

Chapter 15

CONTRACTION THEORIES OF FITZGERALD, LORENTZ AND EINSTEIN

Fitzgerald (in 1889), Lorentz (in 1895), and later Einstein attempted to explain Michelson's paradoxical null results with a radical ad hoc hypothesis. The hypothesis was that a material body (i.e. the longitudinal arm of Michelson's apparatus) physically contracts, or becomes shorter, in the direction of its velocity through the stationary ether. This theoretical contraction of distance could hypothetically explain the missing time interval for light to propagate in the M & M experiments, and therefore could theoretically explain Michelson's null results. But it turns out that Fitzgerald's and Lorentz's two very different mathematical contraction factors were both impossible absolute concepts, and so was Einstein's similar contraction 'solution.'

After the null results of the Michelson and Morley experiment were published in 1887, the various theories concerning the interactions between ether, the velocity of light and the motions of matter reached a critical impasse. No single theory could consistently explain the results, implications, contradictions, conflicts and paradoxes of numerous experiments and other theories. (see Chart 15.1) The door appeared to be wide open for someone to attempt to devise a new theory that would resolve all of these conflicts.

(Bergmann, pp. 26 – 27)

A. Fitzgerald's Contraction Theory

In May 1889, Irish physicist George F. Fitzgerald (1851-1901), largely in an attempt to defend the existence of stationary ether as a fixed reference frame at rest in space, proposed a radical explanation for Michelson's paradoxical null result in a letter to the editors of Science Newspaper. Such letter states, as follows:

“I have read with much interest Messrs. Michelson and Morley's wonderfully delicate experiment attempting to decide the important question as to how far the

ether is carried along by the earth.¹

“I would suggest that almost the only hypothesis that can reconcile this [null result] is that the length of material bodies changes [contracts], according as they are moving through the ether or across it, by an amount depending on the square of the ratio of their velocity to that of light.”² (Fitzgerald, Science Newspaper, Vol. XIII, No. 328, 1889, p. 390)

Although Fitzgerald referred to the 1887 M & M experiment, his contraction explanation is more applicable to Michelson’s 1881 experiment. In 1881, Michelson was attempting to detect a fringe shift equal to 10% of a wavelength, which according to Maxwell and Michelson should require a degree of precision to detect equal to v^2/c^2 . Whereas in 1887, Michelson was attempting to detect an even smaller fringe shift equal to only 4% of a wavelength, which might require an even greater degree of precision to detect. (Chapter 9) The magnitude of contraction that Fitzgerald was conjecturing was equivalent to v^2/c^2 at $v = 30$ km/s. This was the same ratio of magnitude that Maxwell suggested in his 1879 letter for a theoretical increase in the time interval of propagating light, and which Michelson was attempting to detect in his 1881 experiment.

In effect, Fitzgerald hypothesized that if the length of every material object (i.e. the Earth) physically ‘contracts’ or becomes shorter in the absolute direction of its absolute motion through the stationary ether, then every observer sharing the same motion of the shortened Earth (including Michelson, Morley, and the longitudinal arm of

¹ Here Fitzgerald is referring to M & M’s attempted explanation of their 1887 null result, vis. if the Earth dragged or carried the ether along with it (called ‘ether drag’) then this could theoretically explain why the motion of the Earth relative to the dragged along ether and the resulting difference in the time interval of propagating light (in the ether) was not detected by M & M. The theory was that if the moving Earth was at rest relative to the dragged along ether, then there would be no increased time interval of propagating light relative to the ether that could be detected by any method. But, by 1889, this ether drag hypothesis had been substantially repudiated by M & M and others.

² Fitzgerald, like almost every scientist since 1887, believed that the light ray in the M & M experiment propagated over a greater distance/time interval in the direction of the Earth’s solar orbital motion. But see Chapters 10 and 12.

their apparatus) would also proportionally physically contract.³ (Born, pp. 219, 220) According to Fitzgerald, these physical contractions of distance would in turn proportionally reduce the time interval which light had to propagate at its transmission velocity of c to and fro along the linearly contracted longitudinal arm of the apparatus, and in the direction of the Earth's solar orbital velocity. (see Figures 15.2 and 15.3) *A priori*, the amount of this conjectured hypothetical contraction was just sufficient to mathematically compensate for the 'undetected time interval' in Michelson's experiments. (see Einstein, *Relativity*, p. 59) What an amazing coincidence!

B. Lorentz's Contraction Theory

Several years later, in 1892 – 1893 and again in 1895, Lorentz also devised an *ad hoc* contraction hypothesis similar to Fitzgerald's, which he likewise hoped could theoretically save the concept of stationary ether.⁴ Lorentz's 1895 treatise concerned both his theory of the electron, and the first order 'ether drag' light experiments referred to in his final chapter of such treatise, entitled: "Experimental Results Which Cannot be Accounted for Without Further Aids." (Goldberg, p. 96) The title of this final chapter (which described Lorentz's contraction hypothesis in detail) was later changed to "Michelson's Interference Experiment," and in it Lorentz briefly referred to Fitzgerald's

³ *A priori*, the contraction could not be measured by the observers themselves, because their measuring rods would also shrink in the same proportion as the longitudinal arm of Michelson's apparatus, as would everything else on Earth. (Lorentz, 1895 [Dover, 1952, p. 6]; D'Abro, 1950, p. 132)

⁴ In 1892-3 Lorentz wrote: "this experiment [Michelson and Morley] has been puzzling me for a long time, and in the end I have been able to think of only one means of reconciling its result with Fresnel's theory." (Miller, p. 28) Lorentz then suggested a contraction of matter hypothesis similar to his later 1895 hypothesis. (*Id.*, pp. 28 – 29) Fresnel's early 19th century theory was that ether is absolutely at rest in space, and the Earth moving through the ether partially drags the ether along with it. (Lorentz, 1921, p. 793)

somewhat different contraction hypothesis.⁵ (Lorentz, 1895 [Dover, 1952, p. 4])

It is important to realize that Lorentz's mathematical contraction factor, $\sqrt{1-v^2/c^2}$, resulted in different magnitudes of contraction than Fitzgerald's contraction factor (v^2/c^2), because Lorentz was attempting to explain Michelson's 1887 experiment with Morley, which was attempting to detect a fringe shift equal to 4% of a wavelength, and its null result.⁶ Whereas Fitzgerald, as previously mentioned, was apparently attempting to explain away the null result of Michelson's somewhat different 1881 experiment (which attempted to detect a theoretically larger fringe shift equal to 10% of a wavelength).

It is also important to realize that both Fitzgerald (in 1889) and Lorentz (in 1892 and 1895) were only attempting to justify Michelson's specific null results with a specific magnitude of contraction at the absolute solar orbital velocity of 30 km/s and in the absolute solar orbital direction of such velocity.⁷ At any different or greater theoretical velocities their theories totally break down. In any event, the two different theories and their two different magnitudes of contraction directly contradict each other. (see Chart 15.4 and Figure 15.5) All of these theoretical contractions could only *a priori* result with respect to stationary ether, which we now know does not exist. Therefore, such contractions were completely meaningless.

After describing both of Michelson's experiments in some detail in his 1895 final contraction chapter, Lorentz focused only on the M & M 1887 experiment. He concluded

⁵ Lorentz wrote and acknowledged that a contraction hypothesis "has also occurred to Fitzgerald." (Lorentz, 1895 [Dover, 1952, p. 4]) Lorentz also gave Fitzgerald some credit in his follow-up 1904 paper, to wit: "The negative result of [Michelson's experiments] has led Fitzgerald and myself to the conclusion that the dimensions of solid bodies are slightly altered by their motion through the ether." (Lorentz, 1904 [Dover, 1952, p. 11])

⁶ In their 1887 experiment, M & M were assuming an angular path for the light ray, which resulted in their attempting to detect a theoretically smaller fringe shift equal to only 4% of a wavelength.

