Chapter 16

THE LORENTZ TRANSFORMATIONS AND POINCARÉ'S RELATIVITY

By 1904, Lorentz had fully developed his theory of the electron and his modified concept of local time, and Poincaré had repeatedly mentioned his 'principle of relativity' for all of physics (including the velocity of light at c). They then collaborated to convert Lorentz's 1895 transformation equations and contraction ratio into a radical new set of transformation equations for Lange's abstract relativistic model of Galileo's Relativity. However, there were numerous problems with these so-called 'Lorentz transformations.' In September of 1904, Poincaré described what he meant by his 'principle of relativity.' Many of these ad hoc *and artificial concepts Einstein would adopt a year later in 1905 as the mathematical and theoretical foundation for his Special Theory of Relativity.*

A. Theoretical background and difficulties with matter.

Maxwell's equations, which described the transmission velocity of EM waves through the ether (empty space), encountered certain difficulties when light experiments involving matter were taken into consideration. (D'Abro, 1950, p. 129) For example, the phenomenon of dispersion (vis. the separation of white light by a prism into a rainbow of colors) demanded that such different colors would pass through a material prism at <u>different slower velocities</u> depending upon their wave frequencies. Whereas Maxwell's equations required that such slower velocities would be the <u>same</u> for all frequencies (colors).[1] (*Id.*) A similar difficulty was encountered with the phenomenon of polarization. It appeared to many late 19th century scientists that these problems might result from the then crude assumptions with respect to the constitution of matter. (*Id.*)

In addition, since Maxwell's equations only specifically referred to matter at rest in the ether, some scientists thought it necessary to investigate the more general case of applying Maxwell's equations to matter in motion. This investigation became known as

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[1] In Chapter 6C we described why dispersion might occur at the quantum level. Maxwell's equations were obviously wrong for dispersion.

'the electrodynamics of moving bodies.'[2] (D'Abro, 1950, p. 129) Such investigation was first attempted by Hertz in the 1880's, but his assumption that matter would totally drag the ether along with it was in direct conflict with the 'partial drag' result of Fizeau's 1851 experiment and with Fresnel's mathematical equation (convection coefficient) which described Fizeau's experiment.[3] (*Id.*)

In order to attempt to explain and resolve all of these difficulties, Lorentz (in 1892) wrote a treatise which attempted to describe the atomic composition of matter.[4] According to Lorentz's very speculative theory, all matter was composed of electrons, and the ether transmitted electromagnetic radiation (energy) between the electrons.[5] "The electrical, magnetic, and thermal properties of matter were explained by the interactions of the electrons with each other and with the ether." [6] (Goldberg, pp. 93 – 94)

Lorentz's theory of the electron provided a mathematical interpretation for dispersion, an explanation for the difference between conductors and non-conductors (dielectrics), a confirming explanation for Fresnel's convection coefficient, and explanations for other mysterious phenomena.[7] (*Id.*, pp. 130 – 132) Because Lorentz's electron theory was consistent with Fresnel's coefficient and Fresnel's partial ether drag theory, and Fresnel's theory was thought to account for the null results of first order light

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[2] In 1905, Einstein generalized this concept of electricity and also applied it to the velocity of light in a vacuum as it might relate to linearly moving material bodies.
[3] In 1890, Hertz also took the simplifications and reformulations of Maxwell's equations that had been started by Helmholtz and Heavyside and reduced them to just four equations. (Miller, p. 12)
[4] In this treatise, Lorentz slightly reworked Hertz's modifications of Maxwell's equations into the equations that are used today. (Miller, pp. 24 – 25) These resulting equations are sometimes referred to as the 'Maxwell-Lorentz equations.' More about that in Chapter 36.
[5] This, of course, is completely contrary to the current model of the atom. (see Chapters 34 and 35)
[6] "The attribute of mass was explained, at least quantitatively, as electromagnetic inertia." (Goldberg, p. 93; see Chapter 17) Could this concept of EM inertia have been an inspiration for Einstein's later treatise where he concluded that: "radiation conveys inertia between [light] emitting and absorbing bodies [masses]"? (Einstein, 1905e [Dover, 1952, p. 71])
[7] "There was a fair measure of success in deriving and explaining various quantities that had previously been defined, measured and assessed in older and more limited theories." (Goldberg, p. 94)

experiments,[8] Lorentz's theory of electrons was also considered to be consistent with such null results.

However, there was one area where Lorentz's electron theory appeared to be deficient: "the theory could not predict the results of ether drift experiments while applying the Galilean transformations." (Goldberg, p. 94) "In other words, the theory was not successful in predicting the behavior of [bodies and light in one inertial reference frame]…when they were observed from other inertial reference frames." (*Id.*) When the value *c* in one inertial reference frame was transformed by Galilean transformation equations to a differently moving inertial reference frame it became a different value, $c - v$ or $c + v$, depending upon the relative direction of the frames. This perceived problem was then interpreted as follows.

> "When a Galilean transformation is applied to [Maxwell's equations] the primed equations turn out to contain the quantity v in the first-order combination v/c and in the smaller second-order combination v^2/c^2. Because of the presence of *v* in the primed equations, an observer in a laboratory fixed in a moving primed frame of reference ought to be able to find the value of *v* by making electromagnetic (which includes optical) measurements; that is, he ought to be able to detect the ether wind arising from his motion through the ether. But, as we know, first-order experiments that attempted to detect this ether wind had failed to do so." (Hoffmann, 1983, pp. 85 – 86)

Lorentz believed that perhaps the Galilean transformation equations were at fault.

In response to Lorentz's belief, one might ask, what relevance does any transformation equation for material bodies have with respect to Maxwell's equations for the <u>constant velocity</u> of non-material light at *c*, or for predicting the results of electromagnetic experiments? The answer, of course, is <u>none</u>. (see Chapter 23) Most

[8] According to Fresnel's ether drag hypothesis, the more the ether (with light embedded in it) was dragged along by the moving Earth, the less would be the difference in velocity of the Earth relative to the velocity of the ether (with light embedded in it), and the more difficult such lesser difference in velocity would be to detect.

likely, Lorentz automatically performed this meaningless transformation exercise with respect to transmitting light (radiation), because mathematicians had for years transformed anything that moves.[9] The mathematical result ($c \pm$ v) was mystifying to Lorentz.[10]

In 1895, Lorentz published another monograph that mathematically changed the Galilean transformations for time (t = t' and t' = t), as follows:

$$t = t' - vx/c^2 \qquad\qquad t' = t + vx/c^2$$

where the symbol t represented the 'true time' in stationary ether,[11] and t' represented the fictional 'local time' of a body (Earth) moving with respect to the ether.[12] The strange factor vx/c^2 represented the product of two ratios: the ratio v/c (the absolute speed v of the material reference frame relative to the velocity of light at c), and the ratio x/c (the time required for light to propagate from the origin of each coordinate system to a material point). [13] (Goldberg, p. 94) Regardless of interpretations, Lorentz's 1895 concept of 'local time' "was just t_{true} minus vx/c^2."[14] (Galison, p. 205)

Because we now know that there is no stationary ether, it follows that there can be

