become hot. The simple stoppage of the earth in its orbit would develope heat equal to that derived from the combustion of fourteen globes of coal, each equal to the earth in magnitude; and if after this stoppage of its motion, which would be abundantly sufficient to reduce it in great part to vapour, it should fall into the sun, as it assuredly would, the amount of heat generated by the concussion would be equal to that developed by the combustion of 5,600 worlds of solid carbon. Motion arrested is the same as mechanical force arrested, and having ascertained with precision the exact amount of heat generated by the stoppage of the motion of one pound of matter of known speed, it becomes a simple arithmetical calculation to find out the amount of heat produced by the sudden arrest of the motion of any body whose speed and mass are known. Turning from the amazing magnitude of the results which present themselves to our strained imagination, where the earth and sun form the basis of calculation, let us examine the nature of the forces called into action when atoms clash together, as during combustion:—

"It is to the clashing together of the oxygen of the air and the constituents of our gas and candles that the light and heat of our flames are due. I scatter steel filings in this flame, and you see the star-like scintillation produced by the combustion of the steel. Here the steel is first heated till the attraction between it and the oxygen becomes sufficiently strong to cause them to combine, and these rocket-like flashes are the result of the collision. It is this impact of the atoms of oxygen against the atoms of sulphur which produces the flame observed when sulphur is burned in oxygen or air; to the collision of the same atoms against phosphorus are due the intense heat and dazzling light which result from the combustion of phosphorus in oxygen gas. It is the collision of chlorine and antimony which produces light and heat observed when these bodies are mixed together; and it is the clashing of sulphur and copper which causes the incandescence of the mass when these substances are heated together in a Florence flask. In short, all cases of combustion are to be ascribed to the collision of atoms which have been urged together by their mutual attractions."*

Nature is full of anomalies which no foresight can predict, and which experiment alone can reveal. From the deportment of a vast number of bodies, we should be led to conclude that heat always produces expansion, and that cold produces contraction. But water is an exception to this rule, and a most important one; so is bismuth. If a metal be compressed heat is developed; but if a metal wire be stretched cold is developed. If a piece of India rubber be stretched heat is developed; and again, if a piece of India rubber be heated it will be shortened. Wax passing from the solid to the liquid state expands, and the melting point of some substances which contract on solidifying has been raised by pressure as much as 20° and 30° Fahr., thus establishing the fact that the melting point of many bodies is dependent upon the pressure to which they are subjected—a discovery which has an important bearing upon the thickness of the crust of the globe.

The comparatively tranquil boiling of water is dependent upon the air it contains; if pure ice, which contains no air or any foreign matter, be melted under spirit of turpentine, so as to exclude all air, it can be heated far beyond its boiling point, and when ebullition does take place, it occurs with explosive violence. It is probable that the explosion of locomotives, on quitting the shed where they have remained quiescent, just as the engineer turned on the steam, may have arisen from the water being deprived of air by long boiling, and the mechanical act of turning on the steam and thus diminishing the pressure on the water, may have caused the rupture of cohesion between the particles of water and the sudden formation of a large quantity of steam of explosive force.

When the temperature of any body, such as lead, is raised, what becomes of the heat? Here is an important question which the "New Philosophy" is competent to solve—discarding altogether the old notion of latent heat, or the destruction or loss of heat. Nothing is lost in nature, if a force disappear we may be sure to find it again in another form or doing *interior* and invisible *work*.

Suppose that heat is communicated to a lump of lead, how is that heat disposed of within the substance? It performs two different kinds of work. One portion imparts that species of motion which raises the temperature of the lead and is sensible to the thermometer. The other portion goes to force the atoms of lead into new positions so as to destroy the cohesion between the particles of lead, it melts, and we observe the effects produced. When the body cools, the forces which were overcome in the process of heating come into play, and this heat which was consumed by the forcing asunder of the atoms is now restored by the drawing together of the atoms.*

The energy of the forces engaged in this atomic motion and interior work, as measured by any ordinary mechanical standard, is enormous. A

* "Heat considered as a Mode of Motion." By John Tyndall, F.R.S., &c.

* Tyndall's Lectures, page 155.