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ARTICLES.

REVIEW OF THEORIES OF ELECTRICAL ACTION.*

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The physics section of this association congratulates itself because it deals with topics of the most lively and general interest, not only from a practical point of view, but still more from a theoretical one. Even popular interest in electricity is now well nigh universal. Its applications increase with such prodigious rapidity that only experts can keep pace with them. At the same time the developments in pure electrical theory are such as to astound the intelligent layman and to inflame the imagination of the most profound philosopher.

Of the practical applications of electricity it is not necessary to speak. They bear witness of themselves. A million electric lamps nightly make more splendid the illustrious name of Faraday; a million messages daily over land and under sea serve to emphasize the value of Joseph Henry's contribution to modern civilization. Blot out these two names alone from the galaxy of stars that shine in the physical firmament, take from the world the benefits of their investigations, and the civilization of the present would become impossible. The value of the purely scientific work of such men is attested by the resulting well-being, comfort, and happiness of mankind.

But the mind can never rest satisfied with the facts and applications of a science, however interesting and useful they may be. It feels an inward impulse to link the facts into a related whole, to inquire into their causes, to frame a satisfactory theory of their correlation, and so to build on them a true science. It is, indeed, interesting to study the history of any scientific doctrine and to trace its development from the crude notions of its earliest stages to the more refined conceptions of later periods, comporting indefinitely better with the marvelous processes of nature. Such a history we have in the views which have been held regarding the nature and action of electricity. The transition from the glutinous effluvium of the sagacious Robert Boyle to the magnetic and electric waves of the present, traversing the omnipresent ether with the velocity of light, is not an easy one to make, even in a period of two hundred years. For more than twenty centuries natural philosophers had nothing better than the emission theory to account for the attraction exhibited by rubbed amber and other similar substances. Their notion was that the rubbing of the amber caused it to emit an effluvium which returned again to its source and carried light bodies back with it.

In one respect this fanciful attempt to explain electrical attraction deserves commendation, for it evinces a mental inaptitude to account for physical actions "at a distance," or without some intermediate agency. Later philosophers, satisfied perhaps too easily with mathematical explanations founded on the observed laws of attraction and repulsion, and not demanding a medium, did not feel the same intellectual necessity of filling the space between bodies acting on one another, either with emanations from those bodies or with an invisible, imponderable medium, suspected by no sense of man, but required only to meet a demand of his highest intelligence. For when the Newtonian philosophy had made some progress the doctrine of unctuous effluvia was given up, and physicists acquiesced in the unexplained principle of attraction and repulsion as properties of certain bodies communicated to them by the Divine Being, the mechanism of which they scarcely attempted to explain. "Many superficial philosophers thought they had given a very good account of electricity, cohesion and magnetism by calling them particular species of attraction peculiar to certain bodies." *

The discovery by Stephen Grey that "the electric virtue" could be conveyed along a wire for several hundred feet without sensible diminution, and the invention of the Leyden jar by Kleist, or Cuneus, had the effect of annihilating many mushroom theories constructed on the slimmest basis of facts. The latter discovery disclosed a power in electricity not previously suspected, and excited the greatest interest in both Europe and America. At this period Franklin turned his attention to the subject, and "spent more time in diversifying facts and less in refining upon theory" than some of his European contemporaries. In fact, he tells us that he was never before engaged in any study that so totally engrossed his attention and his time. His discovery that the two electricities are always excited in equal quantities, that the charge resides on the glass and not on the coatings of the Leyden jar, and his experimental identification of lightning with frictional electricity excited the liveliest interest abroad, and secured

* Address by Professor Carhart, Vice-President Sec. B. American Association for the Advancement of Science, delivered at the annual meeting, Toronto, August 28th, 1889.

* Priestley's Hist. of Elec., vol. ii., p. 18.