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[9] Lorentz was also at fault for misapplying the Galilean transformation equations of mechanics to non-material electromagnetic waves.
[10] In effect, Lorentz was mystified by his own fallacious mathematics.
[11] This was, of course, Newton's 'absolute time' or universal simultaneous time for all observers in the Cosmos. (see Chapter 2)
[12] "Because this new quantity t' depended on the location [of the moving body x], he called it local time." (Hoffmann, 1983, p. 86; Galison, p. 205) "Lorentz's idea was that there was one true physical time, t_{true}. True time was the appropriate time to use for objects at rest in the ether. For any object moving in the ether, it proved useful for Lorentz to introduce this fictional time (a mathematical artifice) in terms of which the laws of electricity and magnetism for that object would artificially resemble the laws for an object sitting still in the ether." (Galison, p. 205)
[13] By modifying the Galilean transformation equations in this manner, Lorentz was impliedly modifying Newton's theory of measurement for absolute time. For this reason, Lorentz referred to his modification of time (local time) as merely "an aid to calculation." (Goldberg, pp. 94 – 96) In effect, Lorentz created a metaphysical dichotomy of measurements. (*Id.*, p. 96)
[14] "Why did Lorentz choose this local time? Only because it gave a sharp, if purely formal, result: local time allowed a real object moving in the ether to be redescribed as a fictional object at rest in the ether." (Galison, p. 205)

no 'true time' of ether, and thus there can be no 'local time' measured from it.[15] Both of these absolute concepts of time and their magnitudes were completely meaningless. For similar reasons, the contrived factor vx/c^2 was also *ad hoc*, absolute, arbitrary, and completely meaningless. Lorentz did not derive his 'local time' equations from empirical observations or first principles. Rather his only "justification was that the equations worked." (Goldberg, p. 96) For all of these reasons, Lorentz's 1895 concept of 'local time' and his transformation equations that described 'true time' and 'local time' were totally *ad hoc* and without any meaning.[16] (*Id*.)

When these changed Galilean transformation equations were applied to Maxwell's electromagnetic wave equations, the mathematical result was: the <u>first order</u> factor, v/c, disappeared.[17] (Hoffmann, 1983, p. 86) Evidently, Lorentz interpreted this disappearance of v/c to mean that the Galilean transformation equations were to blame for the mysterious first order null results (and, of course, in a literal sense he was partially right). Lorentz's rationale, based on the ether theory, was that there was no absolute velocity of the Earth that could be detected by electromagnetic wave experiments to the first order, v/c (one part in 10,000). In other words:

> "a first-order electromagnetic experiment could not distinguish between stationary and uniformly moving laboratories. Lorentz thus deduced that first-order electromagnetic experiments to detect whether a laboratory was moving relative

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[15] In effect, Lorentz's 'local time' was Newton's universal simultaneous time for the occurrence of all events in the Cosmos at any instant, minus the absolute velocity of the moving body relative to the ether and the time required for light to propagate from the origin of the ether frame to the moving body divided by the velocity of light squared. This ridiculous concept of 'local time' and its impossible magnitude speak for themselves.

[16] In 1905, Einstein would adopt these *ad hoc* and meaningless transformation factors as a mathematical foundation for his Special Theory, albeit with different interpretations for the symbols.

[17] This was interpreted by Lorentz to mean "that, to the <u>first order</u>, any electromagnetic experiment in a laboratory moving uniformly through the ether when interpreted in terms of local time would give the same result as a corresponding experiment in a stationary laboratory interpreted in terms of true time." (Hoffmann, 1983, p. 86) This theoretically allowed Lorentz to predict electromagnetic results in one inertial reference frame when observed in another inertial reference frame.

to the ether would fail to detect any motion." (Hoffmann, 1983, p. 86)

At this point, Lorentz had artificially and mathematically explained away the paradoxical null results of such first order EM experiments. Even so, other theoretical problems remained. Although Lorentz's changed 1895 Galilean transformations for local time appeared to mathematically explain away the null results of first order experiments, they also mathematically predicted that second order (v^2/c^2) electromagnetic wave experiments would show a fringe shift. However, second order electromagnetic wave experiments, such as Michelson's 1881 and 1887 experiments, failed to detect a fringe shift. That is to say, such experiments failed to detect the absolute velocity of the Earth through the ether even to a much more precise approximation (v^2/c^2)…one part in 100 million. What could be the answer to this theoretical contradiction to Lorentz's mathematical prediction?

There was yet another theoretical problem. In 1892, Lorentz had theoretically explained away the first order null results of EM experiments by assuming the validity of Fresnel's coefficient and his partial ether drag hypothesis, but obviously this explanation would not work for the second order null results. The more precise second order null results would necessarily imply that the ether had been fully dragged along by the Earth. Yet one cannot have it both ways. Partial drag and full drag at the same time made no sense, even to Lorentz. (Goldberg, pp. 97 – 98) Because of these remaining theoretical problems, Lorentz concluded that some new hypotheses must be invented to explain away both the second order null results and the first order null results.

This is where Lorentz's alternate 1895 theory, the contraction of matter in the direction of motion, came into play. (Chapter 15) At some point after 1895, Lorentz was forced to abandon his Fresnel partial ether drag explanation and substitute his equally *ad hoc* contraction hypothesis in its place. Lorentz then completely reversed his position and declared that the ether must remain completely stationary in space, and must be unaffected by the Earth's motion through it.[18] (*Id*., p. 98)

As described in Chapter 15, Lorentz's 1895 contraction ratio, $1{:}\sqrt{1 - v^2/c^2}$, was specifically designed to explain away the null result of the second order M & M experiment, which failed to detect the solar orbital velocity of the Earth at 30 km/s. This explanation required a specific miniscule contraction of Michelson's longitudinal arm equal to only about one part in 100 million in order to explain away the missing time interval for the M & M experiment. After its publication in 1895, most physicists considered Lorentz's contraction explanation to be "too arbitrary, too *ad hoc*." (Goldberg, pp. 96 – 98) But this did not deter Lorentz, as we shall discover later in this chapter.

B. Poincaré's generalized principle of relativity.

By 1895, there were many optical, electromagnetic and light experiments, to the first and second order of approximation, which had failed to detect the absolute motion of the Earth through space. These included: Römer's observations of Jupiter's moon Io (Chapter 6); Bradley's 1728 aberration of starlight experiment, which only detected and measured the orbital velocity of the Earth relative to the Sun (Chapter 7); the 1851 Fizeau experiment, which only detected and measured the increase and decrease in the velocity of light through moving water depending upon relative directions (Chapter 7); the

[18] This also meant that Lorentz's theory of the electron no longer explained or justified Fresnel's convection coefficient, but so be it. With artificial *ad hoc* mathematical theories we must learn to live with inconsistencies.

Doppler effects of light, which only detected and measured the motion of the Earth relative to other co-moving luminous celestial bodies (Chapter 8); and Michelson's interference of light experiments, which failed to detect or measure the motion of the Earth with respect to anything (Chapter 9).