⁷ "This Lorentz-FitzGerald contraction hypothesis was a hypothesis formulated *ad hoc* for the sole purpose of explaining the null result of Michelson's experiment." (D'Abro, 1950, p. 132)

that the time it takes for a pencil of light to propagate to and fro in M & M's apparatus from the light source to the longitudinal reflecting mirror and back to the beam splitter in the direction of the Earth's absolute solar orbital motion is "longer than the time which the other pencil⁸ takes to complete its journey by Lv^2/c^2 ."⁹ (Lorentz, 1895 [Dover, 1952, p. 5]) Lorentz asserted that this result follows from Maxwell's conclusion, that "...the time required by a ray of light to travel from a point A to a point B and back to A must vary when the two points together undergo a displacement..." with respect to the ether at rest in space.¹⁰ (*Id.*, p. 3; Figure 9.1) But (continued Lorentz's theoretical conjectures):

"If we assume the arm which lies in the direction of the Earth's motion to be shorter than the other by $\frac{1}{2}Lv^2/c^2$...then the result of the Michelson experiment is explained completely." (*Id.*, p. 5)

"The shortening of the one diameter of the Earth would amount to about 6.5 cm.¹¹ The length of a meter rod would change, when moved from one principal position into the other, by about 1/200 micron.¹²...Revolving the apparatus we should perceive no displacement of the fringes." (*Id.*, p. 6)

Based on Lorentz's above conjectures and rationalizations, we must ask the question: What was the longitudinal arm of the M & M apparatus shorter than? According to Lorentz and the ether theory, it was shorter than the length L of the transverse arm that was not oriented in the direction of motion and thus remained at the same length as if it were at rest in the ether. (Lorentz, 1895 [Dover, 1952, p. 5]) This

⁸ *A priori* the other transverse pencil of light was propagating to and fro in the direction perpendicular to the solar orbital motion of the Earth. (Figures 9.6A and 9.7)

⁹ Where L is the equal length of each arm of the apparatus theoretically at rest in the ether (this length, of course, does not exist); v is the solar orbital velocity of the Earth at 30 km/s, and c is the transmission velocity of light.

¹⁰ Even in 1921, Lorentz repeated this conclusion: "if we adopt Fresnel's theory of a stationary aether, supposing also that a material system can have a uniform translation with constant velocity v without changing its dimensions, we must surely expect the result that was predicted by Maxwell." (Lorentz, 1921, p. 793)

¹¹ Lorentz's theory asserts that as the Earth daily rotates 90° on its axis, the side in the direction of its solar orbital motion continually contracts, and thereafter expands.

¹² "One could hardly hope for success in trying to perceive such small quantities except by means of an interference method." (Lorentz, 1895 [Dover, 1952, p. 6])

arbitrary concept was sometimes called the ‘rest length’ of matter in Lorentz’s and other related theories, and mathematically it had a designated magnitude of 1. But of course we now know that this concept of absolute ‘rest length’ was a myth. It was an impossible absolute concept, because there is no ether and there is no such thing as the absolute rest of a material object. (Einstein, 1905d [Dover, 1952, p. 37]) It follows that there could be no contraction of a ‘rest length’ that does not exist, and there could be no comparative measurement with respect to something that does not exist. Therefore, Lorentz’s contraction concept and his mathematical contraction factor were meaningless.

How did Lorentz explain the physical method by which each rotating arm became shorter than the other in the direction of the Earth’s solar orbital motion?

“One would have to imagine that the motion of a solid body...through the resting ether exerts upon the dimensions of that body an influence which varies according to the orientation of the body with respect to the direction of motion.” (Lorentz, 1895 [Dover, 1952, p. 5])

As Born points out: “The contraction hypothesis seems...almost absurd—because the contraction is not a consequence of any forces but appears only as a companion circumstance to motion.” (Born, p. 220) In other words, it was merely an *ad hoc* hypothesis of the imagination without any physical justification. Lorentz also had an imaginary answer for Born’s criticism. He imagined in classic *ad hoc* fashion that “molecular forces are also transmitted through the ether” which change the dimensions of the atoms in a solid body (i.e. the Earth and Michelson’s apparatus) and cause it to be contracted in the direction of its motion through the ether. (*Id.*, p. 6)

Lorentz never stated a viable theory for what physically caused his hypothetical contraction, as Einstein later pointed out: “this key hypothesis, ...is not justifiable by any electrodynamical facts...” (Einstein, *Relativity*, p. 57) In other words, Lorentz’s

contraction hypothesis and his mathematical contraction factor served Lorentz's theoretical agenda, but they were completely unjustifiable empirically and resulted solely from his imagination.

C. Einstein's Contraction 'Solution'

As we pointed out in Chapter 10, Einstein (in his 1916 book, *Relativity*) described and agreed with Maxwell's 1879 and Lorentz's 1895 false absolute assumptions concerning ether that resulted in M & M's paradoxical null results. Einstein also summarized and confirmed Michelson's false absolute hypotheses and experiments, and described the resulting paradox, as follows:

“Imagine two mirrors so arranged on a rigid body that the reflecting surfaces face each other. A ray of light requires a perfectly definite time T to pass from one mirror to the other and back again, if the whole system be at rest with respect to the aether. It is found by calculation, however, that a slightly different time T' is required for this process, if the body, together with the mirrors, be moving relatively to the aether. And yet another point: it is shown by calculation that for a given velocity v with reference to the aether, this time T' is different when the body is moving perpendicularly to the planes of the mirrors from that resulting when the motion is parallel to these planes.¹³ Although the estimated difference between these two times is exceedingly small, Michelson and Morley performed an experiment involving interference in which this difference should have been clearly detectable. But the experiment gave a negative result – a fact very perplexing to physicists.¹⁴ (Einstein, *Relativity*, pp. 58 – 59)

Einstein needed the concept of stationary ether for his Special Theory in order to describe the false assumptions of everyone, the impossible expectations of the scientific community, and the bewildering absolute M & M paradox which desperately needed an explanation...even though he postulated on the same page of *Relativity* (p. 59) that absolute rest and stationary ether could not exist. Again, the reason for Einstein's need

¹³ See Figure 10.1 for these calculations mentioned by Einstein.

¹⁴ This paragraph demonstrates that (even in 1916) Einstein was operating and agreeing with some of the same false absolute mindsets as the rest of the scientific community.

was that his Special Theory provided a false mathematical solution for Michelson's paradox, which Einstein and his followers would later claim was an experimental confirmation for his Special Theory. (see Resnick, 1968, p. 37 and Chapter 22F)

The first theoretical "definite" time interval described by Einstein assumes that the Earth and Michelson's apparatus could be absolutely at rest in the stationary ether. It is from this absolutely stationary reference frame that Einstein asserts: "a ray of light requires a perfectly definite time T to pass from one mirror to the other and back again." (Einstein, *Relativity*, pp. 58-59) The second theoretical time interval is also described by Einstein with reference to the absolutely stationary frame of ether:¹⁵

After Einstein described Michelson's paradoxical null result, he went on to conjecture that:

"Lorentz and Fitzgerald rescued the [ether] theory¹⁶ from this difficulty [Michelson's paradoxical null results] by assuming that the motion of the body relative to the aether produces a contraction being just sufficient to compensate for the difference in time...[T]his solution of the difficulty was the right one." (Einstein, *Relativity*, p. 59)

The above described absolute mindset concerning the detectability of such difference in absolute time intervals, reinforced by Einstein's conjecture and conclusion that such "difference should have been clearly detectable" by Michelson and Morley (Einstein, *Relativity*, p. 59), lingers on even into the twenty-first century. It was also further reinforced by Einstein's conjecture and conclusion that the proposed contraction solution for the M & M paradox presented by Lorentz and Fitzgerald "was the right one."

