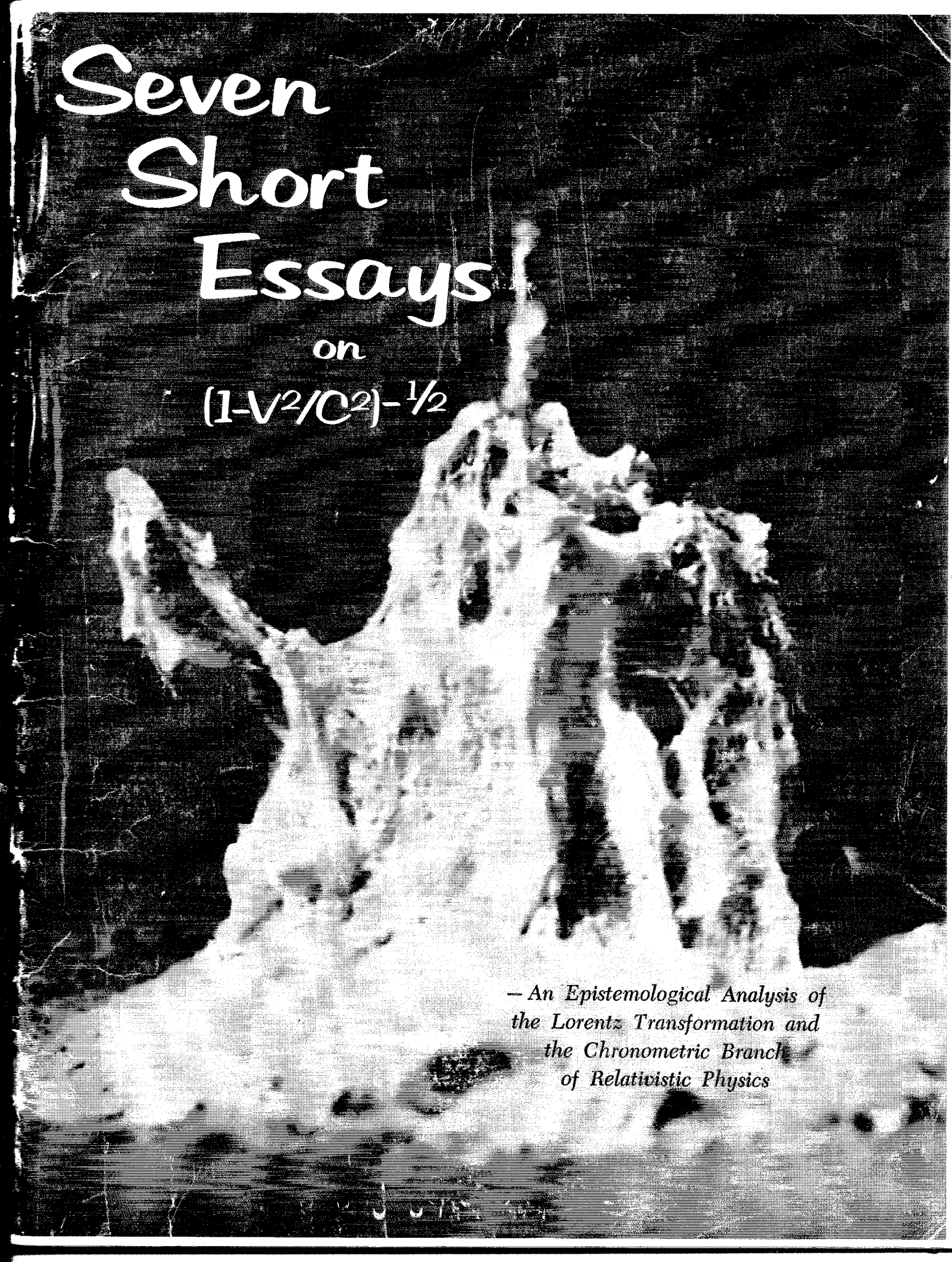
Seven
Short
Essays
on
$(1-V^2/C^2)^{-1/2}$
— An Epistemological Analysis of
the Lorentz Transformation and
the Chronometric Branch
of Relativistic Physics

These relatively short essays represent the reworking of parts or aspects of a larger and as yet unpublished manuscript, originally entitled: *The Einstein Error,* but submitted in abstract form to the 8th International Conference on General Relativity and Gravitation under the title: *An Epistemological Analysis of the Lorentz Transformation and the Chronometric Branch of Relativistic Physics.* The material derives from a detailed historical study of the Special Theory—origins, derivations, and assumptions right into present times. The first essay, which is also the longest, attempts to reduce to summary statement the principal disclosures. The following four play selectively upon some of the features judged particularly critical to the conclusion that both the Lorentz transform and the Special Theory are of fundamentally erroneous construction. The sixth essay analyzes and reconstitutes the Einstein postulates; and finally the seventh proposes a tentative physical model to replace that of the Special Theory until something better comes along. In this (1) both the Newtonian concept of Euclidean space and the Einsteinian hypothesis of velocity-dependent time are abandoned, (2) the cosmological 3-space of the General Theory is brought instead to a quasi-absolutism through a zoning or field-structuring of either gravitational or electrodynamic sort, (3) Einstein's concept of the "inertial" frame is replaced by a "closed frame" defined as having appropriate autonomy over whatever laws of physics may be involved in a given transformation, and (4) the Galilean transform, unmodified except possibly for non-Euclidean curvature in 4-space, is then used relative to natural rest coordinates of the respective embedding frame—electromagnetic for electrodynamics, gravitational for mechanics, acoustical for acoustics.

Since these essays were not prepared in a serialized form as chapters, but variously and individually as separate publications, they may show some overlap and misfit.

# Seven Short Essays on $(1-V^2/C^2)^{-1/2}$

*– An Epistemological Analysis of the Lorentz Transformation and the Chronometric Branch of Relativistic Physics*

by

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# Foreword

In 1905 Albert Einstein consummated a 20-year controversy over the proper form of the transformation equations and the procedures to be used for the mensuration of time and space. To do this, he first formulated two hypotheses, one on the universality of natural law, the other on the constant and limiting velocity of light; and he then derived his transformation equations, which proved to be those previously published by Larmor in England and Lorentz in Holland, also contemporaneously by Poincaré in France:

$$x' = \gamma(x - vt) \quad ; \quad y' = y$$
$$t' = \gamma(t - vx/c^2) \quad z' = z$$
$$\gamma = (1 - v^2/c^2)^{-\frac{1}{2}}$$

Minkowski shortly put these into geometric expression

$$ds^2 = dx^2 + dy^2 + dz^2 - c^2dt^2$$

whereupon Einstein himself turned to the geometrization of space with a metric based upon a concept of spatial curvature as a function of mass density

$$ds^2 = d_{\mu\nu} d_\mu d_\nu$$

This constituted his non-Euclidean General Theory involving acceleration due to gravity, as contrasted to his Euclidean Special Theory restricted to relative motion under conditions of constant velocity.

Both theories have been highly productive. However, where the grandiose concepts of the General Theory have continued to invite exploration, extension, and modification, the simpler but more rigid Special Theory has continuously produced annoying paradoxes. And despite countless rationalizations that have been offered, any paradox stands as a mark of error—often of especially subtle sort, but nevertheless of error. Therefore, something is probably fundamentally wrong with the Special Theory.

About a decade ago the present writer undertook an intensive re-examination of the foundations of relativistic physics, and specifically the Special Theory—an epistemological analysis of the stepwise evolution by which the Special Theory came into being. Epistemology is the discipline of logical processes of thought; and this study finally disclosed an error of considerable subtlety but vastly extenuating sort, having at least a threefold aspect: First was Einstein's choice of a conceptual model of fundamentally mechanical rather than electromagnetic sort—his "inertial frame"—to define and describe local autonomy over natural laws, including those of electrodynamics. For both a jet aircraft and planet Earth qualify equally as an "inertial frame"; yet there is assuredly a great difference between holding a conversation inside the compartment of the aircraft, and attempting to do so out on the wing. Einstein recognized no such distinction in discussing analogies in electrodynamics. Instead he used what might be called an "open frame" for his model—out on the wing—rather than a "closed frame" which properly exerts the alleged autonomy over whatever category of natural law might be under discussion—gravitation, mechanics, acoustics, electrodynamics, or nuclear interactions.

Second, and spawned directly by the first, arose the error of presuming

that the various earthbound instruments of experimental physics aimed at measuring the planetary motion through space were not at rest relative to the transmitting field—that the Michelson interferometer was "out on the wing" instead of inside the compartment, and therefore subject to an "ether wind", yet not responsive to it. He did this despite such evident analogies of local rest coordinates as the known geocentricity and mass-centricity of gravitational fields, also the *Aurora borealis* whose overarching electrodynamic displays are obviously geocentric. He gave no consideration to the possibility that the instrumentation of experimental physics has always produced a null datum because the instrument has always been electrodynamically at rest. To the subsequent action taken to mask out a normally expected second-order Doppler effect by mathematical means—adding the $\gamma$-factor $(1 - v^2/c^2)^{-\frac{1}{2}}$ to the Galilean transformation to create the Lorentz transformation—is to be attributed every paradoxical situation incident to the Special Theory of Relativity.

Third, relativists in general, and Einstein in particular, next proceeded to forget that first crucial assumption of the arbitrarily chosen "open frame" physical model. The result has been the fivefold structuring of "bootstrap" hypotheses which is the subject of the opening essay, bringing relativistic physics back full-circle to points of contradicting that which it originally espoused—a truly relativistic universe with no preferred frame. One should not forget his assumptions.