In 1895, French mathematician Henri Poincaré (1854 – 1912) summed up these and other paradoxical experimental results with the following statement of frustration:

> "It is impossible to measure the absolute movement of ponderable matter, or better the relative movement of ponderable matter, with respect to the ether. All that one can provide evidence for is the movement of ponderable matter with respect to ponderable matter." (see Goldberg, p. 208)

Poincaré even began to believe that nature was conspiring against the experimenters to prevent the detection of such absolute motion. (*Id*., pp. 99, 208) During the decade from 1895 to 1904, Poincaré (who ardently believed in the ether theory and Lorentz's theories) became increasingly more uncomfortable with the various patchwork explanations for the null results of both the first order (v/c) and the second order (v^2/c^2) electromagnetic experiments, which had been devised in order to detect the absolute velocity of the Earth relative to the stationary ether. (Lagunov, pp. 24 - 25; Goldberg, pp. 98 - 99) For example, in a paper published in 1900, Poincaré objected to the invention of new and special hypotheses to try to explain each new experimental null result, including the second order M & M null result.[19] (see Lorentz, 1904 [Dover, 1952, pp. 12, 13])

In spite of all of his attempts to discover the absolute motion of the Earth through the ether and to assist Lorentz with his defenses for the concept of ether, Poincaré finally

[19] The real explanations of such null results are, *inter alia*, that: 1) there is no stationary ether from which to measure anything, and 2) there is no greater distance/time interval that a light ray must propagate to and fro between relatively stationary terrestrial mirrors in any direction of the Earth's. Thus, such a non-existent greater distance/time interval could never be detected by M & M, or anyone else. (Chapters 10 and 12)

displayed serious doubts about ether's existence. In 1900, he began his opening speech to the Paris Congress with the question: "Does the aether really exist?" (Pais, p. 127) Thereafter, in his 1902 book, *Science and Hypothesis*, Poincaré raised the same question, and he followed it with the conclusion that he did not believe that absolute motion with respect to ether would ever be detected. (Poincaré, 1902, pp. 169, 171) Also in his 1902 book, Poincaré referred to a 'principle of relativity,' but he failed to define what he meant by this principle at this time. (*Id*., p. 244)

To Poincaré, there were three major lessons to be learned from the null results of all the failed first order and second order ether drift experiments: 1) all motions of matter are relative (Poincaré, 1902, pp. 112 – 113; Goldberg, p. 208); 2) there is no way to measure the absolute velocity of the Earth through the ether (actually empty space) (Goldberg, pp. 99, 208); and 3) the laws of mechanics, electromagnetism, optics, thermodynamics, and other branches of physics seemed to be invariant (the same) in all inertial frames.[20] (Goldberg, pp. 98 – 99) Sometime between 1902 and April 1904, Poincaré publicly suggested to Lorentz that the mechanics principle of Galileo's Relativity should be generalized to include all of physics.[21] (*Id*.)

By early 1904, several other very sensitive second order electromagnetic experiments had also failed to detect the absolute motion of the Earth through the ether.[22] (Lorentz, 1904 [Dover, 1952, pp. 11, 12]) Poincaré again asked the question: Would separate *ad hoc* hypotheses need to be invented to explain each of these new null results?

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[20] Such laws did not appear to change their mathematical form in any inertial frame, even thought the velocities of such frames were different. (Goldberg, p. 99) This fact will be very important when we later discuss Einstein's *ad hoc* conjectures that the laws of such physical phenomena are <u>velocity dependent</u>.
[21] Poincaré was not alone. "During the nineteenth century, there were [many other] attempts to extend the principle [of Galileo's Relativity] from mechanics to all experience." (Goldberg, p. 209)
[22] These experiments included: Rayleigh, 1902 (Phil. Mag., Vol. 4, p. 678); Tranton & Noble, 1903 (Phil. Trans. Royal Society of London, Vol. A202, p. 165); Brace, 1904 (Phil. Mag., Vol. 7, p. 317).

(Pais, p. 128) By this time, even Lorentz conceded that: "Surely this course of inventing special hypotheses for each new experimental result is somewhat artificial." (Lorentz, 1904 [Dover, 1952, p. 13]) Poincaré continued to pressure Lorentz to generalize his theory of electrons and his transformation equations to conform to Poincaré's new generalized principle of relativity. (Goldberg, pp. 98, 99)

Then, in September 1904, at the World Fair in St. Louis, Poincaré made a widely heralded address that attempted to explain all of such experimental null results. (Lagunov, p. 25; Miller, p. 74) He again referred to his 'Principle of Relativity,' and this time he described it as follows to the assembled scientists:

> "…the laws of physical phenomena should be the same whether for an observer fixed or for an observer carried along in uniform movement of translation; so that we have not and could not have any means of discerning whether or not we are carried along in such a motion." (see Goldberg, pp. 208 – 209)

In other words, Poincaré was asserting that we cannot detect nor determine from such physical phenomena whether we are "at rest or in absolute motion." (see Pais, p. 128) Poincaré's principle was obviously an attempt to extend the material and mechanics concepts of Galileo's Relativity to non-material optical and electrodynamic phenomena, and he again "cited experiment as the source of his confidence in the principle." (Goldberg, p. 209) At the end of his lecture, Poincaré also suggested: "Perhaps we must construct a new mechanics…in which the velocity of light would become an impossible limit." [23] (Pais, p. 128)

It is clear that Poincaré's generalized Principle of Relativity incorporated the Galilean transformations before April 1904, because there was no alternative. It is also clear that Poincaré's Principle of Relativity incorporated Lorentz's radical

[23] In other words, Poincaré suggested that "there should be a new mechanics in which nothing could exceed the speed of light." (Hoffmann, 1983, p. 86)

transformations after Lorentz re-invented them in April 1904.[24] Why? Because in early 1904 Poincaré finally convinced Lorentz to invent a new set of transformations that would mathematically describe Poincaré's generalized Principle of Relativity. (see Chapter 16C)

On June 5, 1905, Poincaré sent a paper to his publisher which pointed out that neither the aberration of starlight experiments nor the interference of light experiments of Michelson had detected any absolute motion of the Earth, and that Lorentz had modified his contraction of matter hypothesis so "as to bring it in accordance with the *complete* impossibility of determining absolute motion." (Pais, pp. 128, 129) Poincaré concluded such paper as follows: "It seems that this impossibility of demonstrating absolute motion is a general law of nature." (*Id*., p. 129)

The question now presented is this: Was Poincaré's generalized 'principle of relativity,' which theoretically applied <u>both</u> to the uniform rectilinear velocity of matter (see Figure 24.1A) and to the constant transmission velocity of light at *c* (see Figures 24.1B and 24.1C), really a valid generalization of Galileo's Relativity that should become a general law of nature. Or was it merely an independent, *ad hoc* and meaningless conjecture of expediency that is irrelevant both to Galileo's Relativity and the velocity of light, and should only be attributed to Poincaré's frustrations?[25]

Remember that Galileo's Relativity asserted two separate and distinct concepts. (see Chapter 5)

1) A body exhibiting uniform rectilinear motion (velocity) imparts to an observer

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[24] In the next section of this chapter we shall discuss Lorentz's radical and *ad hoc* transformation equations, which he invented in April 1904.

[25] The reason why the answers to such questions are important is because Einstein adopted a similar generalized principle of relativity (to that of Poincaré's) for his Special Theory of Relativity.

situated on such body a <u>sensory illusion</u> of being at rest. Therefore, a) such observer cannot <u>sense</u> from such uniform rectilinear motion whether he is moving with a uniform velocity or is at rest; and b) all bodies with a uniform rectilinear velocity are <u>equivalent</u> for this purpose.

