in 1887 and repeated many times thereafter. Its essential principle was to split a beam of light and then to send the two half-beams along orthogonal arms of equal length, at whose ends mirrors reflected the beams back to the starting point where they were made to interfere. Then the entire apparatus was rotated in the plane of the arms. If this causes a differential change in the to-and-fro light travel times along the two arms, the interference pattern should change. Suppose originally one of the arms, marked L_1 in Fig. 1, lies in the direction of an ether drift of velocity v. Figure 1 should make it clear that the respective to-and-fro light travel times along the two arms would then be expected to be

$$T_1 = \frac{L_1}{c+v} + \frac{L_1}{c-v} = \frac{2L_1}{c(1-v^2/c^2)},$$

$$T_2 = \frac{2L_2}{(c^2-v^2)^{1/2}} = \frac{2L_2}{c(1-v^2/c^2)^{1/2}},$$

where L_1 and L_2 are the purportedly equal lengths of the two arms. Since $T_1 \neq T_2$, a rotation of the experiment through 90° should produce a shift in the interference fringes. None was ever observed, which seems to imply $v = 0$. Yet at some point in its orbit the earth must move through the ether with a speed of at least 18 miles per second (its orbital velocity) and this should have been easily detected by the apparatus. Of course, in Einstein's theory, this null result is expected *a priori*.

In the Lorentz theory the null result of the Michelson–Morley experiment was explained by the contraction of the arm that moves longitudinally through the ether, so that the *actual* lengths of the arms are related by $L_1 = L_2(1 - v^2/c^2)^{1/2}$, which yields the observed equality $T_1 = T_2$. (It can be shown that the contraction hypothesis ensures $T_1 = T_2$ for *all* positions of the arms.) That there is also need of a second hypothesis—time dilation—in the Lorentz theory can be appreciated by considering a simple thought experiment. Suppose we could measure the original to-and-fro time T_2 directly with a clock, and suppose we could then move the arm L_2 along with the ether so that v becomes zero. Then the to-and-fro time should be $T_3 = 2L_2/c = T_2(1 - v^2/c^2)^{1/2}$. But if nature's conspiracy to hide the ether is complete, we would instead measure $T_3 = T_2$. This could be accounted for by the hypothesis that a clock moving with speed v through the ether goes slow by a factor $(1 - v^2/c^2)^{1/2}$. For then the *measured* time