> From all these results, if they were confirmed, would arise an entirely new mechanics, which would be, above all, characterized by this fact, that *no velocity could surpass that of light,*[1] *any more than any temperature can fall below absolute zero*. [Original footnote 1: Because bodies would oppose an increasing inertia to the causes which would tend to accelerate their motion; and this inertia would become infinite when one approached the velocity of light.][39]

Poincaré continues that the inability to surpass the speed of light would be true also for an observer moving with a uniform velocity (which he would have no way to detect).

> No more for an observer, carried along himself in a translation he does not suspect [i.e., moving with a uniform velocity that he cannot detect], could any apparent velocity surpass that of light; and this would then be a contradiction, if we did not recall that this observer would not use the same clocks as a fixed observer, but, indeed, clocks marking 'local time'.

We see here the culmination of years of hard thought by a brilliant creative genius working on an extremely difficult problem. Poincaré's lecture breaks off at this point, though he returns once again, at the end of the lecture to remind the audience about

> the new mechanics…where…the velocity of light would become an impassable limit. The ordinary mechanics, more simple, would remain a first approximation, since it would be true for velocities not too great, so that the old dynamics would still be found under the new.[40]

But how has the mystery been resolved? For this we must go back to an 1898 work of Poincaré, on 'The Measure of Time'.[41] What do we mean by equal intervals of time? To compare the heights of Deepa and Nanda we can put them side by side and compare them. But how do we put two time intervals side by side? and if we can't put them side by side, how do we compare them? This can only be done by convention. Hence Poincaré's question and reply,

> When I say, from noon to one the same time passes as from two to three, what meaning has this affirmation? The least reflection shows that by itself it has none at all. It will only have that which I choose to give it, by a definition which will certainly possess a certain degree of arbitrariness.[42]

Poincaré objects to Barrow's idea (p. 136)

> Instead of saying: 'The same causes take the same time to produce the same effects', we should say: 'Causes almost identical take almost the same time to produce almost the same effects.'

We must recall in this context that the relativistic time dilation effect, or the use of Lorentz's 'local time', may lead to a difference so small, under everyday circumstances, that we have here exactly the situation where time intervals declared very slightly unequal by relativity theory are called exactly equal according to Newtonian mechanics.

Poincaré's conclusion is that

> Time should be so defined that the equations of mechanics may be as simple as possible.[43]

In other words, it does not intrinsically matter whether one uses a pendulum clock or Lorentz's 'local time'. The choice is decided by the form of the equations that result. Lorentz's 'local time' leads to a simpler form for the equations of physics, hence that is the time that must be used.

The next step is crucial. Poincaré points out that while the notion of equal intervals of time had attracted much attention earlier, the related notion of *simultaneity* had not. What is meant by the simultaneity of events that are spatially separated? There is the famous problem of determining longitude at sea (Chapter 10). The practical way to tell Paris time at sea is to carry a chronometer set for Paris. This is also the theoretical way. The notion of simultaneity depends upon the measurement of time. Which notion of simultaneity should one use? Poincaré illustrates with an example concerning the velocity of light.

> Could not the observed facts be just as well explained if we attributed to the velocity of light a little different value from that adopted, and supposed Newton's law only approximate? Only this would lead to replacing Newton's law by another more complicated. So for the velocity of light a value is adopted, such that the astronomic laws compatible with this value may be as simple as possible.[44]

Whether it is the velocity of light, or the notion of equal intervals of time, or the notion of simultaneity, the guiding rule is simplicity: