single Resultant Force, acting at some assigned point as origin, and to a single resultant couple; the former of these remaining invariable, both in magnitude and direction, whatever origin be assumed while the latter varies in both respects for different origins, remaining constant, however, for origins situated along the direction of the Resultant Force.

Adopting the usual notation by taking as the type of the Forces the rectangular components X, Y, Z of the force acting at the point (x, y, z), we have as resultants at the origin of co-ordinates the single Force whose rectangular components are $\Sigma(X)$, $\Sigma(Y)$, $\Sigma(Z)$; and the single couple whose momental components round the same axes are

$$L=\Sigma(Zy-Yz),\ M=\Sigma(Xz-Zx),\ N=\Sigma(Yx-Xy).$$

If we now seek the resultants corresponding to an origin whose co-ordinates are (x', y', z'), we find the same Resultant Force, and a new resultant couple (L', M', N'), where

$$\begin{aligned} L' &= L + \Sigma(Y).z' - \Sigma(Z).y' \\ M' &= M + \Sigma(Z).x' - \Sigma(X).z' \\ N' &= N + \Sigma(X).y' - \Sigma(Y).x' \end{aligned}$$

From these equations we have

$$L'.\Sigma(X) + M'.\Sigma(Y) + N'.\Sigma(Z) = L.\Sigma(X) + M.\Sigma(Y) + N.\Sigma(Z)$$

Hence if the resultant couple be resolved into two whose axes are respectively perpendicular and parallel to the direction of the Resultant Force, the latter remains invariable in magnitude whatever origin be adopted; and hence also the resultant couple will be the least possible when the origin is so assumed that the former vanishes, or, in other words, when the axis of the couple is in the direction of the Force.

If we seek an origin which shall make the resultant couple vanish, or which shall cause the system of Forces to be reduced to a single resultant Force, we must have for the determination of this origin (x', y', z'),

$$L' = o,\quad M' = o,\quad N' = o,$$

or

$$\left.\begin{aligned} o &= L + \Sigma(Y)z' - \Sigma(Z)y' \\ o &= M + \Sigma(Z)x' - \Sigma(X)z' \\ o &= N + \Sigma(X)y' - \Sigma(Y)x' \end{aligned}\right\} \quad \ldots\ldots\ldots(1)$$

These equations are inconsistent unless a certain condition hold, which is,

$$o = L.\Sigma(X) + M.\Sigma(Y) + N.\Sigma(Z) \quad \ldots\ldots\ldots(2)$$