

Until the time that Fowler\* wrote, I do not know that any steps were taken attempting to prove any closer relationship between the vital and physical forces than is expressed in the term vital stimuli. Since then, however, the belief in the mutual convertibility of these two sets of forces—the vital and physical—has been steadily gaining ground, and is at present held by some of the most distinguished physiologists.

Now it has never been doubted, so far as I am aware, that however unlike in almost every way they may be, the matter which enters into the composition of any organised structure is the same as that met with in the mineral kingdom, but with its elements combined together in different relative proportions; † the forces that bind them in any one whole, whether chemically or physically, are also known to be the same as those we see in the world of dead matter, namely, chemical affinity and attraction of cohesion. But what is generally supposed to separate, by a well marked line, the living from the dead, is, that in the former is perceived the operation of certain forces which do not exist in the latter; which forces, under the name of functions, are most of them exhibited in common by the members of both the animal and vegetable kingdoms, while in the vegetable kingdom, and peculiar to it, we see displayed a power of organizing mineral matter; and in the animal kingdom, and peculiar to it, two distinct forces, the nervous and muscular, with special structures provided for their evolution; while at the same time in the inorganic world, are certain dynamical agents such as light, heat, electricity, &c., which specially belong to it, and which although they have always been allowed to have very similar actions upon living beings, and to be of vital importance to them, yet are not considered as belonging to them in the same sense as they do to the mineral kingdom: Now the question which I am about to consider may be thus stated—Is this line of demarcation, which I have attempted to point out, real or only apparent? Are these forces, or rather these two groups of forces, distinct and separate the one from the other, or are the forces which we see manifested by organized beings another and modified form of the forces existing in the inorganic world, borrowed from it, and when used again returned to it; just as the matter of which living beings are composed is taken from that by which they are surrounded, and when used, again returned to the dead world from which it was taken? It is the object of this paper to shew that, abstractedly considered, no such line can be drawn; ‡ that in fact there is no difference between these two groups of

\* I refer to the notice of a paper by R. Fowler in the Report of the British Association for 1849, called "If vitality be a force having correlations with the forces, chemical affinities, motion, heat, light, electricity, magnetism, so ably shown by Prof. Grove to be modifications of one and the same force."

† "The elements of organic bodies are the same as those that constitute the inorganic world, *save that the relative proportions are different.*" Encyclopædia Britannica, eighth edition, Vol. VI, p. 501.

‡ Compare Buckle's "History of Civilization in England." He says, "What we call the divisions of nature into 'organic and inorganic' have no existence except in our own minds." Vol. II, p. 402. He is speaking of Sir John Leslie, who as early as the end of last century, seems to have had the same idea. He says, "All forces are radically of the same kind, and the division of them into living and dead is not grounded upon just principles." Leslie on heat, p. 133.