2) All accelerated motions which occur on a body which is exhibiting uniform rectilinear motion will appear to work in the same way; that is to say, the variable magnitudes (F, m and a) which result in such accelerated motions vary or operate <u>covariantly</u> (one variable increases in magnitude as another proportionately decreases), and regardless of such changed magnitudes they invariantly describe Newton's second law (F = ma) on every body with a uniform velocity. Therefore, <u>empirically</u> no observer can tell from such accelerated motions whether he is moving at a uniform velocity or is at rest.

Let us attempt to answer the above question by referring to Figure 24.1. Poincaré's 'principle of relativity' is relevant to the mechanics experiments in Figure 24.1A where an observer is experiencing inertial motion and observes covariant accelerated results, but it is obviously irrelevant to the light experiments in Figures 24.1B and 24.1C where inertial motion and other material concepts are irrelevant to the results. The failure to detect the motion of the Earth through space in Figure 24.1A (either by sensation or observation) was a direct result of inertial motion. For example, if the Earth had been moving in an arbitrary or herky-jerky manner, an observer on the Earth would have sensed and observed such crazy motion; whereas, the failure to detect the inertial motion of the Earth by non-material light experiments in Figures 24.1B and 24.1C had nothing to do with inertial motion. Such light experiments would have failed to detect the motion of the Earth through space even if they were conducted on a rotating body or on an arbitrarily moving herky-jerky body. A light ray passing through the air of an inertial reference frame or any frame obviously cannot sense or observe the motion of the frame. The same is true with respect to a light experiment conducted in or on such frame. Any of the above material motions are and were irrelevant to such light experiments. For all of the above reasons, Galileo's material principle of relativity should not have been generalized to include non-material light.

Poincaré's 'principle of relativity' was also invalid upon its face because it assumed the existence of stationary ether. An observer can never be 'fixed' because there is no ether; therefore there can be no such thing as 'absolute rest.' For the same reason, there can be no such thing as absolute motion with respect to something that does not exist. If there is no absolute motion then the justification for Poincaré's 'principle of relativity,' the failed attempts to detect and measure absolute motion relative to something that does not exist, becomes meaningless…and so does Poincaré's principle itself. Gamow's and Feynman's conclusions were correct:

> "if there is not world ether filling the entire space of the universe, there cannot be any absolute motion, since one cannot move in respect to nothing…One can speak only about the relative motion of one material body in respect to another." (Gamow, 1961, p. 173)

> "You can only define what you can measure! Since it is self-evident that one cannot measure a velocity without seeing what he is measuring it relative to, therefore it is clear that there is no *meaning* to absolute velocity. The physicists should have realized that they can talk only about what they can measure." (Feynman, 1963, p. 16-2)

Nevertheless, Poincaré's generalized principle of relativity <u>without ether</u> would be partially correct, but for very different reasons. The laws of physical phenomena (in reality all general laws of nature) <u>are empirically the same</u> for any observer in the

Cosmos, at any time, in any position, and in any state of relative motion.[26] This is the Universal Principle, which we will postulate in Chapter 18. The fact that all motions are relative, or that an inertial observer cannot detect that he is moving or cannot tell which relative inertial observer is doing the moving, is irrelevant to the Universal Principle.[27]

C. Lorentz's transformation theory of April 1904.

Pursuant to continued urging by Poincaré, Lorentz finally (during the spring of 1904) resurrected the radical set of transformation equations, which he had initially devised in 1899. (Pais, p. 125) *A priori* they would: 1) mathematically justify the null results of all electromagnetic wave experiments no matter what the relative velocity of the moving frame might be; 2) they would predict the Lorentz contraction; 3) they would provide a modified local time for each inertial system which would be unique for each inertial reference frame; and at the same time 4) they would "satisfy the principle of relativity which Poincaré had been talking about." (Goldberg, p. 99) In this regard, Lorentz stated:

> "It would be more satisfactory if it were possible to show by means of certain fundamental assumptions and without neglecting terms of one order of magnitude or another, that many electromagnetic actions are entirely independent of the motion of the system…The only restriction as regards the velocity will be that it be less than that of light." (Lorentz, 1904 [Dover, 1952, p. 13])

How did Lorentz's radically changed April 1904 paper satisfy Poincaré's Principle of Relativity?

> "Lorentz modified his old assumption about length contraction and his fictional 'local time' in such a way that, when the shortened length and [the modified]

[26] As we shall discover in Part II of this treatise, Einstein falsely claimed that the laws of nature depend upon such things as relative motion, simultaneity, the Lorentz transformation, his own generalized principle of relativity, and which observer is doing the measuring.

[27] The failure of such experiments to detect the absolute velocity of the Earth through space was also irrelevant to the Universal Principle.

> local time were inserted into the equations of physics, the equations were no longer *approximately* the same in any frame of reference moving inertially through the ether, but instead *identical*"[28] (Galison, p. 218)

This was a "striking vindication of Poincaré's understanding of the relativity principle…" (*Id*.) Why? Because Lorentz's radical new transformation equations of April 1904 not only mathematically described Poincaré's principle of relativity, they also became embedded in such principle after April 1904. More importantly, when Einstein copied Poincaré's principle of relativity in 1905 for his own Special Theory, Lorentz's 1904 radical transformation equations were already embedded in Poincaré's principle of relativity

In 1907, Einstein agreed with the above conclusion that the Lorentz transformation equations are essentially just a mathematical description of Poincaré's principle of relativity. Einstein stated in his late 1907 Jahrbuch article:

> "Surprisingly, however, it turned out that a sufficiently sharpened conception of time was all that was needed to overcome the difficulty discussed. One had only to realize that an auxiliary quantity introduced by H. A. Lorentz, and named by him 'local time', could be defined as 'time' in general. If one adheres to this definition of time, the basic equations of Lorentz's, theory correspond to the principle of relativity, provided that the above [Galilean] transformation equations are replaced by ones that correspond to the new conception of time."[29] (Collected Papers, Vol. 2, p. 253)

The 'local time' that Lorentz invented in 1895 was only a variation of true time in stationary ether:

$$t = t'/\sqrt{1 - v^2/c^2} \quad \text{or}$$
$$t = t - v/c^2 x$$

[28] After Einstein copied Lorentz's April 1904 paper and its radical Lorentz transformations in 1905 for his own Special Theory, this identity of magnitudes for any inertial reference frame was called 'co-variance.' (see Einstein, *Relativity*, pp. 47 – 48)

[29] This 'replacement' of transformation equations is exactly what Lorentz did in his April 1904 paper. The new 'conception of time' that Einstein was referring to in 1907 was Lorentz's 'modified local time,' which Lorentz invented for his April 1904 paper in order that his new radical transformation equations would describe Poincaré's principle of relativity.

The 'modified local time' that was Lorentz's transformation for time in 1904 was the first time that Lorentz referred to a 'different time for each inertial system':[30]

$$t' = \frac{t - v/c^2\,x}{\sqrt{1 - v^2/c^2}}$$

It was Lorentz's 1904 'modified local time' (his 'new conception of time') that Einstein incorporated into his 1905 Special Theory and referred to in his 1907 Jahrbuch article as time "in general;" not Lorentz's 1895 local time that was only a variation of true time in ether. (see Lagunov, pp. 27 – 28) For the above reasons, it is also obvious that Einstein read and understood Lorentz's April 1904 treatise before June 1905.