Two corollaries of the STR have been largely responsible for its subsequent grip upon relativistic physics: (1) The mass-energy equivalence principle $E=mc^2$, and (2) the postulate of the universality of natural law. And indeed these should remain inviolate. The fact that Einstein first derived $E=mc^2$ from the STR, however, does not mean that its derivation depends upon the STR; for Einstein himself in later years showed its deriveability from equations of classical physics. As for the First Postulate, this neither requires nor necessarily leads to a Lorentz transformation, as one of the present essays will show. The Second Postulate properly remains open to tachyonic analysis.

While the seventh essay does offer a program and model for structuring and measuring space and time, these essays do not aim so much at solving the historic puzzle of the so-called ether—a puzzle which remains with us today, even if the ether does not—as merely to call the attention of physicists to the fact that the time has certainly come when the foundations of the STR must be re-examined.

Carl-J Keith
25 July 1977
Medicare Day

Essay I

# The Fivefold Hypothetical Structure Underlying Time Dilation and the Special Theory of Relativity

*ABSTRACT*

*The epistemology of the Special Theory of Relativity is reduced to concise expression under six heads, with a seventh particularizing the Hafele-Keating experiment; and from these there follow the definitions of five hypotheses seen to succeed one another in the constructions incident to the development of modern chronometric relativity.*

In the chronometric branch of relativistic physics—that having to do with Einstein's Special Theory—some physicists have long been disturbed by the so-called paradox of time-dilation. The following analysis of the epistemology of the Special Theory has been reduced to a *précis,* a minimum expression of its fundamental features, in an attempt to come to grips with certain of its aspects which do indeed seem to merit criticism and continued discussion. It is not right that the finest discipline in the physical sciences should contain within it unnecessary violations of those basic rules of logic and reasoning which belong to the guiding hand of epistemology.

## I. The Theory

That which is today known as the Special Theory of Relativity is neither more nor less than the body of specialized information contained within, and inherent in, the set of mathematical equations known as the Lorentz Transformation:

$$x' = \gamma (x - vt) \quad ; \quad y' = y$$
$$t' = \gamma (t - vx/c^2 \quad z' = z$$
$$\gamma = (1 - v^2/c^2)^{-\frac{1}{2}}$$

These equations uniquely express, on the one hand, the content of the Special Theory; and on the other hand they define its span of authority. Rendered in terms of geometry:

$$ds^2 = dx^2 + dy^2 + dz^2 - c^2dt^2 = 0$$

the equations uniquely produce that particular hyperdimensional form known as the Minkowski space-time continuum. Therefore all three aspects—physical theory, mathematical formulation, and geometrical representation—concern a unity, a single subject within the discipline of physics, such that any alteration of one must similarly alter all three.

## II. The Founders

Since the Lorentz Transformation was proposed and published[1] more than an entire year before Einstein finished writing his manuscript[2], Lorentz might properly be called the Founder of the Special Theory of Relativity. Because Poincaré had independently derived these equations[3] prior to the time that Einstein completed his manuscript, he might also be regarded as the Founder of the Special Theory, and more particularly because he was (a) the first to discuss the new physics in terms of a *Postulat de relativité,* (b) the first to discuss the two Postulates later identified with Einstein, and (c) the first to derive the mass-energy equivalence principle[4]. But in view of the fact that Joseph Larmor in England had published the identical transformation in a book four years prior even to Lorentz, and in a paper two years before that[5], Larmor has the best claim among these three. The historically accepted mantle of founder, however, has fallen upon Einstein, and properly, because he was (1) the first to generalize a previously particularized hypothesis, (2) the first to discover and then to explore the consequences of the new mathematical form in terms of a universal physical model, and then (3) the first boldly to treat the consequences not only with respect to measurements of space, but above all to measurements of time. For when the attention of the geometer Minkowski was drawn to the newly postulated physics, it was this feature of a velocity-dependent unit of time that attracted him, with its prospects of bridging the heretofore absolutes of time and space in a velocity-sensitive "space-time continuum"[6].

## III. The Original Derivation

The Lorentz Transformation—and hence the Special Theory—represents a particularized attempt to solve the problem of simultaneity for physical systems in relative motion, when information is limited to signals of finite velocity. Despite the modern consensus, its equations are not restricted to light signals, neither are they unique to electrodynamics; for they can be derived with equal facility from sonic or even ballistic considerations depending upon one's choice of physical model*. Rather does their uniqueness follow from a *critical assumption,* namely that the relative velocity of the two systems in question is without effect upon signal velocity—not only for each observer within his own system, and for signals passing between the two systems, but even for signals within the one or the other system as may be measured by observers in either system. Thus $c$ becomes an "everywhere constant"—an assuredly unique concept, but completely dependent upon the assumption behind it.

Regardless of the manners in which the equations of the Lorentz transformation have later been applied, they stem directly and historically from the null optical datum of the Michelson-Morley experiment[7], and should be so viewed for epistemological analysis. To Lorentz and FitzGerald the first challenge was specifically to account for a null datum in a system having supposed real motion relative to the cosmic dielectric field referred to at the time as "ether". This they achieved by hypothecating an actual contraction of the physical system in the line of motion, on the basis of current considerations of dimensional deformation of electrons moving at high velocity. Since the lengthening of signal path along the transverse arm under conditions of real motion would be proportional to the Pythagorean factor $P = (1 - v^2/c^2)^{-\frac{1}{2}}$, as compared to the Dopperlian factor $D = (1 - v^2/c^2)^{-1}$ for the longitudinal arm, the necessary postulated contraction became $D/P = P = (1 - v^2/c^2)^{-\frac{1}{2}}$—the Lorentz-FitzGerald contraction.

To Lorentz, Larmor, and Poincaré a second challenge immediately followed from the first, namely to achieve covariance in group transformation between two systems in relative motion when the units of physical measurement in the one were altered. A greatly extended debate finally found itself restricted by the rather elementary consideration that time-space relationships $x_i = ct_i$ require identical modifications of $x_i$, $t_i$ if $c$ is to be kept constant, and covariant transformation maintained. Thus the Pythagorean factor $(1 - v^2/c^2)^{-\frac{1}{2}}$ necessarily became applied to $t$ as well as to $x$—and the concept of time dilation as well as space contraction came into relativistic physics. But to Lorentz it was a "local" time, observational only, not real.

In points of physical model, this original and *critical assumption* took the form of an "ether wind" to which instrumentation is not responsive, and therefore for which $(c \pm v)$-signal velocities do not apply. In mathematical form, the new transform equations aimed at explaining this seemingly demonstrated lack of response of the Michelson interferometer to what had been *assumed* to be real motion through a real dielectric field. Little thought was given at that time, nor has it been given since, to the alternative and equally valid assumption that the interferometer was at rest relative to the rest coordinates of the signal-transmitting field; neither to the epistemological requirement that any such experiment equally tests the question, not only of instrumental responsiveness or nonresponsiveness to an "ether wind", but whether indeed the so-called "ether" was "blowing" at all, or was quiescent. Therefore, and regardless of all later modifications in both interpretation and application, the Lorentz transformation necessarily retains these two epistemological features: (1) Derivation based upon the particular, arbitrary, and critical assumption of instrumental nonresponsiveness to motion relative to the signal-transmitting field, and (2) neglect of consideration for the equally valid assumption that no such relative motion exists for earth-based instruments.

## IV. The Einstein Modification

When Einstein turned his attention upon the problem of simultaneity, thus presumably presented by the null datum of the Michelson-Morley experiment, he gave his contribution enduring character by generalizing the null datum so as to apply equally—and reciprocally, so he said at first—to all systems in relative motion, and to the extent of denying that any type other than relative motion exists. This last had long been acceptable to philosophers within classical physics anyway, and does not of itself lead to the Lorentz equations. However, in place of the particular physical model provided by the Michelson interferometer, affixed to the earth and presumed to be traversing a field having cosmic rest coordinates, Einstein simply sent the forward arm only, of a "flying interferometer" into space—the "rigid rod" of his famous *Gedankenexperiment*—and then presumed in turn that the null datum would still obtain, despite the fact that to this day no such experiment has ever been performed. Only the circumnavigating clocks of the Hafele-Keating experiment stand as an exception to this statement; and there the results were *non*-null, though strangely enough turned as well to support the Einstein theory.

Interestingly, instead of standing alongside the *real* instrument in this known moving terrestrial system $S'$, with such companions as Michelson, Lorentz, and the previous workers in the new physics, Einstein remained behind in a *theoretical* stationary system $S$ which would correspond to the supposed cosmic frame of Lorentz, then studied the signals from $S'$ as it moved relative to him, into outer space.

Thus Michelson in the Lorentz model directly reported to Lorentz that he could detect no motion of this moving

*See Essay IV: *Acoustical and Ballistical Derivations of the Lorentz Transformation.*

planetary system $S'$, while Einstein in his model let Michelson forward this same information to him by signals of finite velocity $c$, emitted from this now rapidly receding $S'$, and again presumed to be velocity-independent.

