

reasoning, and they signally failed, because man's mind is not competent to determine, *a priori*, what laws it beseems the Creator to impose on his works. The skein of nature cannot be unravelled from that end. We must be content to begin like children with facts of observation, and by comparing things together, to travel upwards to more and more general laws. But though we shall meet with much complexity and many apparent exceptions to general laws, as we are groping our way through the darkness, when the light at last comes, we shall perceive an admirable connection between all the parts of our subject, the exceptions will prove to be only apparent, and the true law will be found to be the most simple and most fit. That *fitness of things* which the old philosophers believed in does exist, but its discovery must come last in order, not first.

A law which has been established in quite recent years has in a remarkable manner served to connect remote branches of natural science, I mean the law of "the correlation of forces." This law asserts that all force is one, and that all the different forms of force are capable of being converted, the one into the other. Mechanical force, for instance, when apparently wasted in friction, or destroyed by percussion, is really converted into its proper equivalent of heat; and conversely when heat is made to do work, as in the steam-engine, a certain portion of the heat disappears, not spreading itself in the air and warming the air, but ceasing to exist as heat in any form, having in fact been converted into mechanical effect. Heat and mechanical energy then are mutually convertible.

Again, chemical attraction, which is another form of force, is transferred into heat, whenever two elements between which it exists are allowed to combine. Sometimes a portion of the force is transformed into light, as in the flame of a lamp; for light, too, is a form of force. Conversely the heat and light of the sun enable plants to grow, and in their growth to deprive the carbonic acid which is in the air of a portion of its carbon. Here, then we have heat and light overcoming the force of chemical attraction; and a portion of heat and light disappear in the process, to reappear when the vegetable is burned. Thus the heat of our fires, whether of wood or coal, is heat that has been originally derived from the sun. Chemical attraction, then, is mutually convertible with heat and light.

Electricity is another form of force, which can be developed either from chemical attraction, as in the galvanic battery, or from mechanical force by means of friction. Conversely it can undo the work of chemical attraction, as in electrolysis, can do mechanical work, as when pith balls are attracted, or can develop heat and light, as in the electric spark.

Upon the whole it appears that force never comes into being, and is never destroyed. It may be mechanical, chemical, or electrical, or it may take the form of heat or of light, and it may be sometimes latent and sometimes sensible; but though it run an endless round of changes, passing in succession through all these forms, it gains nothing and loses nothing, but remains always the same in amount.