On April 23, 1904, Lorentz presented his paper to the Amsterdam Academy of Sciences and it was published in the Dutch language in June 1904. (Holton [American Journal of Physics, Oct. 1960, p. 630]) The paper was entitled: "Electromagnetic Phenomena in a System Moving with any Velocity Less than Light."[31] (Lorentz, 1904 [Dover, 1952, pp. 9-34]) Lorentz adopted Lange's 1885 abstract relativistic model of Galileo's Relativity as the basic framework for his 1904 hypothesis. He then modified the Galilean transformation equations for relative position and distance traveled, $x' = x - vt$ and $x = x' + vt$, by placing his 1895 contraction factor, $\sqrt{1 - v^2/c^2}$, below each of them as the denominator. He also changed the Galilean transformation equations for time, $t' = t$, by substituting his 1895 equations for 'local time,' $t' = t - vx/c^2$, and 'true time,'

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[30] Because Lorentz's new conception of time was a 'different time for each inertial system,' it was no longer Newton's absolute simultaneous time for all observers in the Cosmos which implied that the light signal had an infinite velocity. Rather, it was a different time for every inertial reference frame, which implied a finite velocity for the light signal.

[31] Lorentz limited the velocity of the moving system to "Any Velocity Less Than Light," because according to his contraction factor, $\sqrt{1 - v^2/c^2}$, at the velocity of light the lengths of matter in the moving system would *a priori* contract to zero. In 1905, Einstein would adopt this limiting velocity of *c* as one of the basic assumptions for his Special Theory of Relativity, as exemplified by the Lorentz transformation and Einstein's formula for the 'composition of velocities' in his Special Theory. In effect, this limiting velocity of light became Einstein's equivalent of a mathematician's infinity. (Bird, 1922, p. 103)

$t = t' + vx/c^2$, as the numerator, and again by placing his 1895 contraction factor, $\sqrt{1 - v^2/c^2}$, below each as the denominator. Lorentz's radical new transformation equations for Lange's relativistic model were:

S System	S' System
$x = \dfrac{x' + vt}{\sqrt{1 - v^2/c^2}}$	$x' = \dfrac{x - vt}{\sqrt{1 - v^2/c^2}}$
$y = y'$	$y' = y$
$z = z'$	$z' = z$
$t = \dfrac{t' + vx/c^2}{\sqrt{1 - v^2/c^2}}$	$t' = \dfrac{t - vx/c^2}{\sqrt{1 - v^2/c^2}}$

(Hoffmann, pp. 86-87) By early 1905, Poincaré had corrected some mistakes made by Lorentz and put Lorentz's radical new transformation equations in their final form. Later in 1905, Poincaré referred to them as the "Lorentz transformations," in honor of Lorentz.[32] (Pais, p. 129; Hoffmann, p. 87)

How did Lorentz arrive at his new relativistic transformation equations? What were they based on? They are obviously comprised of three components: the Galilean transformations for position and distance as two numerators; Lorentz's 1895 transformations for 'true time' and 'local time' as two numerators; and Lorentz's 1895 contraction factor as a common denominator. However,

> "As was the case with his 1895 monographs, he did not rationalize or justify these transformations. He did not derive them. He seems to have worked backwards in order to determine what transformations would be necessary to satisfy the principle of relativity which Poincaré had been talking about, and, at the same time, predict such phenomena as the Lorentz-Fitzgerald contraction."[33]

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[32] Poincaré also created new sets of Lorentz transformations for different points of coordinate origin and for rotated directions of orientation, which are now known as the Poincaré-group of transformations. (Rohrlich, p. 87) For a discussion of the Poincaré-group, see Folsing, p. 164.

[33] In other words, the 1904 Lorentz transformation predicted the 1895 Lorentz contraction. Basically, by circular reasoning, it predicted itself!

(Goldberg, p. 99)

"Lorentz did not derive those equations from first principles, they *were* first principles. He postulated their use." (*Id*., p. 455)

For these reasons alone, the Lorentz's transformations were completely artificial, *ad hoc*, and meaningless for use by anyone, including Einstein.

Lorentz's 1904 theory was of matter and how matter interacted with ether.[34] Its only real premise was "the inability to detect the motions of objects in the ether, which implies the [validity of] the Lorentz transformations." (Goldberg, pp. 104, 118; Folsing, p. 164) Even though Lorentz claimed that his April 1904 paper would be based on "fundamental assumptions" rather than on "special hypothesis," in fact it was based upon at least eleven *ad hoc* hypotheses. (Holton [American Journal of Physics, Oct. 1960, p. 630]) According to Holton, these included:

"restriction to small ratios of velocities *v* to light velocity *c*; postulation *a priori* of the transformation equations (rather than their derivation from other postulates); assumption of a stationary ether; assumption that the stationary electron is round; that its charge is uniformly distributed; that all mass is electromagnetic; that the moving electron changes one of its dimensions precisely in the ratio of $(1 - v^2/c^2)$½ to 1; that forces between uncharged particles and between a charged and uncharged particle have the same transformation properties as electrostatic forces in the electrostatic system; that all charges in atoms are in a certain number of separate 'electrons'; that each of these is acted on only by others in the same atom; and that atoms in motion as a whole deform as electrons themselves do." (*Id*.)

Lorentz also assumed the validity of Newton's theory of measurement, including the existence of absolute space and absolute time; the validity of his own contraction of matter theory; the validity of Michelson's *ad hoc* theories, including the lateral inertia of

[34] "The question of what the velocity of light would be did not arise in the Lorentz analysis." (Goldberg, p. 101) Likewise, a radical amended 'velocity addition law,' which Einstein derived from the Lorentz transformations in 1905 and called the 'composition of velocities,' would have had little significance for Lorentz. (*Id*.; see Chapter 29)

light; and the validity of 'true time' and 'local time.'[35]

D. The problems with Lorentz's April 1904 theory and transformations.

Even a non-mathematician can see at first glance that if the value of v in the denominators of Lorentz's transformation equations is anything greater than zero, then the value of the denominator will decrease below 1, and as a consequence the value of all numerators will increase (become larger) in all equations. With this in mind, let us attempt to determine what Lorentz's 1904 transformation equations theoretically mean on their face without any interpretations or derivations, and what their algebraic symbols are apparently trying to tell us.

First, let us explore Lorentz's reciprocal transformation equations for space, relative position and relative distance traveled:

$$x = \frac{x' + vt}{\sqrt{1 - v^2/c^2}} \qquad x' = \frac{x - vt}{\sqrt{1 - v^2/c^2}}$$

Without Lorentz's contraction factor as the denominator, they reduce to the Galilean transformation equations for the relative position of x and x', and for the distance traveled (vt) between them.[36] Therefore, in the second equation for x', the position of the moving inertial body x' is the position of the stationary inertial body x less the relative distance traveled (vt) by x' from x. Therefore, vt is the relative distance which separates both bodies, x and x'. The first equation for x is just the reciprocal of the second.

In his 1895 contraction of matter theory, Lorentz applied his contraction ratio of 1 to $\sqrt{1 - v^2/c^2}$ directly to a material body x moving at v relative to the ether. The

[35] By adopting the Lorentz transformations in 1905, Einstein also implicitly adopted many of such false and *ad hoc* special hypotheses.