¹⁵ Without these impossible measurements with respect to stationary ether, the calculations derived from Figure 10.1 could not occur.

¹⁶ Lorentz and Fitzgerald were attempting to save the ether theory with their contraction concepts, whereas Einstein was attempting to save 'Maxwell's theory and equations for the constant velocity of light at c ' with his somewhat different contraction concept. Nevertheless, Maxwell's theory and equations for the velocity of light did not need saving by Einstein's 'contraction of matter theory' contained in his Special Theory, as we shall learn in Part II of this treatise.

(*Id.*, p. 59)

In Chapter 16 of his book *Relativity*, Einstein at first selectively adopted the concept of stationary ether in order to further his scientific agenda. That is, in order to describe the theoretical absolute difference in time intervals, Michelson's paradoxical null result, and the Fitzgerald/Lorentz contraction theory to explain it, so as to theoretically and mathematically 'save' Maxwell's theory of the constant velocity of light at c .¹⁷ Then, Einstein immediately contradicted himself on the same page of *Relativity* by stating that according to his theory of relativity:

“there is no such thing as a ‘specially favored’ (unique) coordinate system to occasion the introduction of the aether-idea...”¹⁸ (*Id.*, p. 59)

Next, Einstein claimed that such contraction did not really result from the ether or motion *per se*. According to Einstein: “the prime factor involved in this contraction we find was [not] the motion itself [or the motion with respect to the ether, but rather]...the motion with respect to the body of reference chosen in the particular case...” (Einstein, *Relativity*, pp. 59 – 60) In effect, according to Einstein, such contraction of Michelson's apparatus resulted from the ‘relative motion’ of the Earth and a mentally chosen reference body, all at a distance.¹⁹ This absurd and artificial idea was Einstein's attempted relative mathematical ‘solution’ for Michelson's absolute physical and empirical paradox.

It turns out that Einstein, in the above paragraph, was actually referring to his theoretical coordinate measurement and his ‘illusion of a contraction’ of distance, which

¹⁷ The reader will only fully understand what all of this means after reading Chapters 19 through 28.

¹⁸ Is it either reasonable or convincing to assert the concept of stationary ether for one set of purposes and then deny it for another purpose (his Special Theory) on the same page? Of course not.

¹⁹ Einstein never explained the physical process for how this mental contraction ‘action at a distance’ occurs.

could theoretically occur in 1905 because at that time the coordinates for both ends of a moving rod could not simultaneously be measured by a human observer. This subject of an artificial coordinate measurement and an ‘illusion of contraction’ of distance results from Einstein’s concepts of relativistic kinematics. In Chapters 26 and 28, we will fully discuss Einstein’s ridiculous concepts of relativistic kinematics, and we will demonstrate them to be *ad hoc*, arbitrary, invalid and completely meaningless.

In effect, Einstein’s ‘solution’ for the M & M paradox asserted that there was a contraction of Michelson’s apparatus in the direction of motion, but that such contraction was only caused by the method of coordinate measurement which he employed.²⁰

Einstein finally asserted that:

“for a co-ordinate system moving with the earth the mirror system of Michelson and Morley is not shortened, but it is shortened for a co-ordinate system which is at rest relatively to the sun.” (Einstein, *Relativity*, p. 60)

In Einstein’s so-called ‘relative solution’ the Sun takes the place of the stationary ether at rest in Newton’s absolute space, so that Figures 9.1, 9.2, 9.5, and 10.1 can theoretically remain applicable with respect to the relatively stationary Sun. Thus, Einstein’s solution of perception and coordinate measurement and its illusions of a contraction remain nothing more than an *ad hoc* solution of desperation just like those of Fitzgerald and Lorentz.²¹

In Einstein’s so-called ‘relative solution’ he was claiming that his artificial method for coordinate measurements results in a mathematical illusion of contraction,

²⁰ This assertion, of course, ignores the fact that Michelson was not measuring anything with coordinates but rather with his interferometer, and that he was only attempting to detect a change in relative light wave phases (a fringe shift), not a contraction of matter.

²¹ Einstein’s attempted coordinate solution of perception was very similar to his example of relative perception described in our Chapter 3, where a rock falling from a moving train appears to a man on the train to fall straight down with respect to a system of coordinates attached to the train, but relative to the stationary system of coordinates attached to the embankment it appears to the man on the embankment to fall with a parabolic motion. (see Figures 3.5 and 5.1)

and that this illusion explains the physical and empirical M & M null results. As Einstein's follower Resnick confirms: "No actual shrinkage is implied, [there is] merely a difference in measured results." (Resnick, 1992, p. 472) But, on the contrary, any contraction of Michelson's apparatus would have to be an 'actual physical contraction' in order to explain the M & M paradox. Without a physical contraction of distance there could be no physical and empirical explanation for the missing interval of time which was equivalent to the assumed greater distance.

D. Fitzgerald's, Lorentz's and Einstein's *ad hoc* mathematical contraction theories are meaningless.

Referring to Lorentz's and Fitzgerald's contraction hypothesis, Einstein acknowledged: "this *ad hoc* postulate appeared to be only an artificial means of saving the [ether] theory." (Einstein, 1907 [Collected Papers, Vol. 2, p. 253]) Einstein was right. Nevertheless, Einstein claimed in 1916 that Lorentz's artificial and unjustifiable *ad hoc* hypothesis provides us with the same mathematical law of motion as Einstein asserted in his Special Theory of Relativity; the purported difference being that Special Relativity does not require "any special hypothesis whatsoever as to the structure and behavior of the electron."²² (Einstein, *Relativity*, p. 57) In Einstein's Special Theory, the contraction does not occur with respect to the ether, but rather "with respect to the body of reference chosen in the particular case...", i.e. the Sun.²³ (Einstein, *Relativity*, pp. 59 – 60) This *ad hoc* conjecture was Einstein's sole explanation for the M & M null result.

²² Contrary to the implications from Einstein's assertions, as we shall demonstrate in later chapters, Einstein's Special Theory of Relativity does require numerous other special and *ad hoc* hypotheses.

²³ Here, Einstein is claiming that his illusion of a contraction was merely a result of his method of measurement. (see Chapter 28) But how could an illusion of a contraction explain the empirical M & M null result? It could not. In order to explain the M & M null result with a contraction, the theoretical contraction must be physical. (see Figure 15.2)

Do the above attempted distinctions, rationales and conjectures by Einstein convince anyone?²⁴ The only way that Einstein's contraction theory could even theoretically work as an explanation for Michelson's null results, would be based on the ether theory where the absolute velocity of the Earth through space is exactly 30 km/s. But Einstein rejected the ether theory as invalid. Therefore, he also rejected his own contraction theory or solution.

Folsing described Lorentz's theory as follows: "In the artificial and contrived Lorentzian hypothesis, contraction had been invented solely for the interpretation of the Michelson experiment..." (Folsing, p. 219) Arthur Miller described Lorentz's hypothesis of the contraction of matter based on velocity as "clearly a physics of desperation." (Miller, p. 28) If Lorentz's contraction hypothesis was artificial, contrived, and a physics of desperation, how can Einstein's very similar contraction of matter theory (which uses exactly the same mathematics and ether computations) be logically rationalized to be any different? It cannot.

