When this condition is satisfied, (provided $\Sigma(X)$, $\Sigma(Y)$, $\Sigma(Z)$, do not all vanish,) the equations (1) are equivalent to only two independent equations, and represent a straight line, every point of which is an origin such as required.

In the particular case where the system consists of Forces in parallel directions, taking F as the type of *one of these at the* point (x, y, z), and l, m, n for the direction-cosines of their common direction, we have

$$\Sigma(X) = l\,\Sigma(F); \quad \Sigma(Y) = m\,\Sigma(F); \quad \Sigma(Z) = n\,\Sigma(F);$$
$$\begin{aligned} L &= n\,\Sigma(Fy) - m\,\Sigma(Fz) \\ M &= l\,\Sigma(Fz) - n\,\Sigma(Fx) \\ N &= m\,\Sigma(Fx) - l\,\Sigma(Fy) \end{aligned}$$

The condition (2) is in this case satisfied, and (provided $\Sigma(F)$ do not vanish) the equations (1) assume the form

$$\frac{x' - \dfrac{\Sigma(Fx)}{\Sigma(F)}}{l} = \frac{y' - \dfrac{\Sigma(Fy)}{\Sigma(F)}}{m} = \frac{z' - \dfrac{\Sigma(Fz)}{\Sigma(F)}}{n}$$

Hence the line of action of the single Resultant passes through the point whose co-ordinates are $\dfrac{\Sigma(Fx)}{\Sigma(F)}$, $\dfrac{\Sigma(Fy)}{\Sigma(F)}$, $\dfrac{\Sigma(Fz)}{\Sigma(F)}$; these are independent of l, m, n, and this point therefore remains the same so long as the forces and their points of application are unaltered, whatever be their direction; for this reason, it is called the *Centre of Parallel Forces*.

In like manner, the motion at any instant of a free rigid body can be reduced to a single rotation about an axis passing through some assigned point as origin, and to a single motion of translation proper to this origin and common to all the points of the body; 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 axis of Rotation.

Adopting the usual notation by taking ω_x, ω_y, ω_z, for the components of the rotation round three rectangular axes, and u, v, w *for* the components of the velocity of translation along the same axes, we have for the velocities u', v', w', along these axes, of a point (x', y', z')

$$\begin{aligned} u' &= u + \omega_y z' - \omega_z y' \\ v' &= v + \omega_z x' - \omega_x z' \\ w' &= w + \omega_x y' - \omega_y x' \end{aligned}$$