The electromotive force E may be that of a voltaic battery introduced between the points named, care being taken that the resistance of the conductor is the same before and after the introduction of the battery.

282 *a*.] If an electromotive force E_{pq} act along the conductor $A_p A_q$, the current produced along another conductor of the system $A_r A_s$ is easily found to be

$$K_{rs} K_{pq} E_{pq} (D_{rp} + D_{sq} - D_{rq} - D_{sp}) \div D.$$

There will be no current if

$$D_{rp} + D_{sq} - D_{rq} - D_{sp} = 0. \qquad (12)$$

But, by (11), the same equation holds if, when the electromotive force acts along $A_r A_s$, there is no current in $A_p A_q$. On account of this reciprocal relation the two conductors referred to are said to be *conjugate*.

The theory of conjugate conductors has been investigated by Kirchhoff, who has stated the conditions of a linear system in the following manner, in which the consideration of the potential is avoided.

(1) (Condition of 'continuity.') At any point of the system the sum of all the currents which flow towards that point is zero.

(2) In any complete circuit formed by the conductors the sum of the electromotive forces taken round the circuit is equal to the sum of the products of the current in each conductor multiplied by the resistance of that conductor.

We obtain this result by adding equations of the form (1) for the complete circuit, when the potentials necessarily disappear.

*282 *b*.] If the conducting wires form a simple network and if we suppose that a current circulates round each mesh, then the actual current in the wire which forms a thread of each of two neighbouring meshes will be the difference between the two currents circulating in the two meshes, the currents being reckoned positive when they circulate in a direction opposite to the motion of the hands of a watch. It is easy to establish in this case the following proposition :—Let x be the current, E the electromotive force, and R the total resistance in any mesh : let also $y, z, \ldots$ be currents circulating in neighbouring meshes

* [Extracted from notes of Professor Maxwell's lectures by Mr. J. A. Fleming, B.A., St. John's College. See also a paper by Mr. Fleming in the *Phil. Mag.*, xx. p. 221. 1885.]