At the end of his 1895 paper, Lorentz set forth a contraction factor, $\sqrt{1-v^2/c^2}$, and a contraction ratio that described his contraction hypothesis:

"[the] effect [is] a shortening in the direction of motion in the proportion of 1 to $\sqrt{1-v^2/c^2}$..." (Lorentz, 1895 [Dover, 1952, p. 7])

Again, the whole number 1 in Lorentz's theory refers to the uncontracted rest length of matter (i.e. Michelson's longitudinal arm) at rest in the stationary ether. In turn,

Lorentz's factor $\sqrt{1-v^2/c^2}$ represented the theoretically contracted longitudinal arm in

²⁴ How could Michelson's apparatus physically contract at a distance relative to the Sun (its body of reference chosen)? Einstein never told us how this magic could occur. If Michelson had chosen the core of the MW Galaxy as his body of reference (rather than the Sun), Michelson's apparatus would theoretically have physically contracted seven times as much (because this relative velocity of the Earth would be 225 km/s, not 30 km/s)? According to Einstein's Special Theory, *a priori* it would. If it did, how could this much greater contraction explain the much less contraction needed to explain the unique M & M null result? It could not.

Michelson's 1887 experiment that was necessary to explain the missing theoretical difference in the time intervals of light propagation assumed by Maxwell, Michelson, Lorentz, and Einstein. All of these are artificial absolute concepts.

If the absolute velocity of the Earth (v) remains zero, then the square root of 1 minus zero remains 1, and there is no contraction. According to the ether theory, the only way that this could theoretically happen was if the Earth remained at rest in stationary ether. On the other hand, if the absolute theoretical velocity (v) of the Earth through space is exactly 30 km/s, as Maxwell, Michelson, Lorentz, Fitzgerald, and Einstein assumed, then the above factor produces a mathematical contraction of the length of the longitudinal arm exactly necessary to explain the null result of the M & M experiment. Another fascinating coincidence!

But if the velocity (absolute or relative) of the Earth is 225 km/s, or 310 km/s, or 455 km/s, or any other relative velocity (as we now know it to be), then the null result of the M & M experiment is not explained. Why? Because the longitudinal arm would theoretically contract much more than the exact amount necessary to explain the missing time interval in the M & M experiment, and such much shorter distance for light to propagate would *a priori* produce a large fringe shift (possibly equal to 100% of a wavelength). None of these contraction theories explain Michelson's null results, nor make any sense.

How did Lorentz arrive at the contraction magnitude of $1:\sqrt{1 - v^2/c^2}$ for his contraction hypothesis? Goldberg concludes that Lorentz merely backed into his contraction factor by adopting a ratio which would *a priori* exactly compensate for the difference in time intervals which M & M assumed but failed to detect in 1887. Thus,

Lorentz's contraction factor was arbitrarily designed only for the specific purpose of explaining the unique M & M null result at $v = 30$ km/s. As Goldberg put it:

“In...his 1895 monograph, [Lorentz] did not rationalize or justify [his contraction factors]. He did not derive them. He seems to have worked backwards in order to determine what...would be necessary...” (Goldberg, p. 99)

As should be obvious, Lorentz's 1895 contraction factor and contraction ratio results in a very different progression of numbers (Chart 15.4C) and graphical depiction thereof (Figure 15.5) than Fitzgerald's contraction ratio v^2/c^2 (Chart 15.4B). When these two different contraction factors and their numerical computations are plotted on a graph, Fitzgerald's velocity and contraction values correlate exactly with his theory (Figure 15.3), but they do not correlate with Lorentz's values. (see Figure 15.5) Let us again describe the theoretical reasons for these different values.

How did Fitzgerald arrive at the contraction magnitude of v^2/c^2 for his contraction hypothesis? He obviously adopted the identical magnitude that Maxwell had suggested in his 1879 letter for the difference in time intervals which light must theoretically propagate to and fro in the direction of the Earth's absolute solar orbital motion relative to the stationary ether: v^2/c^2 . (Chart 15.4B) For Michelson, v^2/c^2 represented the theoretical magnitude of the difference in time interval for a light ray to propagate a certain distance in the direction of the Earth's solar orbital velocity (30 km/s), as compared to the time interval for such light ray to propagate the same distance in a direction perpendicular to such solar orbital velocity...a ratio of 1 to 100,000,000. However, the null result of the M & M experiment empirically implied that such theoretical difference in time intervals did not exist. Therefore, for Fitzgerald, v^2/c^2 represented the theoretical contraction in distance of the longitudinal arm in Michelson's

1881 experiment that would be necessary to explain such missing theoretical difference in time intervals.

On the other hand, Lorentz arrived at a contraction factor of $\sqrt{1 - v^2/c^2}$, which produced a smaller theoretical contraction of matter than Fitzgerald's contraction factor. What is the reason behind these two very different contraction ratios? The obvious reason is that Fitzgerald was attempting to explain away a specific larger theoretical difference in time intervals, and Lorentz was attempting to explain away a different smaller specific difference in time intervals. The theoretical time interval difference that Fitzgerald was trying to explain away in Michelson's 1881 experiment was equivalent to 10% of a wavelength. Whereas, the smaller theoretical time interval difference which Lorentz was attempting to explain away in M & M's 1887 experiment was equivalent to only 4% of a wavelength.²⁵

Again, what was the reason for these theoretical differences in specific time intervals? Remember that the primary reason that Michelson had decided to undertake a second experiment with Morley in 1887 was that he believed his 1881 calculation for the specific difference in time intervals was wrong. (Chapter 9) In 1887, Michelson assumed that the perpendicular mirror in his apparatus was also displacing from the stationary ether therefore the perpendicular light pencil was also propagating at an angle relative to the direction of the Earth's solar orbital motion (Figure 9.5), rather than strictly perpendicularly relative thereto. (Figures 9.6A and 9.7) This greater angular distance of propagation resulted in only 40% of the theoretical specific time interval difference which needed to be detected in his 1881 experiment. (M & M, 1887, pp. 334 – 336; see

²⁵ Their different algebraic factors were an obvious *ad hoc* attempt to explain away a different specific difference in time intervals.

Figure 10.1) Remember also that in Chapter 9 we dismissed this arbitrary hypothesis as nonsense, because a light ray has no mass and therefore is not subject to the lateral inertial motion of the Earth.

This invalid concept of the perpendicular light pencil propagating farther at an angle, and the theoretical blunder by M & M in conceiving it, was incorporated into Lorentz's contraction hypotheses and his mathematical contraction factor which attempted to explain why such smaller specific difference in time intervals was not detected by M & M.²⁶ Lorentz's hopelessly flawed contraction factor, $\sqrt{1 - v^2/c^2}$, was also incorporated into his 1904 Lorentz transformation equations, which we shall discuss in Chapter 16. These hopelessly flawed Lorentz transformation equations were in turn adopted by Einstein in 1905 as the mathematical foundation for his Special Theory. (see Einstein, *Relativity*, Chapter 11 entitled "The Lorentz Transformation," pp. 34 – 39; and our Chapter 27, *infra*) Aside from all of its many other problems, which we shall describe in later chapters, Einstein's Lorentz transformation equations and his Special Theory based thereon can have no validity for the simple reasons described above. The Lorentz transformation was completely *ad hoc*, artificial, arbitrary and meaningless. How can any theory based on it have any real or justifiable meaning? It cannot!

It also turns out that the algebraic factor which Lorentz adopted in 1895 to explain the paradoxical null result of the 1887 M & M experiment, $\sqrt{1 - v^2/c^2}$, is merely a special application of the more general algebraic factor $\sqrt{1 - x^2/y^2}$, which basically describes the quarter arc of a circle. (Figure 15.6) How can the algebraic description of the quarter arc of a circle have any real meaning as the foundational basis for Einstein's Special Theory?

²⁶ The fact that Lorentz's contraction hypothesis was even more *ad hoc* and more absurd than Fitzgerald's does not lend any credence to Fitzgerald's hypothesis. Both contraction concepts were ridiculous, *ad hoc*, artificial, and completely invalid, as Folsing, Miller and even Einstein pointed out.

