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179. There are certain known facts which would tend to the conclusion that the action of the ether in gravitation was the main physical cause concerned in the original development of the sun's heat. If we take the case of a quantity of matter converging towards a common centre at a high speed, under the feeble but long-continued propulsive action of the ether in "gravitation," then at the collision of this matter the stationary vibration of the intercepted ether would be necessarily largely intensified, due to the high speed of approach of the molecules; the latter, which are

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in synchronous vibration with the ether, thereby receiving a sudden large accession of vibrating energy (heat), and then rebounding in translatory motion.

If we single out any pair of the approaching molecules, then it may be observed, that however feeble the initial vibratory motion might be immediately previous to the collision, this vibratory motion would be at once reacted upon and raised to a high intensity, due to the rapid shortening and forcible compression of the oscillating ether column by the rapid, approach of the two molecules against which the column abuts, the intense oscillations of the column then driving the molecules backwards with an energy which is the greater, the greater the rapidity of their approach, and vibratory motion is thus converted after the normal method into translatory motion. The component molecules of the entire mass of matter would thus, after the approach, rebound from each other in the free translatory motion of the gaseous state.

180. In regard to the mode of action in the development of vibratory motion, there are certain points worthy of notice. Firstly, the increments of motion given to the oscillating ether column by the approaching molecules would tend to rarefy the column, and drive it out circumferentially; but this is resisted by the intense ether pressure, so that the oscillating mass of ether is forcibly curbed between the opposed vibrating molecules, and thereby its vibratory motion has to bear the full brunt of the collision, the intensification of the vibratory motion of the elastic column being greater, the greater the velocity of approach of the molecules; and from this latter fact it may be inferred that, how- ever great the velocity of approach might be, the molecules could never come into contact.

This point may be illustrated if we suppose an elastic sphere to be rebounding between two parallel surfaces at a slow rate: then if it be attempted to make the surfaces approach quickly by using great force, the impulses given to the sphere would be such that it would be a complete impossibility to bring the surfaces together, and the greater the force used, the greater is the resistance encountered; and however great the energy of the impulse given to the surfaces to make them approach, it would only cause the sphere to rebound with greater energy, the force used defeating itself. The same point might even be roughly illustrated by attempting to bring down the hand suddenly upon an indiarubber ball which rebounds between a horizontal surface and the hand, when the greater the energy used the greater will be the energy with which the ball repels the attempt to shorten its path. The same considerations apply to any intercepted oscillating mass of matter whatever, as to the previous case of the oscillating mass of ether between two opposed vibrating molecules in the act of rapid approach. It is important to observe that by the approach of the opposed vibrating molecules, not only are the pulsations of the intercepted ether column intensified on account of the velocity of approach itself, bat also on account of the rapid shortening of the intercepted column attendant on the approach of the molecules, the number of the successive reflections of the impulses backwards and forwards between the opposed molecules increases rapidly as the molecules approach; and since a fresh impulse is received at each successive reflection, the vibrating energy of the column therefore rises in a rapid ratio as the molecules come into proximity.

181. It would be difficult, perhaps, to form a just idea of the intensity of the vibrating energy that must be developed by the collision of matter at cosmical speeds, which are so beyond com- parison with any terrestrial

velocities. One of the finest illustrations of the effect produced by these high speeds is afforded by the passage of those masses of matter termed " meteors " through the earth s atmosphere, when the molecules of air at their successive collisions rebound with an accession of vibrating energy equal to that of flame, and the mass itself is dissipated in vapour.

182. In the case of matter coming together at a high speed under the long-continued action of gravity, the same considerations apply as to the general case of collision, i.e. translatory motion is converted into vibratory motion, and then reconverted into translatory motion.

The difference in the effect is, therefore, merely one of degree, not of kind. Thus, for example, if we suppose the case of two billiard-balls which come into collision at an ordinary speed, then translatory motion is converted into vibratory motion (heat), and then reconverted into translatory motion; the feeble vibratory motion developed being merely sufficient to cause a slight recession of the molecules without separating; but if we suppose the balls to come together at a cosmical speed (say at fifty miles a second), the vibratory motion developed would at its conversion into translatory motion cause the rebound of the integral molecules of the balls in the form of dissociated vapour at the temperature of flame.

It may be observed, that on account of the possible ? long continuance of the propulsive action in the case of gravity, the final speeds attained may be very much greater than in the case of chemical action, so that by the approach of matter under the action of gravity, the vibratory motion developed may be Buch, that at its conversion into translatory motion, the chemical elements of the entire quantity of matter may be dissociated.

