clocks at A is moved in a closed curve with constant velocity until it returns to A, the journey lasting t seconds, then by the clock which has remained at rest the travelled clock on its arrival at A will be $\frac{1}{2}tv^2/c^2$ second slow. Thence we conclude that a balance-clock[7] at the equator must go more slowly, by a very small amount, than a precisely similar clock situated at one of the poles under otherwise identical conditions.

§ 5. The Composition of Velocities

In the system k moving along the axis of X of the system K with velocity v, let a point move in accordance with the equations

$$\xi = w_\xi \tau, \eta = w_\eta \tau, \zeta = 0,$$

where w_ξ and w_η denote constants.

Required: the motion of the point relatively to the system K. If with the help of the equations of transformation developed in § 3 we introduce the quantities x, y, z, t into the equations of motion of the point, we obtain

$$\begin{aligned} x &= \frac{w_\xi + v}{1 + vw_\xi/c^2} t, \\ y &= \frac{\sqrt{1 - v^2/c^2}}{1 + vw_\xi/c^2} w_\eta t, \\ z &= 0. \end{aligned}$$

Thus the law of the parallelogram of velocities is valid according to our theory only to a first approximation. We set

$$\begin{aligned} V^2 &= \left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2, \\ w^2 &= w_\xi^2 + w_\eta^2, \\ a &= \tan^{-1} w_y/w_x, \end{aligned}$$

a is then to be looked upon as the angle between the velocities v and w. After a simple calculation we obtain

$$V = \frac{\sqrt{(v^2 + w^2 + 2vw\cos a) - (vw\sin a/c^2)^2}}{1 + vw\cos a/c^2}.$$

[7]Not a pendulum-clock, which is physically a system to which the Earth belongs. This case had to be excluded.