When Lorentz applied this special case factor $\sqrt{1 - v^2/c^2}$ to explain the specific null result of the 1887 M & M experiment (where the Earth is moving at 30 km/s), he also implied that matter in general contracts progressively in the direction of motion in increments of v^2 , from a velocity equal to 0% of c^2 to a velocity equal to 100% of c^2 (Chart 15.4C and Figure 15.5), in the same manner as the circular arc described by $\sqrt{1 - x^2/y^2}$ on Figure 15.6. Mathematically, this appeared to work because *a priori* the increase in the time interval of light propagating along the progressively displacing longitudinal arm of the M & M apparatus at ever increasing velocities, as compared to the time interval of light propagating at an angle along the transverse arm, was exactly compensated for by such progressively increasing contraction of length (distance) of the longitudinal arm. (Einstein, *Relativity*, p. 59) In other words, the distance/time interval for a light ray at c to propagate a progressively greater contracted distance in the longitudinal direction of motion, and to propagate an unchanging distance in a direction substantially transverse to such motion, would be exactly the same. (Figure 15.3) Therefore, *a priori*, no fringe shift for Michelson would result.

At the solar orbital velocity of the Earth (30 km/s) a miniscule difference in the time interval (shown just to the right of zero on Figure 15.5) could not be visually detected by Michelson. It could only theoretically be detected by the fringe shift of interfering light waves in an interferometer. Because this method did not detect the expected difference in the assumed time intervals, Fitzgerald suggested that almost the only hypothesis that could reconcile Michelson's 1881 null result was his contraction of matter theory. (Fitzgerald, *Science Newspaper*, Vol. XIII, No. 378, 1889, p. 390) However, as we discussed in Chapters 10 and 12, now other much more viable

hypotheses and explanations do exist.

What theoretically happens at the other end of Lorentz's circular 'arc of contractions,' when the theoretical velocity of Michelson's apparatus equals or almost equals the velocity of light: $v^2 = c^2$? According to the mathematical contraction factors of Fitzgerald, Lorentz, and Einstein, the longitudinal arm of the apparatus contracts to zero length; Michelson, his apparatus, and the Earth also contract to zero length and become one dimensional, but the transverse arm of the apparatus remains uncontracted at 'rest length.' (see Einstein, *Relativity*, p. 41) If this zero length apparatus is then somehow rotated through 90° , *a priori* the former transverse arm at rest length will immediately contract to zero length and the former longitudinal arm will immediately spring back from zero length to its uncontracted rest length. All of such mathematical contraction theories obviously cannot withstand their logical maximum extensions.

Numerous supporters of Einstein and other scientists have tried to explain and/or justify these ridiculous contraction hypotheses, apparently in order to support Einstein's Special Theory and his contraction measurements. For example, here are several quotes: "In the Michelson – Morley experiment, the arm of the interferometer in the direction of motion would shrink enough to compensate for the otherwise expected time difference for the round trip of light parallel and perpendicular to the direction of motion." (Goldberg, p. 98) "Every body which has the velocity v with respect to the ether contracts in the direction of motion by the fraction $\sqrt{1-v^2/c^2}$." (Born, p. 220) "The proposed contraction would exactly cancel the second-order effect $[v^2/c^2]$ that had inspired the Michelson-Morley experiment." (Hoffmann, 1983, p. 82) All of these *ad hoc* attempted justifications are also meaningless.

There is also another problem. According to Fitzgerald, Lorentz, and Einstein, the M & M apparatus contracted in the direction of the Earth's motion by a specific amount, “the amount of contraction being just sufficient to compensate for the difference in time.” (Einstein, *Relativity*, p. 59) However, based on current knowledge of the universe, this concept requires us to ask the question: What motion of the Earth were they all referring to, and what was the specific amount of the contraction? Was the motion of the Earth its solar orbital velocity of 30 km/s relative to the Sun, 225 km/s relative to the core of the MW Galaxy, 310 km/s relative to the Andromeda Galaxy, 450 km/s relative to stars on the other side of the MW galaxy, or some other velocity? If there is no absolute or single specific velocity of the Earth through space, how can there be a specific physical contraction of the apparatus exactly sufficient to compensate for it? Michelson's apparatus could not be physically contracting relative to a multitude of different specific magnitudes of velocity all at the same time. By the same token, Michelson's apparatus could not selectively choose just one relative velocity of the Earth (to the exclusion of all others) in order to decide what distance its longitudinal arm must contract.²⁷ (see Chapter 10B)

Therefore, there can be no meaning nor validity to Fitzgerald's, Lorentz's and Einstein's assertions that the dimensions of a rigid body (vis. the Earth and Michelson's apparatus) physically contracts to a specific magnitude in its specific direction of its one specific velocity through space, or with respect to the non-existent ether. (Lorentz, 1904 [Dover, 1952, pp. 11, 21, 28]) Nor can there be any meaning or validity to Einstein's assertions that the ‘difference in time’ intervals “should have been clearly detectible” and

²⁷ We now know that there is no one specific or absolute direction of the Earth's motion through space, and that there is no one specific or absolute *velocity* of the Earth through space. (see Chapter 10)

that Lorentz's contraction solution for the null result "was the right one" (Einstein, *Relativity*, pp. 58 – 59); or that such specific contraction occurs "with respect to the body of reference chosen in the particular case..." (*Id.*, p. 60)

Einstein tried to justify the Fitzgerald-Lorentz ether physical contraction concept as the correct explanation for the M & M null result paradox, so that he could claim the M & M null result as an experimental confirmation of his own similar contraction theory. (see Chapter 36) While at the same time, Einstein and his followers asserted that the contraction was not physical,²⁸ but merely an illusion of Einstein's method of measurement "with respect to the body of reference chosen in the particular case..." But Einstein can't have it both ways. He can't have his illusionary theoretical cake and physically eat it too!

It becomes patently obvious that Fitzgerald and Lorentz's absolute contraction hypotheses make no sense whatsoever for any purpose. They are both completely artificial and meaningless. They were merely illogical mathematical myths of desperation asserted in an attempt to solve a mystifying empirical paradox and a scientific dilemma.²⁹ Likewise, such myths of desperation cannot be selectively used by Einstein in an attempt to confirm his equally artificial contraction concept or his equally meaningless Special Theory.

Aside from the completely *ad hoc* nature of Fitzgerald's, Lorentz's and Einstein's contraction hypotheses, their forced, contrived and circular reasoning, and the other

²⁸ Remember Resnick's statement: "No actual shrinkage is implied, [rather there is] merely a difference in measured results." (Resnick, 1992, p. 472)

²⁹ Even though such contraction hypotheses were a clever and imaginative artificial mathematical fix (Gleiser, p. 194), they were still just invalid hypotheses on their face. If a theory is based on false premises and is logically, empirically or theoretically invalid on its face, then no mathematical ratio or theoretical description of it can rescue such a theory or enhance its validity.