Mathematically, Einstein simply neglected the second-order Dopplerian alteration of signal distance by insisting upon $c$ velocities in place of $(c \pm v)$ for all spherically propagating wave fronts.

$$x_i^2 + y_i^2 + z_i^2 = c^2 t_i^2$$

as observed from any and all systems in relative motion at velocity $v$. Then, because of the same requirements confronting earlier workers, of an identical alteration of $x$ and $t$ for covariant group transformation, and again with the fortuitous algebraic relationship $D=P^2$, Einstein of course arrived at the identical equations of the Lorentz transformation. Time and space were each equally modulated by the Pythagorean factor $(1 - v^2/c^2)^{-\frac{1}{2}}$, whereupon the doubled use of that factor in $c = x/t$ totally disguised the second-order Dopplerian alteration of motion in real time and real space. And precisely at this point was the great step taken away from the Lorentzian "local" time to something vastly more consequential.

While Einstein's actual stepwise approach was quite labored, and along a somewhat different path from that just given, all derivations of the equations of the Lorentz transform necessarily involve simple algebraic features of substituting $c$ for $(c \pm v)$ velocities in to-fro signalling, erasing thereby the second-order Dopperlian $(1 - v^2/c^2)^{-1}$ factor of real transit in real space, and compensating for it by a doubted application of the Pythagorean $(1 - v^2/c^2)^{-\frac{1}{2}}$ factor—once to time and once to space as required by covariance in group transformation.

## V. Einstein's Two Postulates

Prior to the time of the Michelson-Morley experiment, there was no problem with simultaneity between systems in relative motion, neither in covariant group transformations. Until disturbed by the Lorentz-FitzGerald contraction, Maxwell-Hertz field theory remained in consistent relationship with Dopplerian calculations of classical physics. At that time, and contrary to virtually unanimous modern opinion, neither of Einstein's two postulates carried any really new message to physics*: The laws governing a game of tennis aboard a moving ship are the same as those ashore, and the velocity of any signal transmission, whether through field or medium, is not only a constant, but a characteristic of the transmitting agent and independent of the velocity of the source. Neither do these postulates today depend upon the particular form of the Special Theory for their support—though certain extensions in their interpretation assuredly do.

Instead, Poincaré and Einstein were expressing reaffirmations of faith in two basic principles of classical physics which had become seriously threatened by *the particular choice of interpretation*, virtually unanimous at the time, placed upon the null datum of the Michelson-Morley experiment. The First Postulate—that the laws of nature remain both valid and consistent for any observer, in any place and at any time—never needed statement until this seeming requirement appeared for altering the basic intervals or units of measurement for time and space. The Second Postulate—the constant and limiting value of $c$ for the velocity of light, independent of the velocity of the source—stood, and still stands, so inherent a part of Maxwell-Hertz formulations for the electromagnetic field that it would be necessary to alter the ratio of the electrostatic unit to the electrodynamic unit in order to change it. Thus the Second Postulate reaffirmed that this basic feature of natural law must remain as defined by classical physics. Purely as an adventitious growth, consequent to the Special Theory rather than antecedent to it, has been the strange "everywhere constant" $c$, referring to intersystem as well as intrasystem exchanges. The fact that both Postulates thereafter became so closely identified with the Special Theory followed not from any novelty of the Postulates themselves, but rather from the interpretations subsequently attached to them by relativists struggling with the seeming requirement of velocity-dependent time. Remove that requirement, and the postulates will be found still to stand, in the form originally given by Einstein and Poincaré.

## VI. The Third Hypothesis

At the time of the interferometric experiment there were three possible physical models from which to choose. To quote Michelson[8] in 1897: (1) There is no interaction of moving bodies with the presumed "cosmic ether", (2) the moving body contracts as proposed by Lorentz and FitzGerald; or (3) the orbiting earth carries "cosmic ether" with it to some thickness perhaps the order of an earth radius. This today would obviously be the magnetosphere. The first would conflict too severely with Maxwellian field theories, the third apparently seemed unreasonably hypothetical in those days before the magnetosphere was well identified and measured. This left only the second model. And from this unfortunate but understandable choice there then followed everything that we have today in the way of the Special Theory of relativistic physics, the Lorentz transformation, and the hyperdimensional space-time continuum—along with all the annoying "paradoxes" incident to an unrealistic distortion of space and time. Hindsight—with its advantages of modern knowledge of geophysics and astrophysics—now clearly shows that the physicists who founded the Special Theory should have selected for their physical model the Third Hypothesis, as it was termed by Michelson at the time[8].

For we now seem to have demonstrated for us, in the province of geophysics, that the earth does indeed carry its own electromagnetic field—or "ether" in the earlier terminology—to distances outward which suffice

*See Essay VI: *Einstein's Three Postulates and the Erroneous "Inertial" Frame*

to embed and protect measuring instruments of electromagnetic sort, such as Michelson's interferometer, stationed upon the surface of the earth and at rest with respect to earth axes. Just as the rest coordinates of the magnetosphere are obviously geocentric, so are those of the instrumentation. Like the sonic analog provided by a jet aircraft, where sheet aluminum protects passengers from the violence of traversing an embedding atmospheric field, so does a magnetopause locate the bounding walls of contact and collision of the magnetosphere as the earth plunges through the embedding heliosphere. There is indeed a difference between holding a conversation using sonic signals within the aircraft, or attempting to do so out on the wing; and this difference Einstein failed to recognize. Michelson's interferometer registered a null datum for relative rest because it was at rest relative to the embedding magnetospheric field. As for Einstein's "rigid rod", physics to this day holds no datum proving that any instrument sensitive to detecting variations in a Maxwellian field would fail to register real motion through that field.

## VII. The Atomic-Clock Transport

Only one experiment has thus far gone on record, in the entire history of physics, in which the instrumentation incident to studies of the Special Theory has itself actually had a real velocity $v$ with respect to the axes of the embedding terrestrial magnetosphere—the "ether" of classical and Maxwellian physics. This was the renowned Hafele-Keating circumterrestrial experiment with cesium "clocks"[9]. The meticulous consideration of these authors for such factors as temperature, pressure, magnetic fields, and even the gravitational red-shift, relative to the delicate functioning of their highly accurate mechanisms, has unquestionably led to real data on hyperfine electronic transitions in the ground state of the $^{133}Cs$ atom relative to this real velocity $v$; but as for their data standing as experimental proof of the Special Theory, the following three points need first be raised and answered:

*Query I*

First, the question must be asked: Is this cesium clock really the equivalent of the "rigid rod" of the Einstein *Gedankenexperiment,* upon which the Special Theory is assuredly based? We will recall that the original conflict—the presumed conflict, that is—with classical physics concerned the nature of time-space relationships in the transmission of light; that the mathematical origins arose out of considerations of defining simultaneity between two systems whose relative motion necessarily altered spatial measurements because of unavoidable delays incident to finite signal velocities; that the final choice of the transformation equations was based upon acceptance of the Lorentz-FitzGerald alteration of the spatial length or unit itself, as seemed to be required by the interferometric experiment, also acceptance of the associated mathematical requirement of an identically altered chronometric interval or unit; and that this then led to the adoption of a particular kind of an "everywhere constant $c$" physical model which repudiated the Dopplerian $(c \pm v)$ velocities of classical relativistic physics.

Even those historians who de-emphasize the dependence of the Einstein concept upon the Michelson experiment will admit that both that concept and that experiment fundamentally concerned the passage of light waves through space, and in identical to-fro manner as signal carriers. Therefore hypothesis must assuredly enter in relating a conclusion drawn from the passage of light waves to data on frequency variations in electronic orbital transitions.

Hafele and Keating say:

> Special Relativity predicts that a moving standard clock will record less time compared with (real or hypothetical) coordinate clocks distributed at rest in an inertial reference system.

But this is not quite what Einstein said, at least not in his original exposition. For certainly Einstein began with a discussion of the physical model which became defined by his First and Second Postulates, and which specifically freed physics from the singular reference system indicated in this quote. Born[10] defines the First Postulate as follows:

> There are an infinite number of systems of reference (inertial systems) moving uniformly and rectilinearly with respect to each other, in which all physical laws assume the simplest form (originally derived for absolute space or the stationary ether).

Einstein[2], discussing spatial contraction and time dilation in his paper, states:

> It is clear that the same results hold good of bodies at rest in the 'stationary' system, viewed from a system in uniform motion.

So we have to do not with "an" inertial reference system, but with two or more, each of which enjoys equal privileges. Einstein's considerations were *not* based upon a "*moving* standard clock . . . compared with . . . clocks distributed at rest in *an* inertial reference system", but rather upon *clocks at rest,* each within its own system, these *systems* then having motion relative to each other. Einstein did not have to shield his moving clocks against possible effects of lines of force from traversing the geomagnetic field; Hafele and Keating did.

Since Einstein himself later said some things not entirely consistent with his original *Gedankenexperiment*, we shall rephrase the Hafele-Keating quote in the following manner, judged to be in better keeping with the epistemology and the fundamental formalism of the Special Theory:

> Special Relativity predicts that a standard clock at rest within any given system $S'$, this system having motion relative to an observer's system $S$, will record less time than clocks distributed at rest within $S$.

As for Einstein's own statement regarding the very experiment that Hafele and Keating set out to check, he states[2]

> . . . that a clock at the Equator must go more slowly, by a very small amount, than a precisely similar clock situated

at one of the poles under otherwise identical conditions.

So to follow the letter of the law, the cesium clocks should be left at rest, one at a low altitude and the other at a high, the rotation of the earth itself producing the motion whose velocity causes the predicted changes. This would avoid one of the most serious charges to be made against the experiment, namely that the *Einstein clock had no real motion with respect to the coordinate axes of the Earth's field*; the clocks of Hafele and Keating did.

