Summary of the conclusions of the three previous seminar talks

(I) The basic postulate of special relativity theory, the relativity principle, does not hold in relativistic physics in general. In classical mechanics, Galilean covariance and the principle of relativity are completely equivalent and hold for all possible dynamical processes. In contrast, in relativistic physics Lorentz covariance and the principle of relativity are not completely equivalent; Lorentz covariance in itself does not guarantee that the physical laws in question satisfy the relativity principle in general. Actually, the principle of relativity is a kind of thermodynamical principle: it only holds for the equilibrium quantities that characterize the thermodynamical equilibrium of the systems in question. In the light of this fact, there is no reason to regard Lorentz covariance as a fundamental symmetry of the laws of physics.

Besides our empiricist approach, our analysis of the relativity principle was based on what Bell calls "Lorentzian pedagogy". Namely, that the laws of physics in any one reference frame account for all physical phenomena, including the behavior of moving objects and the observations of moving observers. In other words, not only is the question of whether or not the relativity principle holds an empirical matter, not only is the validity of this "second order" law determined by the empirically confirmed "first order" laws of physics, but it is completely determined by the empirically confirmed laws of physics in a single reference frame.

(II) In comparison with the pre-relativistic theories, special relativity theory tells us nothing new about the spatiotemporal features of the physical world; except the apparent differences on the surface of the words. It turned out from the empirical definitions of the space and time tags of events that different physical quantities are called "time", and similarly, different physical quantities are called "distance" in special relativity and in classical physics. (We called them $\widetilde{\text{time}}$ and $\widetilde{\text{distance}}$ versus $\widehat{\text{time}}$ and $\widehat{\text{distance}}$.) Special relativity theory makes "novel" claims not about what were originally called "space" and "time" in pre-relativistic physics ($\widehat{\text{space}}$ and $\widehat{\text{time}}$), but about some different properties of physical reality ($\widetilde{\text{space}}$ and $\widetilde{\text{time}}$). On the other hand, the detailed calculations show that both special relativity and the pre-relativistic Lorentz theory have identical assertions about all of the four quantities $\widetilde{\text{time}}$, $\widetilde{\text{distance}}$, $\widehat{\text{time}}$, and $\widehat{\text{distance}}$.

The terminological distinction between $\widehat{\text{space}}$ and $\widehat{\text{time}}$ versus $\widetilde{\text{space}}$ and $\widetilde{\text{time}}$ was based on the following very weak "operationalist" premise: physical terms, assigned to measurable physical quantities, have different meanings if they have different empirical definitions.

(III) Special relativity and the Lorentz theory are completely identical theories. In terms of $\widehat{\text{space}}$, $\widehat{\text{time}}$, $\widetilde{\text{space}}$, and $\widetilde{\text{time}}$, our analysis

shed more light on the relationship between special relativity and pre-relativistic physics. Actually, we proved that special relativity and the Lorentz theory are completely identical in both senses, as theories about space-time and as theories about the behavior of moving physical objects. They have identical claims about whether or not relativistic deformations are real physical changes; they have identical claims about simultaneity, about the velocity of light; about the addition rules of velocities; about Galilean and Lorentz covariance; the two theories have identical predictions about the validity of the relativity principle; they have identical predictions about the result of the Michelson–Morley experiment; they both are logically independent of any hypothesis about the existence of aether.

Contrary to the conventionalist thesis, there is no actual choice between the two theories, because, in the contemporary reconstruction, there are no two different theories.

(IV) The consequent non-circular definition of spatiotemporal concepts is highly non-trivial; it leads to the concepts of absolute space and time; and raises open empirical questions. In the definitions of $\widehat{\text{space}}$, $\widehat{\text{time}}$, $\widetilde{\text{space}}$, and $\widetilde{\text{time}}$ tags we just reconstructed how "space" and "time" tags of events were understood in pre-relativistic physics and special relativity theory. However, neither the classical nor the relativistic definitions are trouble free. They are based on vicious circularities and a prioristic pre-assumptions about reference frames, inertial motions, etc. To avoid these difficulties we tried to define the space and time tags of events by means of a consequent "standard clock + light signals" method. As it turned out, the task is not trivial. (Traditionally speaking, the definition of space and time tags is a non-trivial problem even "in a single inertial frame of reference".) The analysis of the problem led to the following conclusions: 1) Although the space and time tags so obtained are relative to the trivial semantical convention by which we define the meaning of the terms in question, they are absolute in the sense that they are not relative to a reference frame but prior to any reference frame. 2) We cannot provide meaning to the concept of "proper" time, expressible in terms of our experiences. "Proper" time is what the *etalon* clock reads, by definition. 3) It is meaningless to talk about "non-inertial reference frame", "space-time coordinates (tags) defined/measured by an accelerating or rotating observer", and the likes. 4) Whether the standard clock used in the contemporary physical laboratories is appropriate at all for the definition of the space and time tags is still an open empirical question. Finally, 5) I pointed out that the usual arguments, pro and con, about the conventionality of simultaneity are pointless in a real circularity-free operational context; there is no additional conventionality attached to simultaneity over and above the original choice of the value of Reichenbach's ε in the definition of absolute time tag, as a part of the trivial semantical convention; and this freedom merely consists in the choice

of a single real number between 0 and 1; but it cannot depend on "space coordinates" and/or "direction", simply because there are no such things as "space coordinates" and "direction" prior to fixing the value of ε. On the other hand, however, one can give an empirically testable argument against the $\varepsilon \neq \frac{1}{2}$-synchronization.