stretched, contract again. The particles are therefore in the state represented by B in figure 1, 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, 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 elastic or compressible. It again expands by heat. It again absorbs a prodigious quantity of heat, and becomes elastic 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 less, 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 three to four. 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 Cc, D*d*, Ee, F*f, &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=p∙ 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 1. 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 volocity 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, which we call velocity, as a distinction of condition, the same impossibi­lity of conception, or the same absurdity, occurs. Nor can it be avoided in any other way than by saying, that this change of A’s motion is brought about by insensible grada­tions ; that is, that A and B influence each other precisely as they would do if a slender spring were interposed. The reader is desired to look at what we have said in the article Physics.

The two magnets there spoken of are good representa­tives of two atoms endowed with mutual powers of repul­sion ; and the communication of motion is accomplished in both cases in precisely the same manner.

If, therefore, we shall ever be so fortunate as to discover the law of variation of that force which connects one *atom* of matter with another atom, and which is therefore charac­teristic of matter, and the ultimate source of all its sensible qualities, the curve whose ordinates represent the kind and the intensity of this atomical force will be something like that sketched in fig. 2. The first branch *a n* B will have

AK (perpendicular to the axis AH) for its assymptote. and the last branch *lino* will be to all sense a hyperbola, having AO for its assymptote; and the ordinates *l*L, *m*M, &c. will be proportional to -ry—, ~~L ;~~, &c. expressing the universal

ALz ΑΛΙ\*

gravitation of matter. It will have many branches B*b*C, D*d*E, F*f*G, &c. expressing attractions, and alternate repul­sive branches C*c*D, E*e*F, G*g*H, &c. All these will be con­tained within a distance AH, which does not exceed a very minute fraction of an inch.

The simplest particle which can be a constituent of a body having length, breadth, and thickness, must consist of four such atoms, all of which combine their influence on each atom of another such particle. It is evident that the curve which expresses the force that connects two such par­ticles must be totally different from this original curve, this hylarchic principle. Supposing the last known, our mathe­matical knowledge is quite able to discover the first ; but when we proceed to conquise a body of particles, each of