But Hafele and Keating countered by saying:

> Because the Earth rotates, standard clocks distributed at rest on the surface are not suitable in this case as candidates for coordinate clocks of an inertial space . . .

Nevertheless, Einstein regarded the Earth body as a suitable inertial reference frame, as appears from the quotation just given.

To recapitulate some of the earlier discussion: The mathematical form for the Special Theory is the Lorentz transformation, and neither the transformation nor the Special Theory in its fundamental formalism has anything to do with the physical functioning of real clocks, only with the time interval to be associated with the passage of a light beam across a measured course. Subsequent playback of the mathematical equations, unfortunately chosen for a wrong physical model, then led, firstly, to the hypothesis that a clock in some unreachably distant position—hence necessarily a hypothetical clock —having a velocity relative to an observer whose information was restricted to signals of finite velocity, would register time intervals altered by that relative velocity. Secondly, this was extended by Einstein to include *potentially observable* clocks at Pole and Equator—which were nevertheless at physical rest on the Earth's inertial frame, hence having only relative motion. Thirdly, there followed the further hypothesis, originating more or less simultaneously with Einstein and Langevin in 1911, and used by Hafele and Keating, namely that these calculated alterations of time must work themselves out as actual changes in the physical function of real clocks. But such a position is both interpretative and extrapolative, one of the strange and erroneous legacies of the "ether wind" which is actually concealed within the equations of the Lorentz transformation, rather than belonging to the Special Theory in its original idealized formalism, operating from the base of the two Postulates.

Such distinctions are important to the epistemology of modern relativistic physics. And they become critical from the necessary modern viewpoint of a total Earth body comprising a "magnetospheric frame" as well as the "inertial frame" of lithosphere and atmosphere. For Hafele and Keating have obviously, and by their own admission, subjected their timekeepers to *real* motion through both the atmospheric and magnetospheric bodies —witness their precaution to insulate against the magnetic lines of force of the terrestrial field. If left at rest respectively on Pole and Equator, the instruments would not only fulfill more closely the requirements of the original *Gedankenexperiment,* but would also faithfully reproduce the conditions of the Michelson-Morley experiment —in which case the present study predicts that they would also observe the same null datum, except for fluctuations attributable to causes other than time dilation.

*Until somebody drags a "flying interferometer" through the Maxwellian dielectric—call it ether or field—belonging to the magnetospheric sheath of the Earth body, and still finds a null interferometric response instead of the classical Dopplerian relationship and interference fringes, which Michelson and all others have always expected under such conditions of real motion,* explanations for the variations in the cesium emitters should be sought elsewhere than in time dilation.

If at stake were a fit of the Hafele-Keating data to some uniquely constituted and complex mathematical form, their argument would be impressive. But the question solely concerns the single feature of an alleged dilation of the chonometric interval due to motion, with no recognized restrictions arising from the necessarily associated but presumably insignificant spatial contraction, which they do not bother to mention; and the single and complete difference between the Galilean and Lorentzian transforms with respect to time is nothing other than the simple cosine function expressing the Pythagorean factor.

Natural law abounds in cosine functions. Perhaps we deal with another law than that governing time.

What Hafele and Keating have probably done is to add to the known factors affecting hyperfine transitions the further factor of motion with respect to the coordinate axes of a planetary Maxwellian field. The differential east-west effect then becomes interesting for reasons of its own, but not for time dilation. Possibly the cosmic and solar radiative particles of the heliosphere or the 3°K background radiation, breaking through the magnetosheath of the planetary magnetosphere, produce an asymmetric field component to which hyperfine transitions are responsive. Perhaps it is something else.

*Query II*

Second, we must raise once again that dispute which, particularly in earlier days, divided the proponents of the Special Theory themselves, and which has never been satisfactorily answered, regardless of expressed opinions to the contrary. In reference is the historic schism over the very matters just discussed, namely the criticism that the modern interpretation of the Special Theory has wandered far from its original formalism. To repeat: Just what has happened to the *reciprocity aspect* of the physical model, and the *symmetry aspect* of the mathematical model, both of which originally conformed with, and in turn gave rise to, the fascinating philosophical concept of "motionless relative motion" as contrasted to the real relative motion of classical physics, which always required an absolute frame of reference?

For the greatest single selling point of Einsteinian physics has always been its epistemological and philo-

sophical aspects of "turnabout is fair play". If not, to what else shall the term "relativistic" physics apply? Classical physics also has its provisions for relative motion. But Einstein and all of his proponents specifically argued—as every relativist today must surely agree—that there is no absolute frame of reference; that any and every observer has a perfect right to regard his own system as a reference frame within which all laws of physics remain valid; and that the distortions of time and space incident to the transformation equations then belong to that arbitrarily chosen system $S'$—always "the other guy"—whose remoteness produces the simultaneity problems due to finite velocities of signal transit.

Since Hafele and Keating rode with the instrument in the circumnavigating aricraft, the epistemology of relativity should require that they be permitted to regard their own system as $S$, with the Earth-bound clocks in Washington as the system $S'$, in relative motion to themselves. They would then necessarily calculate the Washington clocks to run *slower* than their own by the Einstein factor, and similarly for both easterly and westerly trips. Upon "stopping the Earth" and climbing back out of their plane, of course, they would then confront the facts as we all now know them to be, namely that the Washington clocks in the relativistically moving $S'$ had *not* run as calculated by Einstein's theory.

Instead, Hafele and Keating made experimental use of "the mere existence of a definite east-west directional asymmetry in the observed time differences". Whereas the Special Theory should allow any of the three observers —westbound, eastbound, or ground-based—to regard himself as the privileged frame, Hafele and Keating removed their observer's base from any one of these several privileged real systems $S$, to some vastly removed hypothetical location merely defined as "an inertial observer looking down on the North Pole from a great distance".

*But this would return the epistemology at least to Ernst Mach,* rather than to Albert Einstein—and perhaps even to Isaac Newton.

For this is little other than an attempt to establish some kind of foothold in some kind of absolute space, or at least a quasi-absolute space—which students of the General Theory would probably recognize as the Schwarzschild metric, others as the 3°K background radiation—from which all three sets of clocks can be viewed in a sense of *real* motion, which indeed two of them do possess relative to the rest coordinates of the planetary Maxwellian frame. Their conclusions then become drawn from data on real motion, analyzed by a theory specifically designed to answer problems of relative motion, where laws of physics for real motion were thought not to apply. This reminds us of Einstein's own use of an "ether wind" to prove its nonexistence. The same criticism must apply as well to any argument which seeks to prove the Special Theory by means of the General Theory[11]. That step cannot belong to the original logic of the Special Theory, nor even to the several recognized stages of its expanded logic; and one must inquire at just what point in the evolving epistemology of relativistic physics has this transition from truly relative motion to unquestionably real motion become justified? Hafele and Keating do not tell us; nor has anyone else, since it is not justifiable.

In fact, an interesting measure of the inconsistency defacing the whole history of such physical testing of the Special Theory shows in Einstein's[12] vigorous defense of the reality of the Ehrenfest Paradox. His argument, we recall, was that the modification of time and space by the Lorentz transformation should not pose a question of being real or unreal, neither a matter of an arbitrary means having been chosen for determining simultaneity; but rather that the only unreal thing about it is that a *co-moving observer does not exist.* This is Einstein himself on record with regard to interpreting his own theory; whereupon a question would seem properly to arise as to which set of the Hafele-Keating clocks had no observer.

*Query III*

Finally, a third question arises naturally out of this second: If experimental physics is to be granted justification in studying terrestrial events from some such hypothetical inertial frame far out in cosmic space, where equatorial rotation of the earth produces transverse motions which can then be analyzed in terms of the longitudinal motions relative among the objects themselves, should not permission be granted to astronomy to apply this technique in reverse? Such an astonishing consequence immediately follows, that it is surprising not to find it as a deadly argument long ago used by opponents of the Special Theory.

For there is no problem in finding extragalactic systems which fulfill all requirements of Hafele and Keating for "an inertial observer looking down on the North Pole from a great distance". The theoretically ideal position, of course, would not be the North Pole, but rather the North Celestial Pole, from where the Earth's rotational motion would appear purely transverse. But for the Earth-bound astronomer the entire celestial sphere contains innumerable instances of bodies having similarly transverse motion with respect to the astronomer's line of sight; and while these transverse velocities can achieve an appreciable fraction of the velocity of light even for bodies of known shape and configuration within our own Galaxy, such as the planetary nebulae and the globular clusters, there is no question about velocities approaching that of light in the case of the distant galaxies. In the current model of the expanding universe, for example, transverse velocities for widely separated objects might even exceed the velocity of light; and this seems already to have been encountered in measurements of quasars 3C279 and 3C272 where—if a cosmological interpretation is to be granted their red-shifts—the velocity of separation $v > c$.

For all such systems with appreciable transverse velocities, the mere possibility of an observer residing upon or within either or both of any two of them would im-

mediately require Lorentz-FitzGerald contractions that were longitudinal, and hence invisible for those observers, though fully viewable transversely from the Earth—and without complication by a transverse Doppler effect if the motion with respect to the Earth is purely radial. More specifically, a proved time-dilation in the Hafele-Keating model would demand this associated Lorentz-FitzGerald contraction as a cosmic feature. The same would be required—we shall remark in passing—from all who accept as real the contraction in the Ehrenfest Paradox.

The result would rule out every sphere in the heavens.