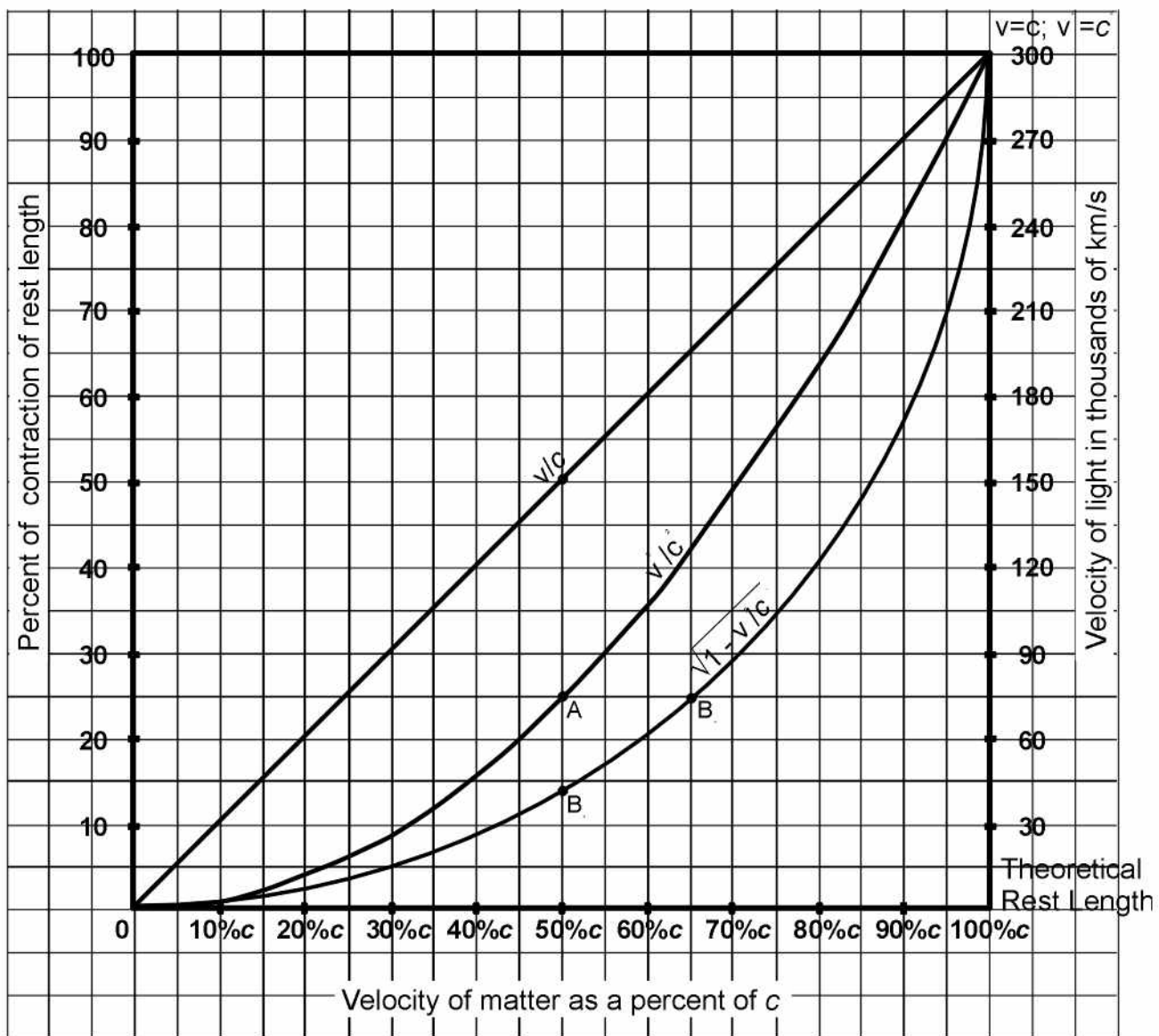
concerns already mentioned, there are two more major problems concerning these contraction hypotheses which need to be mentioned. First, the false assumption that light must travel a greater distance in the direction of the Earth's motions (upon which Einstein's contraction was based) contradicts the second part of Einstein's second fundamental postulate that light propagation on the surface of the Earth is independent of the Earth's motion. (see Chapter 22F) Second, there was really nothing for Fitzgerald, Lorentz and Einstein to attempt to explain. Michelson's experiments measured exactly what they were designed to measure: the constant transmission velocity of light at c in all directions, regardless of the assumed motion or direction of its material terrestrial light source (real or imagined), and nothing else.³⁰ The then widely accepted concept of ether turned out to be non-existent, thus no creative hypothesis could rescue it. No physical terrestrial displacement of Michelson's mirrors with respect to the ether was possible. The relative motions of the Earth vis-à-vis an infinite number of other co-moving bodies floating in the Cosmos also turned out to be impossible to detect or measure, especially by Michelson's interferometer method. The paradox of Michelson's null results was readily explainable on its face, without any contrived hypothesis concerning the contraction of matter. (Chapters 10, 11 and 12) Thus, Fitzgerald's, Lorentz's, and Einstein's *ad hoc* mathematical 'theories of desperation' were never even necessary. They were all meaningless, unnecessary, and irrelevant to anything.³¹

³⁰ Michelson's null results were actually a confirmation of Maxwell's theories and equations concerning the constant transmission velocity of light at c . They merely added two other phrases to Maxwell's concept of the constant transmission velocity of light at c : "in all directions regardless of the motion of its source body," and regardless of the relative motions of other bodies. (see Chapters 21 and 22)

³¹ In later chapters we shall demonstrate that Einstein's Special Theory and his Lorentz transformation equations also suffer from many of the same theoretical problems that render Fitzgerald's, Lorentz's and Einstein's contraction theories and contraction factors invalid and meaningless.

Chart 15.1 Comparison of Experiments and Theories...and Their Assumed Ether Effects

Experiment or Theory & Creator	Date	Assumed Ether Effect	Other Results & Implications
Galilean Relativity (Galileo)	1632	None	
Jupiter Moon Exp. (Roemer)	1676	None	Light has a finite velocity
Aberration of Starlight (Bradley)	1727	None	Velocity of light is constant
Arago's Telescope Focus Exp.	1810	Partial ether drag	The basis for Fresnel's Ether Drag Coefficient
Fresnel's Stationary Ether Theory and Ether Drag Formula	1818	Stationary ether; and partial or total ether drag	Ether is normally absolutely at rest; but it can be dragged along by moving matter depending upon the index of refraction of the medium
Doppler Effect of Light	1848	None	Quantifies velocity of relative linear motion; strongly supported wave theory
Light in a moving medium (Fizeau)	1851	Partial ether drag	44% of the motion of water is imparted to the velocity of light propagating through it
Maxwell's EM Equations	1873	Written with respect to ether	Light is a form of EM; transmission velocity of light is constant c relative to medium of ether in empty space
Michelson Interferometer	1881	Ether does not exist	Velocity of light is c in all directions; ether wind does not exist; all motion is relative
Lange's Relativity and Galilean Transformations	1885	Stationary ether an absolute reference frame	Because of the Galilean Addition of Velocities, the transmission velocity of light appears to mathematically vary from $c - v$ to $c + v$ relative to moving objects.
Michelson & Morley Interferometer	1887	Total ether drag or ether does not exist	c is independent of motion of its source; the velocity of light is c in all directions; result cast further doubt on existence of ether
Contraction Theory (Fitzgerald & Lorentz)	1895	Ether contracts matter in the direction of motion	Matter is contracted in the direction of motion through ether; attempted to defend ether hypothesis; tried to explain M & M results
Lorentz Transformation Equations	1904	Ether contracts matter in proportion to relative velocity	Matter is contracted and time is dilated (expanded) proportionally to the velocity of matter; time is local; the theoretical and mathematical basis for Special Relativity
Einstein's Special Theory of Relativity	1905	Ether is irrelevant (does not exist)	Galilean transformation is modified so that the velocity of light is always a constant c in every inertial frame; tried to defend Maxwell's equations and explain M & M null results



The theoretically contracted M & M longitudinal arm depicted in Figure 15.3 is plotted at point A...a 25% contraction of the apparatus (matter) at its assumed velocity of 50% of c . This correlation is consistent with FitzGerald's contraction magnitude ratio of v/c .