[36] We already know where the Galilean boost equations for distance traveled, $x = x' + vt$ and $x' = x - vt$, came from (Chapter 14), and where Lorentz's contraction factor, $\sqrt{1 - v^2/c^2}$, came from. (Chapter 15)

theoretical result was that the body (the longitudinal arm of Michelson's experiment) contracted in the direction of its motion "in the proportion of 1 to $\sqrt{1 - v^2/c^2}$." (Lorentz, 1904 [Dover, 1952, p. 7]) On its face, this meant that the longitudinal light ray had a slightly shorter distance to travel, which theoretically and mathematically explained the missing time interval in Michelson's experiment.

On the other hand, Lorentz's 1904 transformation equations for space are not just simple ratios for the contraction of material bodies. In his 1904 transformation equations, the position of body x' and its distance traveled (the relative distance between x and x') are being divided by the factor $\sqrt{1 - v^2/c^2}$, presumably in order to determine the modified or contracted relative positions of x' and x. However, assuming that v = 30 km/s, when x – vt is divided by $\sqrt{1 - v^2/c^2}$ such relative distance or space traveled will mathematically become somewhat larger. This type of explanation is normally reserved for the reciprocal expansion of time equation; "a somewhat larger time." (see Einstein, *Relativity*, p. 42) But, mathematically and without further interpretation, it is equally applicable to space; a somewhat larger space.

Thus, on their face, these space equations mathematically require that the distance or space traveled (vt) between the two bodies, x and x', will increase suddenly and physically without any apparent cause…as will the time interval for light to propagate at *c* over this increased distance. How does such relative distance-traveled suddenly and physically become somewhat larger? How does the void of space suddenly and physically become somewhat larger? (see Figure 16.1) What is the physical process by which this mathematical magic is performed? Lorentz neglected to tell us…probably for good reason. Without substantial arbitrary interpretations and manipulations, the Lorentz transformation equations for space (on their face) say nothing about the contraction of matter.[37]

How could such increased distance (space) and time interval for light to propagate explain the M & M null result? According to Fitzgerald's, Lorentz's, and Einstein's explanation, Michelson's apparatus undetectably contracted in the direction of motion, which produced a shorter time interval for light to propagate from mirror to mirror. (see Figure 15.2) The M & M paradox was theoretically explained by Lorentz's 1895 contraction of matter ratio, which produced a theoretically shorter time interval. But a larger space and time interval for light to propagate between two more distantly separated bodies because of Lorentz's 1904 transformation equation is heading in the wrong theoretical direction.

What happens if both bodies, x and x', are approaching each other? Because of the Lorentz transformation equations, the space between them will *a priori* instantly expand even more than in the prior example, because both bodies are moving in opposite directions of approach and at an even greater relative velocity of v.

More importantly: How can these mathematical expansions of space result in a physical contraction of any bodies (such as Michelson's longitudinal arm)? It becomes obvious, at least to the author, that Lorentz's transformation equations for distance and relative position, on their face, made no sense and achieved no theoretical goal.

How was Lorentz able to turn an expansion of space or distance into a contraction of matter? In order to advance his theoretical agenda, Lorentz arbitrarily manipulated and interpreted these transformations so that material objects are theoretically contracted

[37] The same was true when Einstein applied these Lorentz transformation equations in 1905. The difference being that Einstein arbitrarily interpreted and manipulated such equations to arrive at mathematical results that satisfied his agenda. (see Chapter 28)

in the direction of their motion by a factor equal to the square root of 1 minus the square of the ratio of the speed v of the object with respect to the ether as compared to the velocity of light at *c*. (see Goldberg, p. 98) In algebraic symbols, he in effect arbitrarily interpreted L_0 to be the 'absolute length' or 'rest length' of an object (i.e. the longitudinal arm of Michelson's apparatus) when it is at rest in the stationary ether. He also arbitrarily interpreted L to be the length of the same object when it is moving in the direction of its length through the stationary ether. When the two theoretical lengths were related by Lorentz's contraction factor, the contracted length $L = L_0 \sqrt{1 - v^2/c^2}$ (or $L = 1x\sqrt{1 - v^2/c^2}$) resulted. (*Id.*)

Some of the main difficulties with these absolute and arbitrary interpretations (or derivations) are that ether does not exist, therefore the absolute rest length L_0 of an object with respect to the non-existent ether cannot exist, and the contracted length L of the object as compared to the non-existent L_0 cannot exist either. They are all completely imaginary and meaningless concepts. Another major difficulty was that:

> "Lorentz ignored the problem that, since the amount of the contraction depended on the relative velocities of frames of reference, different frames of reference would calculate <u>different contractions</u> for the same object." (Goldberg, p. 98)

We described these <u>impossible</u> different contradictions of the same object at the same instant in time in some detail in our prior Chapter 15.

There is yet another major problem. If the theoretical contractions of absolute rest length are computed for all relative velocities of x' from zero to *c*, such values are shown on Chart 15.4C. When such values are displayed on a graph for all relative velocities of x' from zero to *c*, the result is a curve of theoretical contractions. (see Figure 16.2A) However, as we shall soon see, the <u>reciprocal</u> mathematical values for the expanded intervals of time do not at all correlate with such contraction of length (distance) values. (see Figure 16.2B and Chart 16.3; also see Resnick, 1968, p. 65) What is the justification for this contradiction? There is none.

"[Lorentz] extended the notion of the contraction from macroscopic objects to the fundamental entities of his theory, the electrons, so that these carriers of the basic charge were now to be deformable, changing from spheres to ellipses." (Goldberg, p. 99) In 1905, Einstein adopted this conjecture in order to further his *ad hoc* theory of relativistic kinematics. (see Einstein, 1905d [Dover, 1952, pp. 42, 48])

Next, let us explore Lorentz's reciprocal transformation equations for the time intervals on x and x':

$$t' = \frac{t - vx/c^2}{\sqrt{1 - v^2/c^2}} \qquad t = \frac{t' + vx/c^2}{\sqrt{1 - v^2/c^2}}$$

What do these equations mean? What are their algebraic symbols trying to tell us? We know where Lorentz's *ad hoc* 1895 contraction factors in the denominators came from. (Chapter 15) We also know where the strange factors for 'local time,' $t' = t - vx/c^2$, and 'true time,' $t = t' + vx/c^2$, in the numerators came from. They were the absolute and *ad hoc* transformation equations for time in Lorentz's 1895 monograph. (Chapter 16A) In April 1904, Lorentz arbitrarily added his contraction factor as a denominator. In order to remain mathematically reciprocal and consistent with his contraction of space interpretations, Lorentz would have to interpret the resulting transformation to mean $t' = t_0/\sqrt{1 - v^2/c^2}$ (the way Einstein reciprocally did in 1905).[38] (see Goldberg, pp. 99, 100)

[38] These unwelcome transformations for time resulted in a concept known as 'time dilation,' "That is, the rate at which time ran in inertial frames of reference would depend on the relative speed of the frames." (Goldberg, p. 100) In other words, "the clocks moving relative to us are running slower" than our clocks.

We must now ask the following question: what relevance does a contraction of matter factor, $\sqrt{1 - v^2/c^2}$, have in Lorentz's transformation equations for time? This factor was invented in 1895 for the sole purpose of asserting a physical contraction of the material longitudinal arm of M & M's apparatus moving at 30 km/s. Time is not matter, it is not tangible or physical, and it does not move at 30 km/s, or at any other material velocity. Therefore, this contraction of matter factor should never have been arbitrarily applied to the meaningless factors for time. Why then was it applied? Because Lorentz was modifying the Galilean transformation equations which inconveniently also had time equations. Without applying $\sqrt{1 - v^2/c^2}$ as a denominator for time, Lorentz's two sets of 1904 transformation equations would not be reciprocal, nor would they have had mathematical symmetry. They would obviously be very *ad hoc*.