In place of the beautifully regular extragalactic bodies so well known to astronomers, they would be confronted instead with flattened or distorted forms. Worse, a meticulous philosopher, acquainted with the epistemological details of the Special Theory—such as they are—could easily argue that the physical distortion of the cosmic body might depend upon the whimsicality of whether an observer was actually present or not. Certainly he could require that anyone claiming spatial contraction under these conditions of one-way travel cannot seek refuge in the effect cancelling out on a return trip. And if defense is to be sought in the Lorentzian nonvariant $y',z'=y,z$, then one must again raise that question: On what basis, within the epistemology of the Special Theory, did Hafele and Keating choose an observer's position which displayed the motions of their instruments transversely with respect to themselves, yet permitted calculating the relativistic effects longitudinally with respect to themselves?

### VIII. The Fivefold Hypothetical Structure

Although these remarks are insufficient to a point of being trivial, considering the profundity of the several disciplines involved, they should suffice to advance the main thesis to a point where no less than five successive layers of hypotheses disclose themselves, built one upon another since the time of the cosmic ether of classical physics. Even Einstein's Special Theory shows itself to be no less than a fourth generation, while the modern interpretations from the several fields of experimental physics stand as a fifth generation. They can be listed as follows:

Hypothesis I *(Classical Physics)*
A cosmic Maxwellian dielectric bathes the Earth body in the course of its annual orbital motion, therefore an interferometer at rest upon the Earth's surface, and partaking of that Earth motion, must register the differential of the second-order Doppler effects for light jointly traveling the longitudinal and transverse axes.

Hypothesis II *(Lorentz, FitzGerald)*
Spatial contraction must occur in the line of Earth motion, and to exactly that extent which will compensate for the demonstrated absence of the differential Doppler effect hypothecated under I above.

Hypothesis III *(Larmor, Lorentz, Poincaré)*
Time must dilate in direct proportion to the contraction of space hypothecated under II above, because of inescapable requirements of covariance in group transformation.

Hypothesis IV *(Einstein)*
What applies specifically to an interferometer at rest upon the Earth's surface, as hypothecated under I, II, and III above, similarly applies equally and generally to any and all "flying interferometers", in relative motion to an observer or to one another, and regardless of real motion with respect to (embedding electromagnetic fields of) planet, star, or cosmos.

Hypothesis V *(Modern Experimental Physics)*
That which follows from Hypotheses I and IV above, applied to electromagnetic waves and interferometers, applies as well to subatomic and nuclear phenomena, indeed to any and all conceivable physical forms and forms of motion, whether real or relative with respect to any field structuring of space, such that *motion itself produces a slowing of time and contraction of space* as a part of natural law.

Since this astonishing disclosure of "bootstrap" hypothesizing should in itself devastate the Special Theory, some closing remarks seem in order on several profoundly important aspects of relativistic physics which a widespread tradition has erroneously come to associate with it. In reference are the Einstein Postulates and the mass-energy equivalence law $E=mc^2$. Fortunately, and despite the modern consensus, neither follows uniquely from the Special Theory, nor does either the Lorentz transformation or the Special Theory follow uniquely from them. As we have just defined, these last followed solely and precisely from a particularized and unrealistic physical model in which an "ether wind" was *presumed* to exist, while behaving as if it did *not* exist.

To the contrary, and to repeat some of that which was given earlier on the two Postulates, the first of these dates back to times when men such as Galileo contemplated the motion aboard passing ships; and as early as 1710 Bishop Berkeley can be found giving relativistic physics its preliminary formal statement in his *Treatise Concerning the Principles of Human Knowledge:*

> It does not appear to me that there can be any motion other than relative . . .

There is nothing whatever in this First Postulate, therefore, which in itself distinguishes between Galilean and Lorentzian transformation—this distinction depending purely upon the manner in which signals are *presumed* to pass between systems in relative motion.

As for the Second Postulate, there is likewise nothing in this, neither in its combination with the First Postulate, which leads singularly to the Special Theory rather than to a classical model, and specifically to a model based upon the now known magnetospheric structuring of real space. For that same Second Postulate can be applied as well to acoustics with its own characteristic velocity, or to any other vibrational means for signal transmission, and specifically to a Michelson interferometer and any other instrument of experimental physics whose rest coordinates are those of the transmitting field. Without the *presumption* of an "ether wind" there would never have arisen even a FitzGerald contraction, let alone a Lorentz transform, or an Einstein Special Theory.

Similarly, mass-energy equivalence $E=mc^2$ traces back at least as far as Newton's *Opticks* published in 1704:

> Are not gross bodies and light convertible into one another?

Maxwell's field equations published in the 1860's laid the foundation for the equivalence by establishing $E/2c$ as the momentum of a moving charge. By 1881 J. J. Thompson was calculating the change in mass of a moving charge as a function of its velocity; in 1902 an exchange between Abraham and Kaufmann essentially produced the equivalence law without resort to any parts of the then rapidly unfolding Lorentz transformation; and in Einstein's later years[13] he himself showed how $E=mc^2$ does indeed follow in elementary manner from principles of classical physics—namely the mere applying of the law of conservation of momentum to this Maxwellian measure for momentum, and demonstrable with a simple *Gedankenexperiment* employing the aberration constant $\beta=v/c$.

## IX. Conclusions

From these observations the following five conclusions are drawn:

A. Modern knowledge of the magnetosphere now confirms the Third Hypothesis or Stokes' Proposal, considered but dismissed by Michelson and all others at the time of his historic experiment;

B. Since the field of the magnetosphere has geocentric rest coordinates, Michelson's interferometer and all subsequent stationary Earth-based instruments and experiments with electromagnetic phenomena have produced at-rest registrations because they have been at rest with respect to the planetary Maxwellian field;

C. With no basis, therefore, for regarding a null datum in reference to a presumed relative motion, no basis similarly exists for either the Special Theory, the Lorentz transformation, or the associated velocity-dependence of measurements of time and space;

D. As for mass-energy equivalence $E=mc^2$—so thoroughly proved by elementary-particle physics—this is not a singular product of the Special Theory, but follows just as directly from elementary considerations of classical physics and Maxwell field theory, as Einstein himself later showed; and

E. Similarly Einstein's two Postulates of the universality of natural law and the constancy of the velocity of light remain valid; for despite widespread belief, these on the one hand do not by themselves lead in singular manner to the Lorentz transformation, rather only when given the faulty interpretation which followed the Michelson-Morley experiment; and on the other hand they belong just as securely within a model of magnetospherically structured space using covariant transformations of classical physics, modified only for the non-Euclidean nature of space—which is the model here proposed.

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# Essay II

# A Metallurgical Gedankenexperiment Testing the Lorentz Transformation and the Special Theory of Relativity

In the course of studying the possibilities of reducing paradoxical features of the Lorentz transformation and the Special Theory of Relativity to potentially realizable physical models, such that the epistemology of these basic tools of modern physics can be better scrutinized and evaluated, a *Gedankenexperiment* was devised along lines differing considerably from those usually chosen. This followed from a background as a metallurgical engineer; and it was promoted by a strong conviction, developing out of an interdisciplinary study of relativistic physics over the past decade, that some gross epistemological defect lies at the root of the many so-called paradoxes which have now become the hallmark of the Special Theory. Since these in turn derive from the particular mathematical form of the Lorentz transformation, both transform and theory become suspect.

Consider the problem of rigging a telephone wire from Earth to Mars. Since we will not here be interested in any relativistic motion of the two planetary bodies, but only in the problem of measuring the interplanetary distance from another inertial frame in relative motion, we shall presume them to be at some constant interplanetary distance $x$, hence essentially at rest relative to one another.

Wire drawing is characteristically conducted at a uniform velocity $v$; and to propose stringing a wire from Earth to Mars, either from a coil or directly from the die, by no means exceeds those bounds of hypothesis already set by relativists discussing far-fetched situations incident to the Special Theory. In the first place, instead of the traditional extrasolar trip to Proxima Centauri at velocity 0.8c, which has so long delighted relativists in lecture and textbook, we shall reduce the stage to a mere intrasolar setting, and the usual hypothetical velocity 0.8c to a modest 0.1c. For that which is found wrong in principle, will also be found wrong in fact, and vice versa.

Second, metallurgists have already produced wire in sufficient length to add up to such a span; current sophisticated techniques in the production of fine fibers are at stages suggesting at least remote probability to such a proposition; and in view of the remarkable ductility of a metal such as gold, which permits production of structural forms measured in dimensions of Ångstroms for thickness, we come to tread upon fairly firm ground. The distance to Mars during closest approach is approximately 56 x $10^6$km, which would only require some 3.6 x $10^6$ kg of gold if brought to the thickness of ordinary goldbeater's skin. This load need not be transported, since it could either be pulled from a free-spinning type of coil stationed on earth; or better yet, it could be picked up directly from an extrusion die fixed with motor drive to take all drawing load off the spacecraft.

Therefore let us consider some suitable vehicle setting out from earth, or—if one also wishes to avoid the problem of acceleration—catching an extrusion loop during fly-by. In fact, let it fly past the Mars-based observer as well, so that he can clock the instant of arrival while the craft is still under uniform velocity. This will take care of an epistemological nicety which many modern relativists seem to have forgotten. Our equations are:

$$x' = (x - vt)\,(1 - v^2/c^2)^{-\frac{1}{2}}$$
$$t' = (t - vx/c^2)\,(1 - v^2/c^2)^{-\frac{1}{2}}$$
$$v = 0.1c$$

We can forget the calculation regarding time, since the problem at hand precisely concerns the alleged Lorentz-FitzGerald contraction.