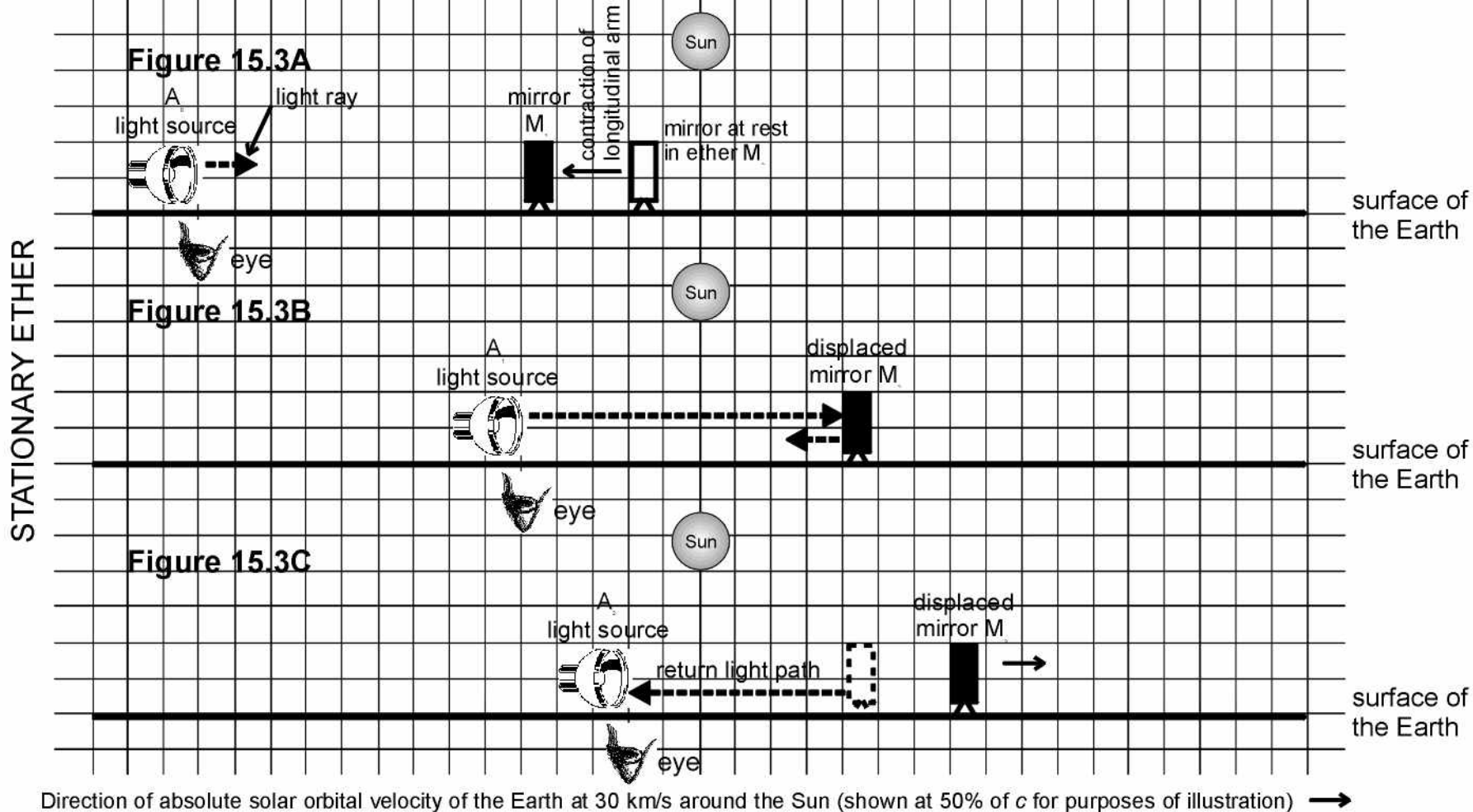
However, when the same values are plotted for the Lorentz's contraction factor $\sqrt{1 - v/c}$, such contraction is located at B₁ and such velocity at B₂. Thus, Lorentz's contraction factor shows no correlation with FitzGerald's contraction ratio, except when $v = 0$, or $v = c$.

The two contraction factors contradict each other.

Figure 15.5 FitzGerald's Contraction Ratio (v/c) Compared With Lorentz's Contraction Factor $\sqrt{1 - v/c}$

Chart 15.4
Algebraic Increments Of Contraction Factors & Ratios

A	B	C	D
Velocity of matter	Fitzgerald's Contraction Ratio v^2/c^2	Lorentz Contraction Factor $\sqrt{1 - v^2/c^2}$	Lorentz Rest Length Uncontracted Factor $1/\sqrt{1 - v^2/c^2}$
v as a % of c	% of contraction of rest length	% of contraction of rest length	% of uncontracted rest length
0% (rest)	0%	0%	100%
1%	0.01		
5%	0.25		
10%	1.0	0.5013	99.4987
15%	2.25	1.1315	98.8685
20%	4.0	2.0205	97.9795
30%	9.0	4.6061	95.3939
40%	16.0	8.3485	91.6515
50%	25.0	13.3975	86.6025
60%	36.0	20.0000	80.0000
70%	49.0	28.5858	71.4142
80%	64.0	40.0000	60.0000
90%	81.0	56.4111	43.5889
95%	90.2500	68.7751	31.2249
96%	92.1599	72.0000	28.0000
97%	94.0900	75.6900	24.3100
98%	96.0400	80.1003	19.8997
99%	98.0100	85.8933	14.1067
99.5%	99.0025	90.0126	9.9874
99.9%	99.8001	95.5290	4.4710
99.99%	99.9800	98.5858	1.4142
99.999%	99.9980	99.5528	0.4472
99.9999%	99.9998	99.8586	0.1414
99.99999%	99.99998	99.9998	0.000019



The light source and the mirror M_0 are at rest in the stationary ether and they are affixed to the surface of the Earth at a finite distance of 12 squares apart. Then we assume that they move in tandem to the right at 50% of c relative to the stationary ether and the Sun theoretically at rest in the ether. A priori the distance between them was now contracted to 9 squares. A light ray leaves the terrestrial light source at point A_0 and transmits at 100% of c toward the mirror at point M_0 . (Figure 15.3A) During such propagation, the mirror displaces from point M_0 to point M_1 due to such absolute solar orbital velocity of the Earth with respect to the stationary ether. (Figure 15.3B) The light ray contacts the mirror at point M_1 after traveling 18 squares (from A_0 to M_1). The light ray then reflects from the mirror at M_1 and begins to propagate back toward the light source. (Figure 15.3B) During such propagation, the light source and Michelson's eye displace from point A_0 to point A_1 and thereafter to A_2 .

When the light ray returns to the light source at A_2 (Figure 15.3C) the light ray has traveled a total distance/time interval of 24 squares while the light source and the mirror have displaced in tandem 12 squares. A decrease of 8 squares because of the contraction. Theoretically, if there had been no contraction, then the light ray would have traveled a total distance/time interval of 32 squares (see Figure 9.2). These were proportional to Einstein's computations for a greater distance/time interval 'difference,' which he referred to in his book "*Relativity*" at pp. 58 - 59.

Figure 15.3 What *A Priori* Happens When A Light Ray Travels From Beam Splitter (A) To Reflecting Mirror (B) And Back To (A) In The Direction Of Motion Of Michelson's Longitudinal Arm Which Is Contracted

