condensed, and exerts an elaſticity proportioned to the condenſation. This ſerves to ſeparate the die from the metal when the ſtroke is over. The hollow part of the die has not touched the metal all the while, and we may ſay that the impreſſion was made by air. If this air eſcape by any engraving reaching through the border, they cohere inſeparably.

We have admitted that the glaſs plates are in contact when they cohere thus firmly. But we are not certain of this : for if we take theſe cohering glaſſes, and touch them with water, it quickly inſinuates itſelf between them. Yet they ſtill cohere, but can now be pretty easily ſeparated.

It is owing to this repulſion, exerted through its proper ſphere, that certain powders ſwim on the ſurface of water, and are wetted with great difficulty. Certain infects can run about on the ſurface of water. They have bruſhy feet, which occupy a considerable ſurface ; and if their ſteps are viewed with a magnifying glaſs, the ſurface of the water is ſeen depreſſed all around, reſembling the footſteps of a man walking on feather-beds. This is owing to a repul­ſion between the brush and the water. A common fly cannot walk in this manner on water. Its feet are wetted, becauſe they attract the water inſtead of repelling it. A ſteel needle, wiped very clean, will lie on the ſurface of wa­ter, making an impression as a great bar would make on a featherbed ; and its weight is leſs than that of the displaced water. A dew drop lies on the leaves of plants without touching them mathematically, as is plain from the extreme brilliancy of the reflection at the poſterior ſurface ; nay, it may be ſometimes obſerved that the drops of rain lie on the ſurface of water, and roll about on it like balls on a table. Yet all theſe ſubſtances can be wetted ; that is, wa­ter can be applied to them at ſuch diſtances that they at­tract it.

What we ſaid a little ago of water inſinuating itſelf be­tween the glaſs plates without altogether deſtroying their coheſion, ſhows that this coheſion is not the ſame that obtains between the particles of one of the plates ; that is, the two plates are not in the ſtate of one continued maſs. It is highly probable, therefore, that between theſe two ſtates there is an intermediate ſtate of repulſion, nay, perhaps many ſuch, alternated with attractive ſtates.

A piece of ice is elaſtſe, for it rebounds and it rings. Its particles, therefore, when compreſſed, resile ; and when ſtretched, contract again. The particles are therefore in the ſtate repreſented by B in figure I. acted on by repulſive forces, if brought nearer ; and by attractive forces, if drawn further aſunder. Ice expands, like all other bodies, by heat. It abſorbs a vaſt quantity of fire ; which, by combining its attractions and repulſions with thoſe of the particles of ice, changes completely the law of action, without making any ſenſible change in the diſtance of the particles, and the ice becomes water. In this new ſtate the particles are again in limits between attractive and repulſive forces ; for water has been ſhown,by the experiments of Canton and Zimmerman, to be elaſtſe or compreſſible. It again expands by heat. It again abſorbs a prodigious quantity of heat, and becomes elaſtſe vapour ; its particles repelling each other at all distances yet obſerved. The diſtance between the particles of one plate of glaſs and thoſe of another which lies on it, and is carried by it, is a diſtance of repulſion ; for the force which ſupports the upper piece is acting in oppoſition to its weight. This diſtance is leſs than that at which it would *ſuſpend* it below it with a ſilk fibre interpoſed ; for no priſmatic colours appear between them when the ſilk fibre is interpoſed. But the diſtance at which glaſs attracts water is much leſs than this, for no colours appear when glaſs is wetted with water. This diſtance is left, and not greater, than the other ; for when the glaſſes have water interpoſed between them inſtead of air, it is found, that when any par­ticular colour appears, the thickneſs of the plate of water is to that of the plate of air which would produce the ſame colour nearly as 3 to 4. Now, if a piece of glaſs be wet­ted, and exhibit no colour, and another piece of glaſs be sim­ply laid on it, no colour will appear ; but if they are ſtrongly preſſed, the colours appear in the ſame manner as if the glaſſes had air between. Alſo, when glaſs is simply wetted, and the film of water is allowed to evaporate, when it is thus reduced to a proper thinneſs, the colours ſhow themſelves in great beauty.

Theſe are a few of many thouſand facts, by which it is unqueſtionably proved that the particles of tangible matter are connected by forces acting at a diſtance, varying with the diſtance, and alternately attractive and repulſive. If we repreſent theſe forces as we have already done in fig. 1. by the ordinates C *c,* D *d,* E e, Ff*,* &c. of a curve, it is evident that this curve must croſs the axis at all thoſe di­ſtances where the forces change from attractive to repul­ſive, and the curve must have branches alternately above and below the axis.

All theſe alternations of attraction and repulſion take place at ſmall and inſenſible diſtances. At all ſenſible diſtan­ces the particles are influenced by the attraction of gravita­tion ; and therefore this part of the curve muſt be a hyperbola whoſe equation is *y — a3/x2.* What is the form of

the curve correſponding to the ſmalleſt diſtance of the par­ticles ? that is, what is the mutual action between the par­ticles juſt before their coming into abſolute contact? Ana­logy ſhould lead us to ſuppoſe it to be repulſion : for solidity is the laſt and ſimpleſt form of bodies with which we are acquainted. Fluids are more compounded, containing fire as an eſſential ingredient. We ſhould conclude that this ultimate repulſion is inſuperable, for the hardeſt bodies are the most elaſtic. We are fully entitled to ſay, that this repelling force exceeds all that we have ever yet applied to overcome it ; nay, there are good reaſons for saying that this ultimate repulſion, by which the particles are kept from mathematical contact, is really inſuperable in its own nature, and that it is impoſſible to produce mathematical contact.

We ſhall juſt mention one of theſe, which we conſider as unanſwerable. Suppoſe two atoms, or ultimate particles of matter A and B. Let A be at reſt, and B move up to it with the velocity 2 ; and let us ſuppoſe that it comes into mathematical contact, and impels it (according to the com­mon acceptation of the word). Both move with the velo­city I. This is granted by all to be the final reſult of the colliſion. Now the inſtant of time in which this commu­nication happens is no part either of the duration of the ſolitary motion of A, nor of the joint motion of A and B : It is the ſeparation or boundary between them. It is at once the end of the firſt, and the beginning of the ſecond, belonging equally to both. A was moving with the velocity 2. The diſtinguiſhing circumſtance therefore of its mechanical ſtate is, that it has a determination (however incomprehenſible) by which it would move for ever with the velocity 2, if nothing changed it. This it has during the whole of its ſolitary motion, and therefore in the laſt inſtant of this motion. In like manner, during the whole of the joint motion, and therefore in the firſt inſtant of this motion, the atom A has a determination by which it would move for ever with the velocity 1. In one and the ſame inſtant, therefore, the atom A has two incompatible deter­minations. Whatever notion we can form of this ſtate,