So at the instant of arrival, *where* is *what* length of wire? Would not the Lorentz transformation require us to conclude that the wire was shorter by 280,000 km than the distance measured by astronomers, and necessarily traveled in actuality by the astronauts? Must the space outside system $S'$ also contract, as at least one relativist has already suggested, merely because an observer passes through it? And if so, which observer, in case we sent several at different velocities?

Furthermore, if we follow some relativists and allow restoration of the Lorentz contraction, in just what manner could the situation be reconciled with the continuing attachment of the wire to the Earth-bound die, or unwinding coil? Will the wire stretch elastically, or plastically—or clastically? Or does it share the great *mysterium* of the transformation equations, namely that it will simply decontract upon deceleration? If so, what deceleration if the vehicular velocity is kept constant as already described, and particularly if the wire is laid by "free-spinning" from a *transported* coil?

Is metallurgy about to enjoy a new power-free working tool—the Lorentz draw-bench? And who pays for the 280,000 km of restorational "Lorentz wire" after the astronauts have finished stringing the planetary interval of 56,000,000 km with only 55,720,000 km of wire? Fortunately, we have not used the 0.8c figure, or we would be short by 22,400,000 km. While such discussion may sound facetious now, those days are probably certain to come when mankind will have cause to calculate provisions for the extrasolar trip to Proxima Centauri; and it could become a serious matter to stock a 10-year space voyage with only 6 years of provisions.

Perhaps we have at last a *Gedankenexperiment* in which the Lorentz-FitzGerald contraction can neither be conveniently erased by a round trip, nor can ratiocination arise out of complications with either acceleration or curvilinear motion, which Einstein always insisted belongs to the General Theory anyway, and by no means to the Special Theory. Obviously something is wrong.

Although I am a metallurgist rather than a relativist, I am similarly trained in the disciplines of scientific research. And it is an astonishing experience to delve into the history of the STR and find a seeming carelessness with respect to cardinal principles of epistemology—the logic of orderly reasoning. For the founding fathers of the chronometric branch of modern relativistic physics set out with admitted presuppositions, which were thereafter forgotten to be suppositions; and they allowed alternative hypotheses to become abandoned without disproof. I refer to their first supposition wherein Maxwell's dielectric was presumed to be "ether", of more or less substantial sort; then to the second supposition that this ether had a cosmic rather than a local rest frame; and finally to the third supposition that this cosmic medium "blew" upon the surface of the earth because of the known planetary motion. Michelson in 1897 reminded physicists that at least three explanations were possible for the null registration; and to this date the theory of a geocentric rest frame for a terrestrial electromagnetic field has never been tested, despite easily visible demonstrations of such things as the *Aurora borealis* and the encompassing magnetosphere.

I accordingly have these three questions to ask of my fellow professionals: First, with the concept of a "field" having been associated with electromagnetic theory since its beginning; with "action-at-a-distance" characteristics strongly resembling those of gravitation rather than acoustics; with the gravitational equipotential between planetary bodies having resemblance to the magnetopause in points of compartmenting and structuring space—and particularly in view of such prominent geocentricity as that of the electromagnetically involved magnetosphere—why have physicists never given serious consideration to a comparable model of a *geocentric Maxwellian field?* This was proposed by Stokes in 1846, listed by Michelson in 1897 as one of his three possible explanations for the interferometric data, and admitted by Lorentz in his *Theory of Electrons* as follows:

> It must be noticed that all of this could be accounted for at a stroke, and without any mathematical formula, by Stokes Theory . . .

Similarly investigators as late as Ives and Stilwell admitted that the null datum could

> be equally well explained—and more simply—by assuming an ether entrained by the earth . . . instead of assuming two concealed conspiring compensations—contraction of dimensions and of clock rates.

Second, having selected the presuppositious quasi-substantial ether, why have physicists always viewed the boringly long series of null-datum experiments only from the position of sensitivity or insensitivity of various instruments to an "ether wind"? To a research engineer like myself, any such instrumentation equally offers an answer to the question of whether the Earth has its own geocentric electromagnetic field just as it has a geocentric gravitational field. The situation confronting physics in the 1880's required *three* questions, not one, for proper phrasing: (1) Does a "luminiferous ether" exist? (2) If so, are its rest coordinates geocentric or cosmocentric? Lastly (3) if not, is the instrument at rest or not at rest with respect to whatever its signal-transmitting field may be? Certainly the very minimum question should have been: Presuming the ether does exist, does it blow, or not blow? Nobody has yet found the answer to the first question; but to the others it has repeatedly been a simple: *At rest!*

To get a rest datum, then continue to insist that a "wind" is blowing anyway, seems an inexcusable violation of orderly reasoning—epistemology; and yet today the STR and Lorentz transform stand as striking record of precisely that procedure. Later mathematical shortcuts to obtain the transform without mention of either ether or "ether wind" merely sweep them under the rug; and it stands as a simple fact that neither of these two great edifices of modern physics—the Lorentz transform and the Special Theory of Relativity—would be here today without the presupposition of an ether wind.

Third, having selected this illogical model, based upon a *null datum* as demonstrating *insensitivity* of instrumentation to motion, how can physicists now possibly rationalize the *non-null* data of *circumnavigating* cesium clocks as proving the same theory? In engineering, we call this "bootstrap hypothesizing"—circular reasoning; and indeed it is a beautiful example. Careful analysis of the epistemology of the STR—the manuscript now lain fallow for eight years for want of a kindly disposed referee*—shows the clock-transport experiments to stand at no less than the fifth level of "stacked hypotheses"! The measuring of those data against a presumed celestial frame defined as "an inertial observer looking down on the

*Reference is to *The Einstein Error—An Epistemological Analysis of the Lorentz Transformation, the Special Theory of Relativity, and the Minkowski Space-time Continuum*, of which Essay I is a partial summary.

North Pole from a great distance" certainly returns the epistemology to Ernst Mach, which is where Einstein came in. This is not good scientific methodology.

Until somebody drags a "flying interferometer" through the Maxwellian dielectric—call it ether or field —belonging to the magnetospheric sheath of the earth body, and still finds a null interferometric response instead of the expected Dopplerian relationship and interference fringes, explanations for the variations in cesium emitters, elementary-particle decay, Mössbauer effect, and so forth, should be sought elsewhere than in time dilation.

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## The Twin Paradox and the Triplet Disaster

Occasionally critics of the Special Theory have introduced multiple inertial frames to bring out paradoxical situations in measuring space and time, as contrasted with the conventional *Gedankenexperiment* based solely upon $S$ and $S'$ in motion relative to one another. But despite the epistemological power of such an approach, the results have yet to command serious attention from relativists. Furthermore, when a reaction does ensue, the only thing really clear about the debate is that it is hopelessly enmeshed in ambiguity.

Such exchanges assuredly suffer from the dichotomy of interpretation given the relativistic space-time alteration. There is the one school—arising particularly with Langevin in 1911, in recent ascendancy since the Hafele-Keating experiment, and greatly fortified by relativistic interpretation of elementary-particle decay—which holds that time dilation is not only real, but irreversible. The earlier and now essentially vanished school, though represented by able thinkers in its time, has held to the original intent of the word "relativity", namely that the data deriving from the Lorentz-Einstein transformation are observational only, and therefore reversible—purely limitations of an observer in $S$, with regard to measuring time and space in a system $S'$ in relative motion. Einstein in his original paper certainly endorsed this idea of an observational limitation, and later insisted at least that a "comoving observer does not exist"[1]. Classical physics also deals with signal-delay problems in simultaneity, of course, without encountering such complications; but with use of the Lorentz transformation, the presumed need to eliminate the second-order Doppler increment in 2-way signal transmission carries the penalty of distortion of the units of both time and space.

Interestingly enough, however, the modern school insisting upon the irreversibility of time dilation seems to avoid confrontation with the necessarily concomitant Lorentz-FitzGerald contraction. The "traveling twin" always comes back home "with all his clocks slowed up, but his pants not shrunk"—never any mention of foreshortened space ship or his own flattened face. In short, the old School of Reversibility is apparently still with us, hanging for its life on the spatiometric contraction, while the School of Irreversibility rests content upon the chronometric dilation. This conceptual asymmetry assuredly stands in itself as a paradox of first order, and one that receives far less attention than it deserves. For if one accepts irreversibility of time dilation, on what grounds is spatial contraction granted reversibility? Yet, if not made an exception, astronomers would certainly rise in disgust at what this would do to the celestial "spheres". The situation is serious enough as it stands, proposing that such objects contract merely because an observer happens to be in relative motion. Obviously an exceedingly serious point in epistemology is at stake, where there is no possible compromise; and reality can only rest with one or the other.

Recently a novel type of "metallurgical *Gedankenexperiment*" was proposed* in which a ground-based observer in inertial frame $S$ sends a specially devised inertial frame $S'$ on a wire-stringing mission for purposes of rigging a Terra-Mars telephone line. The velocity of $S'$ was geared to $v = 0.1c$, and carefully arranged to be held constant. The result led to such a drastic and obvious contradiction of reality as to throw question upon the validity of the Special Theory itself. What we now wish to do, therefore, is to explore this "metallurgical *Gedankenexperiment*" further, hoping that we might be able to rule upon (1) whether the Lorentz-Einstein transformation properly refers to physical or only to observational reality, and from thence to rule upon (2) whether the Special Theory of Relativity is itself a correct or an erroneous construction.