As with the transformation equations for position, distance and space on their face, when the contraction factor $\sqrt{1 - v^2/c^2}$ is divided into the numerators for time, both the true time t and the local time t' expand and become a larger time interval. But how can 'true time,' the simultaneous instant of time for all observers in the Cosmos, which *a priori* is measured in stationary ether absolutely at rest, become a larger time? Larger than what…itself? Larger than 'regular local time' or a 'larger local time'? In 1895, 'true time' was Lorentz's absolute benchmark with respect to which 'local time' was measured. If 'true time' was now larger, what could the 1904 'modified local time' be compared to and measured against: 'regular true time' or 'larger true time'? Again, it becomes obvious that Lorentz's April 1904 concepts concerning time were also totally meaningless.

If the theoretical expansions of time intervals are computed for all relative velocities of x' from zero to *c*, such values are shown on Chart 16.3B. When such values are displayed on a graph for all velocities of x' from zero to *c*, the result is a strange looking curve of time interval expansions (see Figure 16.2B), which has little or no correlation with Lorentz's contraction of length (distance interval) curve. For example, when there is an 85% contraction of length (distance interval) of a body at the velocity of 99% of *c*, there is only a 7% expansion of time interval on such body. Lorentz never even attempted to explain or justify these asymmetries and contradictions of magnitude. However, it is quite obvious how they occurred. Lorentz arbitrarily multiplied $L_0 \times \sqrt{1 - v^2/c^2}$ to arrive at a contraction of matter, and he divided $t_0/\sqrt{1 - v^2/c^2}$ to arrive at an expansion of time. If Lorentz had arbitrarily reversed his interpretations and his mathematics he would have arrived at an expansion of matter and a contraction of time.[39]

We could logically interpret 'a larger time' to mean a greater or expanded duration of time interval, rather than a slowing down of time (as Einstein and some others did). But, then, we must ask the question: How could there be a greater duration of time interval for light to propagate over a contracted (shortened) distance? How could a greater duration of time interval help to explain the M & M null result? Of course, it could not. It would just make the M & M null result a greater paradox. There is also another question that must be answered: How could either a greater duration of time interval or a slowing down of time physically and magically be created? What was the magical physical mechanism or process? Lorentz never asked or answered either question, nor did Einstein. It becomes obvious that Lorentz's *ad hoc* transformation equations for time could not even aid his theoretical goals.

Because of all the theoretical problems they created, because they formally

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[39] Exactly the same arbitrariness applies to Einstein and his Special Theory. (see Chapter 28)

contradicted Newton's theory of measurement, and because they were so *ad hoc*, Lorentz interpreted his April 1904 transformations for time to be "merely [mathematical] aids to calculation [which] had no physical significance."[40] (Goldberg, pp. 99, 101 – 102) In other words, they were merely curious by-products. "They did not make sense within the framework in which [Lorentz] was working."[41] (*Id*., p. 100)

In the final analysis, what are these bizarre Lorentz transformations composed of? Numerators that algebraically describe the expanded space traveled between the positions of two hypothetical inertial reference frames and other numerators that describe a non-existent 'true time' and an arbitrary mathematical 'local time' that are based on non-existent ether and on non-existent 'true time.' Plus a denominator for each of the above numerators, which is theoretically based on non-existent ether, which is based on an *ad hoc* contraction of matter theory, and which requires the solar orbital velocity of the Earth at 30 km/s to be the Earth's only absolute velocity. It is difficult to imagine how this contrived conglomeration of invalid algebraic factors and symbols could explain anything.

Nevertheless, when Lorentz applied his new transformation equations to Maxwell's equations, the troublesome factor v^2/c^2 also disappeared.[42] (Hoffmann, p. 87) Therefore, Lorentz's revised electron theory no longer mathematically predicted that a fringe shift would be detected in second order light experiments. Lorentz's mathematical fix worked mathematically! This was the primary goal of his April 1904 theory. For

[40] But what calculations did they really aid? And how did they really aid them?
[41] Since these time transformations had no real meaning for his theory, Lorentz did not even bother to interpret, manipulate or justify their mathematical results the way he did with his transformations for space, position and distance.
[42] This is why Dingle asserted that Lorentz created his *ad hoc* transformations: because when they transformed Maxwell's equations for the velocity of light at *c*, Maxwell's equations retained the same velocity *c* in all inertial frames. (see Dingle, 1972, p. 165, infra) It was merely a contrived mathematical result.

Lorentz, his 1904 interpreted transformation equations explained the M & M null results and the other electromagnetic experimental null results, as follows: Mathematically, no electromagnetic or optical experiment could detect the absolute velocity of the Earth through the stationary ether.

Lorentz did not analyze his transformation equations and their algebraic symbols the way that we have done in this chapter. Rather, he arbitrarily substituted his April 1904 transformations for the Galilean transformations and applied them to transform the positions and distances of x and x', and the times of t and t', in an attempt to further his theoretical agenda. Of course, Lorentz's 1904 transformation equations were arbitrary, *ad hoc* and meaningless. They were not based on any empirical experiment or observation, but rather on a myriad of false and artificial assumptions. In fact, as the previous discussion implies, Lorentz most likely discovered the necessary combination of mathematical factors and symbols for his transformation equations, through the random process of trial and error.

In spite of Lorentz's dubious mathematical achievement, and to his credit, he also announced the following caveats at the end of his April 1904 paper:

> "It need hardly be said that the present theory is put forward with all due reserve. Though it seems to me that it can account for all well-established facts, it leads to some consequences that cannot as yet be put to the test of experiment.[43]
>
> "Our assumption about the contraction of the electrons cannot in itself be pronounced to be either plausible or inadmissible." (Lorentz, 1904 [Dover, 1952, pp. 29, 30])

Dingle agreed and concluded: "Lorentz recognized that it was purely an *ad hoc* hypothesis: it did not, like the more limited FitzGerald suggestion, give any explanation

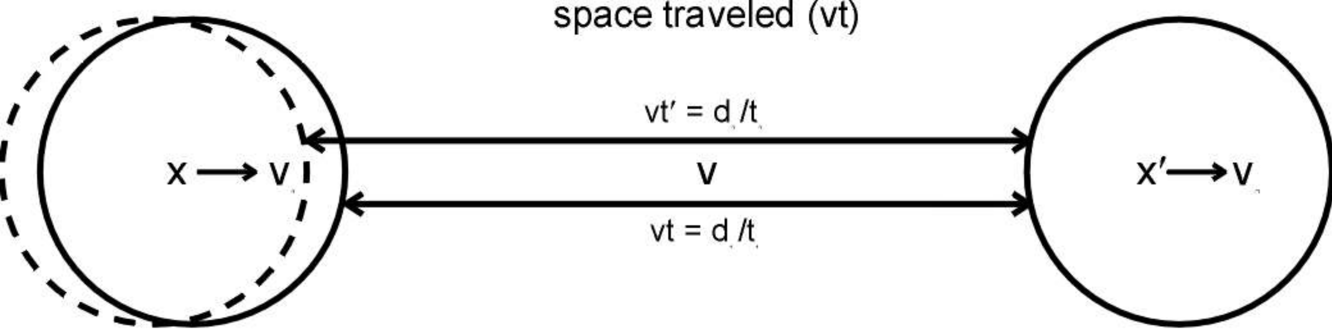
[43] These *ad hoc* mathematical consequences of the Lorentz transformation equations, such as the contraction of matter in proportion to its velocity, and the accompanying expansion (dilation) of time intervals, Einstein would assert in 1905 without any reserve.

