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is no absolute residuum which is exempt from all change and remains constant amid all variation—when the relation of primordial matter to its structural, or rather formative, agencies is properly understood—the whole science of molecular statics and dynamics will press at once for thorough reorganization.

It may be proper, in this connection, before I proceed to the discussion of another topic, to say a few words about the ordinary mechanical explanation of the molecular states of matter, or states of aggregation, on the basis of the atomic theory. This explanation proceeds on the assumption that the molecular states are produced by the conflict of antagonistic central forces—molecular attraction and repulsion—the preponderance of the one or the other of which gives rise to the solid and gaseous forms, while their balance or equilibrium results in the liquid state. The utter futility of this explanation is apparent at a glance. Even waiving the considerations presented by Herbert Spencer ("First Principles," p. 60, et seq.) that, in view of the necessary variation of the attractive and repulsive forces in the inverse ratio of the squares of the distances, the constituent atoms of a body, if they are *in equilibrio* at any particular distance, must be equally *in equilibrio* at all other distances, and that their density or state, therefore, must be invariable; and, admitting that the increase or diminution of the repulsive force, *heat*, may render the preponderance of

either force, and thus the change of density or state of aggregation, possible: what becomes of the liquid state as corresponding to the exact balance of these two forces in the absence of external coercion? The exact balance of the two opposing forces is a mere mathematical limit which must be passed with the slightest preponderance of either force over the other. All bodies being subject to continual changes of temperature, the equilibrium can at best be but momentary; it must of necessity be of the most labile kind. If the mechanical explanation of the molecular states were valid, all bodies would present the phenomena exhibited by arsenic under the action of heat—they would at once pass from the solid into the gaseous form, the intervening liquid state vanishing after the manner of all limits.

The notion of the essential solidity of matter of necessity leads to—indeed, at bottom, is identical with—the assumption of its absolute hardness or unchangeability of volume, and thus involves the theory of the atomic constitution of matter in its ordinary form. This assumption is connected with another fallacious bias of the mind, which results from the inability of the mind to consider phenomena otherwise than singly, and under some one definite aspect—the tendency to assign absolute limits to every series of material phenomena. It has been a favorite tenet, not only of metaphysicians but of physicists as well, that reality is cognizable only as absolute, permanent, and invariable, or, as the metaphysicians of the sixteenth and

seventeenth centuries expressed it, *sub specie æterni et absoluti*. This proposition, like

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