Consider the rather mundane matter of stringing a *pair* of the aforementioned hypothetical wires from Baltimore to Minneapolis, rather than from Earth to Mars. This involves a factually known and experientially unalterable 1500 km by air, give or take a hundred depending upon the choice of tower locations. The operation

*See Essay II.

would require: (1) A ground-based anchoring station and observer $A_B$ in Baltimore, (2) a similar base and observer $A_M$ in Minneapolis, (3) a space vehicle $S_1$ carrying Coil I and scheduled to lay the leader of two lines at a velocity v=0.9c, and (4) a second space vehicle $S_2$ programmed to lay the second wire at a velocity v=0.1c. Five cesium clocks are synchronized in Baltimore. One is placed in each spacecraft; a third is left at the Baltimore ground station; and the other two are then carried on foot to Minneapolis by a Boy Scout to hold the alleged relativistic effect to such negligible values as to afford unquestionable comparison with any high-velocity data; whereupon return of one of these clocks back to Baltimore, again by Boy Scout, anchors the background for deciding what actually went on in Minneapolis.

To avoid later recourse to the GTR by apologists, and to retain a nicety in relativistic physics that is too often forgotten, we shall have both inertial frames $S_1$ and $S_2$ take off from Cape Henlopen, in due line about another 100 km ESE. Furthermore, the launch will be at time intervals $-t_1$, $-t_2$ such that both vehicles pass simultaneously over the Baltimore anchor $A_B$ at precisely $t_{1,2}=0$, and at their respective velocities of 0.9c and 0.1c. Also, when crossing Minnesota skies, we shall have them continue without alteration of either course or velocity until well over the Dakotas—thus avoiding deceleration as well as acceleration. Meantime the wires will be spun out of rearward ports much as a spider extrudes his anal web; and wire catchments on the Baltimore and Minneapolis towers can be of simple slingshot type allowing the lines merely to drop into the crotch and be seized by automatic grips. In fine, we shall have a true Einsteinian "rigid rod", but one now extended sufficiently in length to allow easy disclosure of what should happen in actuality. If one wishes to argue that the unreeling of the coil causes relativistic uncertainties to reappear, we shall only reply that if the wire were put on an unwinding rather than a free-spinning reel, the Ehrenfest Paradox would cause diametric shrink, which would even worsen the situation whose reality we are attempting to disprove. For not only would a contracted reel hold a lesser length of wire per loop, but the lesser diameter would require more rapid rotation to match any given velocity of the spacecraft; and since the unwinding of a reel has all the requirements of a timing mechanism, would not one be faced with time contraction rather than dilation?

Each anchor tower, furthermore, will be electrified to register the wire-laying contact, permitting the exchange of light signals among all four observers—two at the anchors and two in the space vehicles, each of the latter in motion relative to each of the anchors, and also to each other. These towers, incidentally will be constructed sufficiently high, and leaned toward each other, to compensate for earth curvature; and the spacecraft will be covered with protective ablative coatings sufficient to withstand the millisecond heating, at rates of perhaps $10^7$°K/sec, due to this necessary passage through earth atmosphere.

Time: $t_B, t_M, t_1, t_2 = 0$. Two wires drop simultaneously into the Baltimore crotch from the low-flying overhead craft. The spark contact sends its optical signal at velocity *c*, reaching $A_M$ at $t_c=0.005$ sec. Vehicle $S_1$ immediately pulls ahead of $S_2$, passing Chicago while $S_2$ is still over Pennsylvania, their relative motion being 0.8c. Baltimore observer $A_B$, applying the Lorentz transformation

$$x' = \gamma (x - vt)$$
$$t' = \gamma (t - vx/c^2) \; ; \qquad \gamma = (1 - v^2/c^2)^{-\frac{1}{2}}$$

finds that $S_1$ will arrive at Minneapolis in 2.4msec astronaut time, though 5.5msec according to clocks at both Baltimore and Minneapolis. Secondary stringer $S_2$ will make it in 49.7msec by his own clock, though 50msec according to the anchor observers. Meantime $S_2$, still over Pennsylvania, takes a quick check on $S_1$—and immediately gets into a contradictory position with respect to both ground observers. For the clock of his fellow astronaut does not seem to be slowed by the factor of 0.436 calculated for a velocity of 0.9c, but rather by a factor of 0.6 corresponding to the relative velocity 0.8c. Obviously one clock cannot slow by two different values in reality, only observationally.

Far worse, and sufficient to unnerve every engineer on the project, were the contradictory calculations which finally came up for the length *x* strung with their wires:

| | |
|---|---|
| Actual experiential distance: Baltimore/Minneapolis | 1500km |
| Lorentz distance: Spacecraft $S_1$ per ground observers | 654km |
| Lorentz distance: Spacecraft $S_2$ per ground observers | 1492 km |
| Lorentz distance: Spacecraft $S_1$ per Spacecraft $S_2$ | 900km |

In fact, a proposal had also been under consideration to extend these lines another 1500 km to Great Falls, Montana, and by using a second set of space vehicles $S_1$* and $S_2$* flying in a direction exactly opposite to that of $S_1$ and $S_2$, with wire-laying beginning at Minneapolis and proceeding simultaneously East-West. But a faithful student of Einstein's Second Postulate, viewing this pairing of velocities 0.1c and 0.9c, halted the project because no inertial frames can separate from one another at velocities v=c. Possibly the Great Falls extension could be laid the following day, when no observer was going to Baltimore. However, an equally careful student of Einstein's Theorum of Composite Velocities made a quick calculation showing such fears to be ungrounded:

$$(v_2 + v_2^*)/(1 + v_2 \cdot v_2^*/c^2) = 0.995c$$
$$\left.\begin{array}{l}(v_2 + v_1^*)/(1 + v_2 \cdot v_1^*/c^2) \\ (v_2^* + v_1)/(1 + v_2^* \cdot v_1/c^2)\end{array}\right\} = 0.918c$$
$$(v_1^* + v_1)/(1 + v_1^* \cdot v_1/c^2) = 0.198c$$

Nevertheless, this not only compounded the confusion that already existed as to how fast the various wires were being laid, but the playback upon the Lorentz-FitzGerald contraction created such contradictions as had never been heard before.

In short, both of our questions stand answered: First, the Lorentz-FitzGerald contraction is obviously not only reversible rather than permanent, but follows from

purely observational standpoints rather than being real. Second, since that which is true of spatial contraction must apply equally to time dilation, and in view of the hopeless foundering upon hard realities of engineering in the mere matter of rigging a telephone line, one can only conclude that both the Lorentz transformation and the Special Theory of Relativity are erroneous constructions.

Signal-delay problems with simultaneity due to finite signal velocities? Of course. But *time* itself, whatever it may eventually disclose itself to be, is assuredly not a function of a mere rushing around in space.

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# Acoustical and Ballistic Derivations of the Lorentz Transformation

Relativists are generally of the opinion that the Lorentz transformation belongs solely to the province of electrodynamics. In fact, an aura of mathematical mystique has almost come to surround it, as though those equations had been discovered secretly nested within the Maxwell-Hertz field equations. They seem to forget that they arose instead, and along with the Special Theory of Relativity, out of simultaneity problems in signal exchange when using a beam of light; and then they further forget—or never recognized—that they were born of a particularized and quite arbitrary interpretation given those simultaneity problems. That is, the Galilean transform governs covariance in acoustical phenomena, and would have done so in electrodynamics except for the specific supposition initiated at the time of the Michelson-Morley experiment—and then propagated by Einstein and all followers through Kennedy and Thorndike, Ives and Stilwell, and into our own time—namely, that the null datum signified nonresponsiveness to an "ether wind" resulting from the planetary motion through a Maxwellian field or "ether" whose rest coordinates were very arbitrarily *presumed* to be interplanetary or cosmic.

Except for the lone voice of Stokes, no consideration was given the equally deserving presumption of *geocentric* rest coordinates, and this despite the known geocentricity of both the gravitational and magnetic fields within which Michelson's interferometer rested—to say nothing of the readily obvious geocentricity in the high-ceiling electrodynamic displays of the *Aurora borealis* and *australis.* The result was the peculiar form of the Lorentz equations, which involve nothing other than a corrective denominator —a "fudge factor" in engineering parlance—to compensate for the supposition or combination of suppositions, this being strictly and specifically the required tool for canceling the second-order Doppler factor $(1 - v^2/c^2)$ of classical physics.

But aside from its special significance in the field equations as the ratio between the electrostatic and electrodynamic units, $c$ is merely the numerical constant expressing the velocity with which a displacement transmits itself through its own particular field. Other transmitting media have corresponding constants; and the Doppler effect is common to acoustics as well as to electromagnetics, and even to ballistics. As will now be illustrated, the Lorentz equations therefore do not follow uniquely from data appertaining to the Maxwellian field, but rather from a particularized interpretation given those data—the physical model of Einstein's historic *Gedankenexperiment.*

Consider an airline pilot and stewardess in an acoustical Frame I—say a Jumbo Jet traveling at velocity $v$. The stewardess, rearward at position A calls "Hi!" to the pilot at B. The distance between them is $x$; the signal velocity is sonic, which we will designate $c_s$ to keep in mind its analogy with $c$. The pilot replies "Ho!" instantly, such that the Hi-Ho time interval $\Delta t$ calculated by the stewardess for exchange of signals is simply

$$\Delta t = 2x/c_s$$

There is no entry here for the frame velocity $v$ because this is a *closed autonomous system,* acoustically as well as ballistically—that which Einstein meant to imply with his "inertial frame" so crucial to the First Postulate. As with the revolving and rotating Earth, the plane carries its own atmosphere as part of its inertial frame; and *within* each and every plane the laws of physics do indeed equally apply. Outside on the wing it is quite different: and this is what the founders failed to recognize.