183. Taking, therefore, the case of a quantity of matter which has approached a common centre at a high speed under the action of gravity, then the whole body of matter would after the collision be propelled backwards to a considerable distance by the expansive action of the translatory motion of its component molecules,

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the whole quantity of matter expanding over a large radial area in the form of a nebulous mass of incandescent vapour.

Since this expansion can only take place in direct opposition to gravity, part of the translatory motion of the gaseous molecules would be thereby expended on the ether in overcoming the action of gravity; and since this translatory motion is derived from and sustained by the vibratory motion, the conversion of vibratory motion into translatory motion at the expansion of the vaporous mass would be attended by a large expenditure of vibratory-motion (a large absorption of heat). The heat would thus be greatly moderated by the extensive expansion taking place.

These physical conditions would be specially adapted for the eventual development of a large supply of heat, in the subsequent extensive contraction of the nebulous mass under the action of gravity as the cooling down proceeds, and also by the eventual combination and subsequent gradual approach of the molecules of the dissociated.elements as the temperature decreases.

The more intense the development of heat, the more rapid is necessarily its dissipation in the surrounding ether. The above train of physical causation would, therefore, have the effect of pre- venting the extremely rapid dissipation of heat that would occur were the entire energy of the approach allowed to remain in the form of heat. But in the actual fact the intense initial heat lasts but an infinitesimal instant of time, a great part of the heat being instantly converted into translatory motion at the rebound of the molecules and the attendant extensive expansion of the vaporous mass; the development of heat being thereby moderated, and at the same time a train of physical conditions is prepared such that an eventual slow development of heat takes place, whereby a supply of heat becomes available for a long subsequent period.

184. It is a generally admitted point that the sun is losing a greater amount of energy in the form of heat than is being sup- plied/ But is the cooling down of the sun and other stellar suns of the universe into inactive masses of cold dead matter to be the* final end ? We may observe here, in connection with this subject, that the deductions to which we have been led, on necessary theoretic grounds, relative to the weakening of the molecular actions generally, or the weakening of the action of the ether upon molecules, attendant on a

reduction of the vibrating energy of the molecules (reduction of temperature), would appear to have a direct bearing on this subject; for the working of physical phenomena, consisting fundamentally in movements of approach and recession, and a recession being absolutely necessary to a second approach; this weakening of the molecular action attendant on a reduction of vibrating energy would be the physical condition required for that reversal of the physical process which is absolutely essential to its repetition, or to the continued working of physical phenomena, the reversal being the condition required

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for the continued action of the ether in recurring cyclical processes, as consistent with the perpetuity of natural phenomena or the continuance of physical change in the universe; otherwise, the final end of all change and activity in the universe in one uniform state of useless inaction would be the inevitable result of natural causation.

It may, therefore, be observed here, as having a special bearing on this subject, that the theory of " potential energy " and " action at a distance " would necessarily involve the assumption that natural causation is so constituted as eventually to bring the entire universe to a standstill or deadlock : moreover, it may be observed that this theory would also necessarily involve the assumption that, in order for the present state of things to have been brought about, a complete revulsion in the recognized work- ing of natural causation would be required.

185. We cannot avoid the conclusion that there is even direct physical evidence of this disintegration of matter effecting itself at a low temperature, if we truly interpret the meaning of the vast quantities of subdivided and scattered material which pervades space in the form of meteoric matter, as dust, &c, and which it is necessary to conclude must pervade space in every direction, since this disintegrated matter has been actually traced to the paths of comets, which class of bodies is known to pervade space in every possible direction.

That the existence of this vast quantity of disintegrated matter must have a purpose and a most important part to play in physical phenomena must be at once evident. The number of meteor systems contained even within the limited range of the solar system is considered on valid grounds to amount to millions, even the narrow track of the earth being known to pass through hundreds of these systems. What must, therefore, be the fact if we regard the vast volume of space separating the stellar suns? What could be the origin or purpose of this vast quantity of dis- integrated matter if this be not the disintegrated material of former suns on its course towards the formation of new suns, or rather nebulae? If we were to give an opinion on this question, we should be led, on theoretic grounds, to infer that the order of the great cyclical chain of phenomena was: Nebula — Sun— Meteoric matter — Nebula; and that in the present day we have physical phenomena in all these stages, the present being in this respect a type of the past, and that although continual change is going on, and there may be no actual repetition as regards distribution and quantity of matter, still the changes of the universe take place in one fundamental order of succession, in recurring cyclical processes, as consistent with the perpetuity of natural phenomena, and the continuance of physical change and activity in the universe.

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