of the proposed physical effects. These [Lorentz transformation equations] were proposed simply because they led to a transformation relative to which the equations of the electromagnetic theory were [Poincaré] invariant."[44] (Dingle, 1972, p. 165)

Lorentz's 1904 transformation equations were viewed by the scientific community with much skepticism, because they appeared to be so *ad hoc*. (Dingle, 1972, p. 165) It turns out that such skepticism was well founded, because as we have demonstrated, Lorentz's contrived 1904 transformation equations were completely without meaning. Yet these same meaningless Lorentz transformation equations are what Einstein would adopt in 1905 as the mathematical foundation for his Special Theory of Relativity and its many bizarre mathematical consequences.[45]

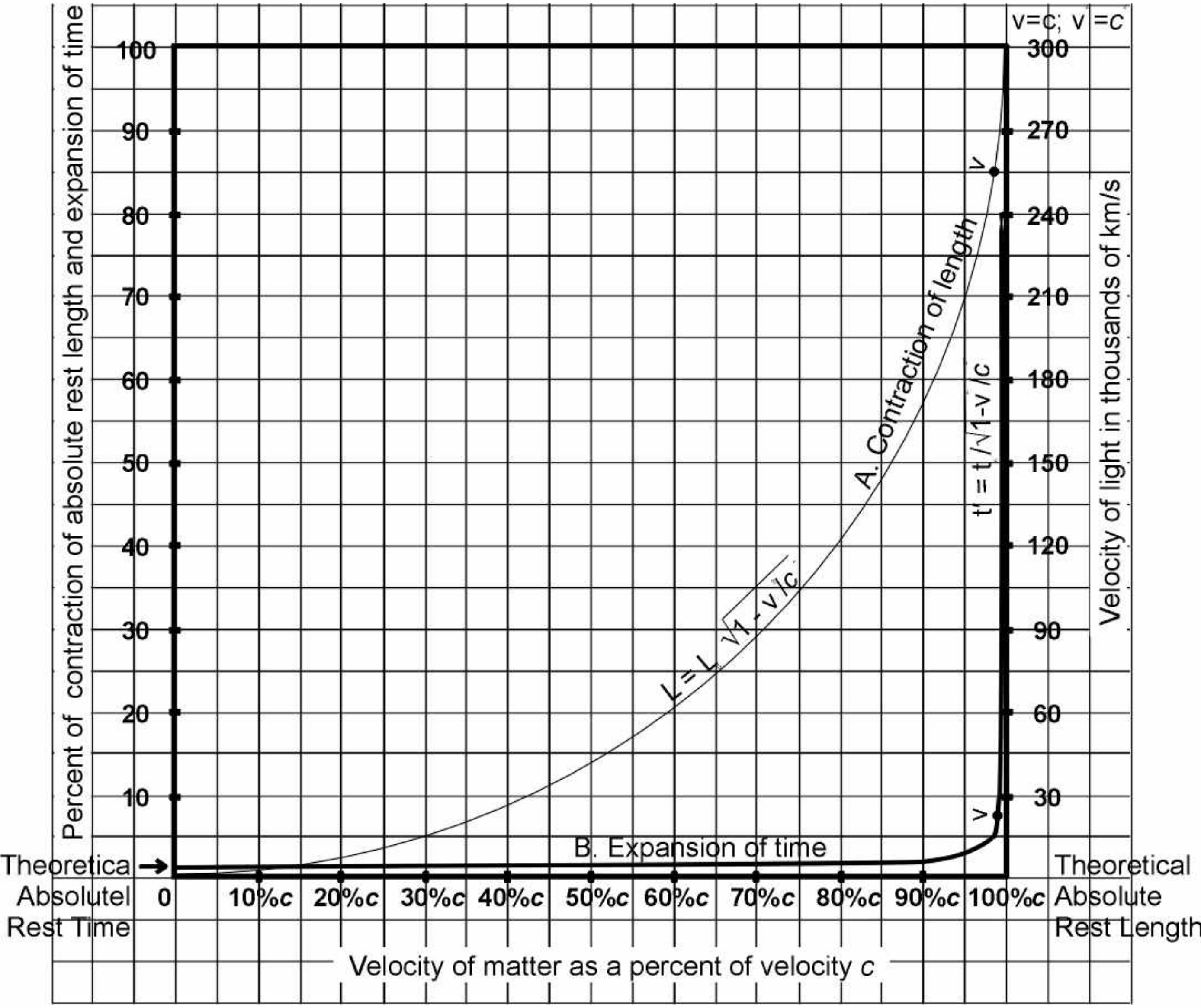
[44] The same was true when Einstein adopted these transformation equations for his Special Theory in 1905, although Einstein claimed that he derived them from postulates. (see Chapter 27)

[45] The only difference is that Einstein would give such invalid transformations a revised interpretation (i.e. a different spin).



If two bodies (x and x′) are moving in the same direction and at relative velocity v, the space and distance (d_1) between them will naturally physically increase by vt. By application of the 1904 Lorentz transformation for distance traveled to this scenario, the space and distance traveled between such bodies instantly and mathematically increases or expands even further to $vt' = d_2/t_2$. How does this physically occur? In this scenario, the distance/time interval for light to propagate to and fro between the two separated bodies will instantly increase from $d_1 t_1$ to $d_2 t_2$. How does this scenario explain the M & M null results, which requires a decrease in distance/time interval?

Figure 16.1 Application Of The Lorentz Transformation For Space And Distance Traveled



There is little or no correlation between Lorentz's interpreted 1904 magnitudes for contractions of length (distance interval), and his uninterpreted 1904 magnitudes for expansion of time intervals.

Figure 16.2 Comparison Of Lorentz's 1904 Contraction Of Length And His Expansion Of Time Concepts

Chart 16.3

Increments Of The Lorentz Transformation For Expansion Of Absolute Rest Time

A priori absolute Rest Time increases arithmetically from magnitude 1.0 to infinity, depending on the velocity of matter as compared to velocity *c*.

A	B
v as a percent of *c*	**Lorentz Transformation** $1/\sqrt{1 - v^2/c^2}$
Relative velocity v as compared to *c*	% of increase in absolute Rest Time t_0 with increase in relative velocity
0% (rest)	1.0
1%	
5%	
10%	
15%	
20%	1.0206
30%	1.0483
40%	1.0911
50%	1.1547
60%	1.2500
70%	1.4003
80%	1.6667
90%	2.2942
95%	3.2026
96%	3.5714
97%	4.1135
98%	5.0252
99%	7.0888
99.5%	10.0126
99.9%	22.3664
99.99%	87.5657
99.999%	223.6136
99.9999%	707.2136
99.99999%	2,236.1680
99.999999%	7,071.0678
99.9999999%	22,360.6798
99.99999999%	70,710.6781