Newton conſidered with patient ſagacity the general facts of gravi­tation, and has deſcribed and claſſed them with the utmoſt preciſion. In like manner, we ſhall understand the nature of coheſion when we have diſcovered with equal generality the laws of coheſion, or general facts which are obſerved in the appearances, and when we have deſcribed and claſſed them with equal accuracy.

Let us therefore attend to the more ſimple and obvious phenomena of coheſion, and mark with care every circumstance of reſemblance by which they may be claſſed. Let us receive these as the laws of coheſion, characteriſtic of its ſuppoſed cauſe, the force of coheſion. We cannot pretend to enter on this vaſt reſearch. The modifications are in­numerable ; and it would require the penetration of more than Newton to detect the circumſtance of similarity amidſt millions of diſcriminating circumſtances.Yet this is the on­ly way of diſcovering which are the primary facts charac­teriſtic of the force, and which are the modifications. The ſtudy is immenſe, but is by no means desperate; and we en­tertain great hopes that it will ere long be ſucceſsfully proſecuted : but, in our particular predicament, we must con­tent ourſelves with ſelecting ſuch general laws as seem to give us the moſt immediate information of the circumſtances that muſt be attended to by the mechanician in his construc­tions, that he may unite ſtrength with simplicity, economy, and energy.

1st,Then, it is a matter of fact that all bodies are in a cer­tain degree perfectly elaſtic ; that is, when their form or bulk is changed by certain moderate compreſſions or diſtractions, it requires the continuance of the changing force to continue the body in this new ſtate ; and when the force is removed, the body recovers its original form. We limit the aſſertion to *certain moderate* changes : For inſtance, take a lead wire of 1/15th of an inch in diameter and ten feet long ; fix one end firmly to the ceiling, and let the wire hang perpendicular; affix to the lower end an index like the hand of a watch ; on ſome ſtand immediately below let there be a circle divided into degrees, with its centre correſponding to the lower point of the wire ; now turn this index twice round, and thus twiſt the wire. When the index is let go, it will turn backwards again, by the wire’s untwiſting itſelf, and make almoſt four revolutions before it ſtops ; after which it twiſts and untwiſts many times, the index go­ing backwards and forwards round the circle, diminiſhing however its arch of twiſt each time, till at last it settles preciſely in its original poſition. This may be repeated for ever. Now, in this motion, every part of tire wire partakes equal­ly of the twiſt. The particles are ſtretched, require force to keep them in their ſtate of extenſion, and recover com­pletely their original relative poſitions. Theſe are all the characters of what the mechanician calls *perfect* elaſticity. This is a quality quite familiar in many cases ; as in glaſs, tempered ſteel, &c. but was thought incompetent to lead, which is generally conſidered as having little or no elaſticity. But we make the aſſertion in the moſt general terms, with the limitation to moderate derangement of form. We have made the same experiment on a thread of pipe-clay, made by forcing ſoft clay through the ſmall hole of a ſyringe by means of a ſcrew ; and we found it more elaſtic than the lead wire : for a thread of 1/20th of an inch diameter and 7 feet long allowed the index to make two turns, and yet com­pletely recovered its firſt poſition.

*2dly,* But if we turn the index of the lead wire four times round, and let it go again, it untwiſts again in the same manner, but it makes little more than four turns back again ; and after many oſcillations it finally ſtops in a position almoſt two revolutions removed from its original position. It has now acquired a new arrangement of parts, and this new arrangement is permanent like the former ; and, what is of particular moment, it is perfectly elaſtic. This change is familiarly known by the denomination of a set. The wire is laid to have taken a set. When we attend minutely to the procedure of nature in this phenomenon, we find that the particles have as it were ſlid on each other, ſtill cohering, and have taken a new poſition, in which their connecting forces are in equilibrio ; and in this change of relative ſituation, it appears that the connecting forces which maintained the particles in their firſt ſituations were not in equilibrio in ſome poſition intermediate between that of the firſt and that of the laſt form. The force required for changing this firſt form augmented with the change, but only to a certain degree ; and during this proceſs the con­necting forces always tended to the recovery of this firſt form. But after the change of mutual poſition has pasſed a certain magnitude, the union has been partly deſtroyed, and the particles have been brought into new ſituations ; ſuch, that the forces which now connect each with its neighbour tend, not to the recovery of the firſt arrange­ment, but to puſh them farther from it, into a new ſitua­tion, to which they now verge, and require force to prevent them from acquiring. The wire is now in fact again per­fectly elaſtic ; that is, the forces which now connect the particles with their new neighbours augment to a certain degree as the derangement from this new poſition augments. This is not reaſoning from any theory. It is narrating facts, on which a theory is to be founded. What we have been juſt now laying is evidently a description of that ſenſible form of tangible matter which we call *ductility.* It has every gradation of variety, from the ſoftneſs of butter to the firmneſs of gold. All theſe bodies have ſome elaſticity ; but we say they are not perfectly elaſtic, becauſe they do not completely recover their original form when it has been