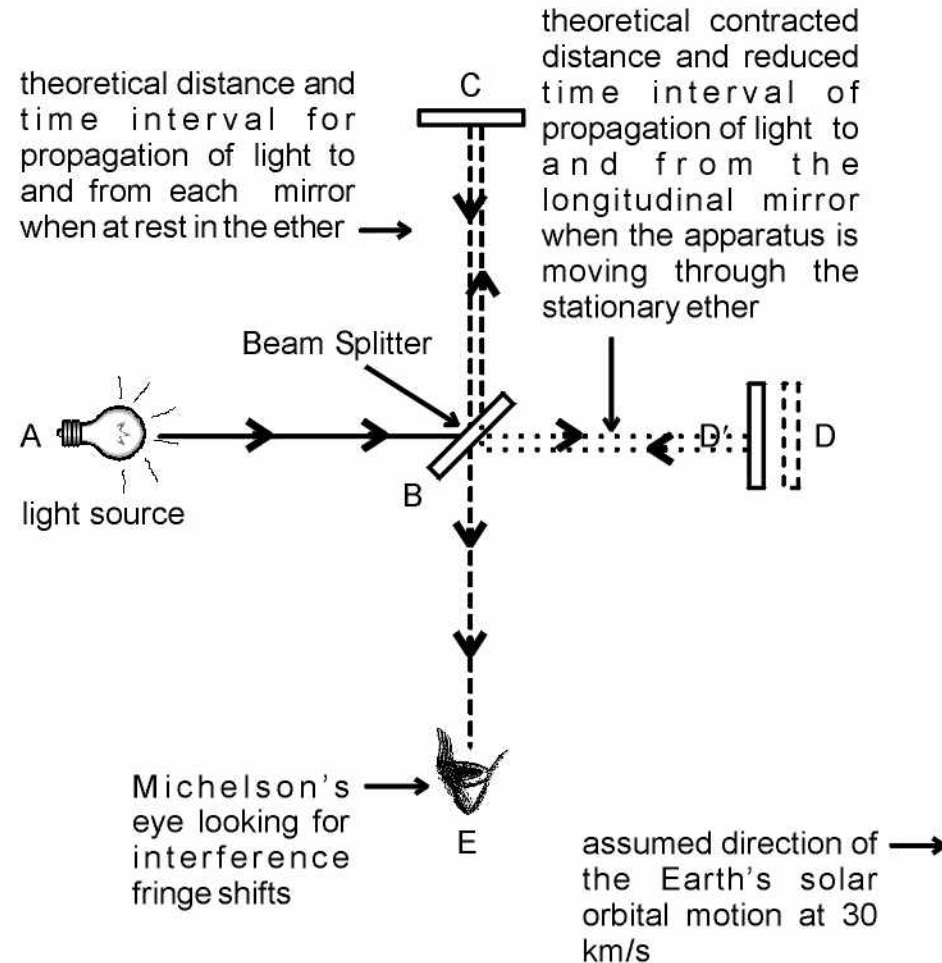
Figure 15.2 The Fitzgerald-Lorentz Theoretical Contraction of Michelson's Interferometer Apparatus

Fitzgerald and Lorentz were both staunch believers in the ether at rest hypothesis and sought to rescue the ether concept by explaining Michelson's null results.

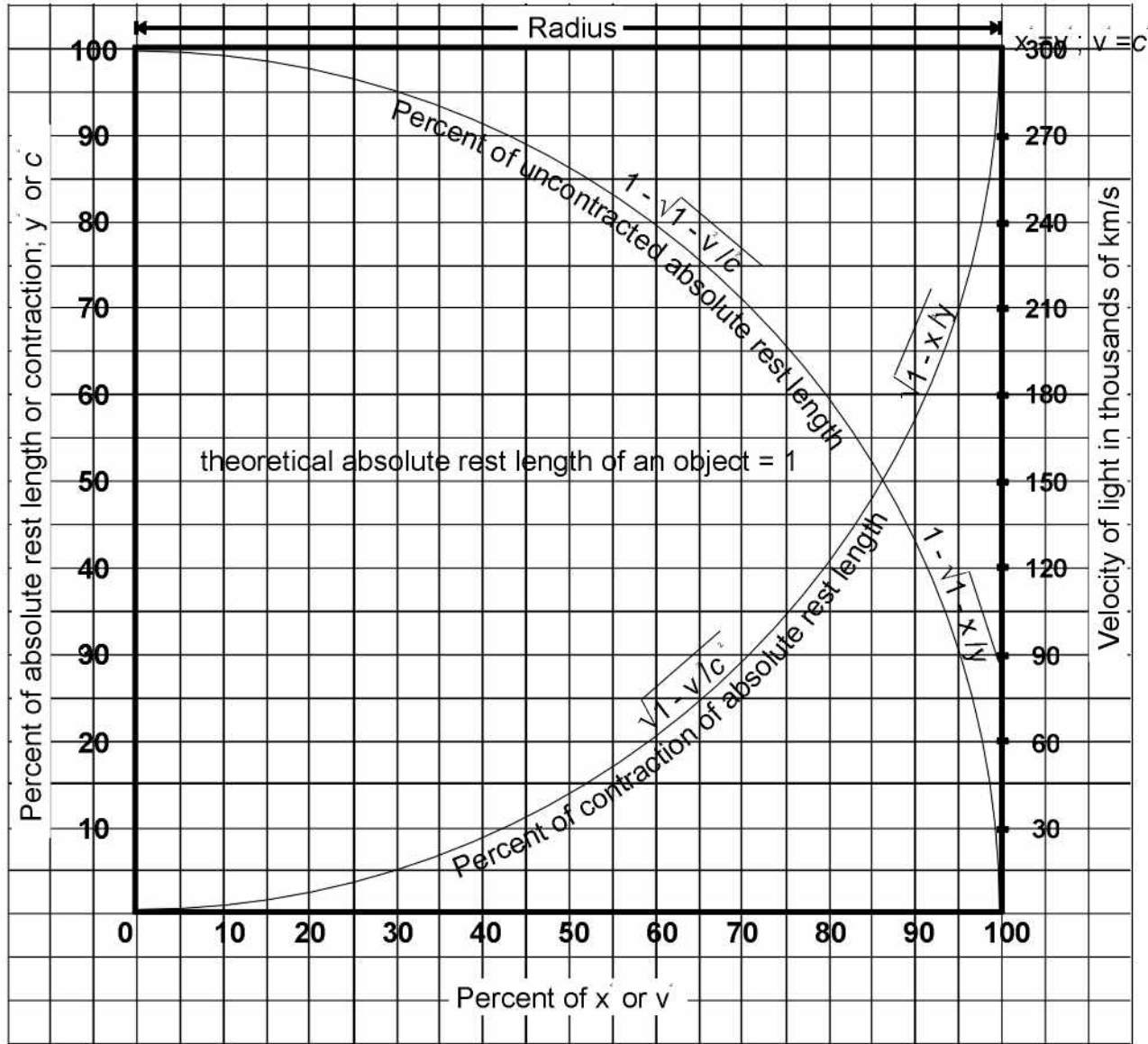
They speculated that if the length (BD) of the longitudinal arm of Michelson's apparatus was physically contracted (shortened) in the direction of the Earth's solar orbital motion (30 km/s) through the ether and became a new shorter length (BD'), then light would have less distance to propagate from B to D' and back to B, than when the apparatus was at rest in the ether. This, of course, was on its face an invalid absolute concept.

Since the time interval of propagation would also be proportionally shortened in the direction of such motion, then we would have "the amount of contraction being just sufficient to compensate for the difference in time." (Einstein, *Relativity*, p. 59) This imaginative theory mathematically explained why a greater time interval of propagation in the direction of the Earth's motion was not detected by M & M in the form of a fringe shift.

But it turns out that Fitzgerald's, Lorentz's and Einstein's wildly *ad hoc* conjectures were based on nothing more than imagination and their scientific agenda.



(NOT EXACTLY TO SCALE)



$\sqrt{1 - x/y}$ is a general algebraic factor which basically describes the moving radius and the ascending arc of a quarter of a circle. It also describes a finite quantity of x increments (i.e. 0 to 300,000 increments) progressively distributed in an arc from 0% of y to 100% of y .

It turns out that Lorentz's contraction factor $\sqrt{1 - v/c}$ is merely a special application of the above general algebraic formula where the moving radius describes progressive increments of v from 0% of c to 100% of c . In other words, it shows the theoretical percent of contraction of absolute rest length. When $\sqrt{1 - v/c}$ is subtracted from 1 (absolute rest length) it shows the 'percent of uncontracted absolute rest length;' again as the descending arc of a quarter of a circle.

[Note: Absolute rest length is an impossible absolute concept because there is no absolute rest of matter.]

Figure 15.6 What Does Lorentz's Contraction Factor $\sqrt{1 - v/c}$ Really Describe?