

previously and independently, as had been done in astronomy. The experiments gave complex results, and the analysis of these into their elementary actions was almost an indispensable step in order to disentangle their laws. We must, therefore, state the progress of this analysis.

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## CHAPTER VI.

### THEORY OF ELECTRODYNAMICAL ACTION.

**A**MPÈRE'S THEORY.—Nothing can show in a more striking manner the advanced condition of physical speculation in 1820, than the reduction of the strange and complex phenomena of electromagnetism to a simple and general theory as soon as they were published. Instead of a gradual establishment of laws of phenomena, and of theories more and more perfect, occupying ages, as in the case of astronomy, or generations, as in the instances of magnetism and electricity, a few months sufficed for the whole process of generalization; and the experiments made at Copenhagen were announced at Paris and London, almost at the same time with the skilful analysis and comprehensive inductions of Ampère.

Yet we should err if we should suppose, from the celerity with which the task was executed, that it was an easy one. There were required in the author of such a theory, not only those clear conceptions of the relations of space and force, which are the first conditions of all sound theory, and a full possession of the experiments; but also a masterly command of the mathematical arms by which alone the victory could be gained, and a sagacious selection of proper experiments which might decide the fate of the proposed hypothesis.

It is true, that the nature of the requisite hypothesis was not difficult to see in a certain vague and limited way. The conducting-wire and the magnetic needle had a tendency to arrange themselves at right angles to one another. This might be represented by supposing the wire to be made up of transverse magnetic needles, or by supposing the needle to be made up of transverse conducting-wires; for it was easy to conceive forces which should bring corresponding elements, either magnetic or voltaic, into parallel positions; and then the gene-