So consider a stopover in San Juan on a sunny afternoon, with these same two people enjoying water-skiing. The stewardess is now on skiis at position A, but again at a distance $x$ from the pilot handling the boat at B; and again the two depend upon a Hi-Ho signal exchange, with

essentially the same velocity $c_s$. While the velocity of this Frame II is far less than that of the jet, we can for convenience still designate it $v$. However, unlike the previous *closed* Frame I, Frame II is now *open*—ballistically autonomous, but not acoustically. The time interval for the informational exchange, as the carefully trained stewardess knows, accordingly becomes:

$$\Delta t = \frac{2x}{c_s} \cdot (1 - v^2/c^2)^{-1}$$

However, a breeze suddenly arises, unbeknownst to her, blowing in exactly her direction and precisely at her same velocity $v$. To her astonishment, her "Hi!" brings back a "Ho!" at $t=2x/c_s$ instead of $t=2x/c_s\ (1-v^2/c_s^2)^{-1}$! Without considering the possibility that the "wind" was not blowing through her hair as usually expected, but was traveling along with her exactly as inside the aircraft, she proceeded to erase the missing second-order Doppler effect mathematically. The operation proved quite simple—mere splitting $(1-v^2/c_s^2) \rightarrow (1-v^2/c_s^2)^{1/2}.\ (1-v^2/c_s^2)^{1/2}$, then applying the one quadratic factor to the space measure $x$, and the other reciprocally to the time measure $t$:

$$x' = (x - vt)\ (1 - v^2/c_s^2)^{-1/2}$$
$$t' = (t - vx/c_s^2)\ (1 - v^2/c_s^2)^{-1/2}$$

But this is the Lorentz transformation!

We should not to have to add that, if these two had first tried their communications system by sticking their heads out of their respective windows in the aircraft, thus truly becoming involved in an analogy of the renowned "ether wind", then insisted upon using the same Dopplerian model when retiring inside, they would have been confronted with the necessity for this same transformation. To this day relativists seem never to have considered either this or the similar analogy of astronauts "sticking their heads" through the magnetospause into the heliosphere, with its separately solar-based rest coordinates, neither the fact that Michelson was no astronaut. But let us proceed.

Meantime on shore a young lass and lad are watching this performance on water skiis; and they decide to "play ski" with a rope, some driftwood for skiis, and with the "pilot" sitting in a dishpan high and dry on the beach. The lass, a young genius with the interesting name of Zweistein, and trained in the "new math" to the point of even knowing about the second-order Doppler effect, shouts out her "Hi!" to the lad, who immediately calls back his "Ho!"; and she thereupon proceeds to time the response and calculate the signal exchange on the classical basis of

$$\Delta t = \frac{2x}{c_s} (1 - v^2/c_s^2)^{-1}$$

as published in every textbook on water skiing. But to her astonishment, the exchange proves to measure merely

$$\Delta t = 2x/c_s$$

—a null datum! The second-order Doppler term has disappeared! The "acoustical wind" apparently is without effect on signal exchange! $c_S$ must be an "absolutely everywhere constant"!

First she reasons that the distance must have become less than originally measured—perhaps the rope shrank, as her little pal FitzGerald helpfully suggested. Then she remembers that velocity is not only a function of both distance and time $v=x/t$, but that for the sake of covariance she must split the embarrassing lost increment between space and time, and equally:

$$x' = (x - vt)\ (1 - v^2/c_s^2)^{-1/2}$$
$$t' = (t - vx/c_s^2)\ (1 - v^2/c_s^2)^{-1/2}$$

And again we have the Lorentz transformation!—now in points of both mathematical form and order of rationalization. More correctly: This is the *Einstein* transformation.

Let us next consider two Boy Scouts, blindfolded and with earplugs, rolling bowling balls to one another on a conveyor belt. Each stands on a small grid raised just above the belt, such that neither partakes of the motion of the belt at velocity $v$. The Tenderfoot at position A rolls his ball to the Eagle Scout at B, who immediately returns another ball held ready in his hand, such that the ballistic signal remains essentially constant at velocity $c_b$. The distance is again $x$; and the time interval $\Delta t$ for the informational exchange, as calculated by the Tenderfoot, will again be the same as in the "open" acoustical Frame II:

$$\Delta t = \frac{2x}{c_b}\ (1 - v^2/c_b^2)^{-1}$$

Blindfolds and earplugs are put in place, heartbeats adjusted to serve as clocks; and both are rehearsed with respect to the "ballistic wind" and the Doppler effect in relation to signal exchange. The Tenderfoot leans forward to roll the first ball.

But unbeknownst to either party, the Scoutmaster pushes the button and stops the belt. The first ball rolls; the reply ball rolls back; the Tenderfoot—who, incidentally, was a third cousin of the little girl on the beach and therefore had the name Fünfstein—makes a quick calculation—astonishing!

$$\Delta t = 2x/c_b$$

—a null datum!

Eagle Scout Lorentz suggested that the motion of the belt had perhaps influenced his grid B to lean toward A, reducing the distance $x$ by some suitable factor compensating for the second-order Doppler effect; but the Tenderfoot—with a few promptings from Life Scouts Larmor and Poincaré on the sidelines—realized that the missing $(1-v^2/c_b^2)^{-1}$increment must be divided evenly between space and time, for the sake of covariance with others who might be watching, and even if it meant distrusting their own heartbeat clocks. Since there was only one way to do this, namely by assigning the square root of the increment separately and reciprocally to $x$ and $t$ so that it would reconstitute in $v = x/t$, he shortly came up with

$$x' = (x - vt)\ (1 - v^2/c_b^2)^{-1/2}$$
$$t' = (t - vx/c_b^2)\ (1 - v^2/c_b^2)^{-1/2}$$

—the Lorentz transformation! And again in all points of historical rationale, interpretation of data, and mathematical form. *Wunderbar*!

Upon this evidence of undoubted ingenuity, the Scoutmaster beamed with pleasure; for this young lad had not only performed the remarkable feat of achieving covariant transformation regardless of belt motion, but had actually brought it to a point where one could forget that the belt even existed!

For after all, is not elegance in mathematics a much more precious thing than the hard facts of life?

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# Einstein and His "Flying Interferometer"--An Analysis of Physical Models for the STR

In so short a note we must drop most of our references and presume instead that the reader knows something of the history of relativistic physics. Our aim is to reduce the historical development of the Lorentz-Einstein transform to physical models in order to analyze and explain the strange situation in which Einstein and Lorentz came to identical mathematical constructions, yet diametrically opposite conclusions as to their implications for physical reality. For after all, what is mathematics other than the handmaid to reality? In a paper[1] published in 1928 just one year before his death, Lorentz stated his position as follows:

> I introduced the conception of local time which is different for different systems of reference which are in motion relative to each other. But I never thought that this had anything to do with real time . . . real time for me was still represented by the older classical notion of an absolute time, which is independent of any reference to special frames of coordinates. There existed for me only one true time . . . the Theory of Relativity is really solely Einstein's work . . .

Lorentz's entry into the field is well known. The story begins with the hard experimental data of Faraday put into elegant mathematical form by Maxwell. The ratio $c$ between the electrostatic and the electrodynamic units is found likewise to be the numerical expression for the velocity of impulse transmission through the electromagnetic field. *Supposition I* then enters: This transmitting field, which Maxwell termed the dielectric, is the "luminiferous ether" discussed by *savants* at least since Huygens and Descartes.

*Supposition II* quickly followed: Because of the known orbital-rotational motion of the Earth with respect to interplanetary space, an "ether wind" must be blowing across the Earth—and probably right through the walls of one's laboratory, in view of the phenomenon of the vacuum produced in an inverted mercury column. The measure of these two suppositions stands in the fact that nobody at that time, or since, likened the newly discovered electromagnetic "field" to the gravitational "field" in points of general model, though magnetism, electrostatics, and gravitation had long displayed the common feature of "action-at-a-distance" which so violently upset the harmony of 18th Century physics. Nobody has ever been disturbed by the concept of a geocentric gravitational field, nor have they sought to correct trajectories in ballistics on the basis of a solar or cosmic rest frame. But for the founding fathers of relativistic physics, there had to be such for electrodynamics, and only such, with the consequences of an "ether wind", and despite suggestions by Stokes[2], Michelson[3], and Lorentz[1] that such need not be.

*Entrée*: Michelson and his interferometer. The null datum had at least two solutions, Michelson himself named three[3]. But the founding fathers instead preferred *Supposition III:* The forward arm of the interferometer, of length $x$ and in line of motion with the presumed "ether wind" of Suppositions I and II, shortens to x. $(1-v^2/c^2)^{1/2}$ in partial compensation for the missing second-order Doppler effect. The remaining compensation x. $(1-v^2/c^2)^{1/2}$ was handled by the orthogonal arm. Poincaré and Larmor then insisted, however, that a correction to space $x$ must be matched by one to time $t$ for purposes of covariant transformation. But as we see in the quotation from Lorentz, the founder of the famous transformation never regarded the alteration of time as anything other than observational —purely due to mensurational limitations in dealing with signals of finite velocity.

When Einstein looked upon this progression of suppositions, now raised to the third order, he accepted in point of fact all three, and along with the null datum; but in matter of approach he took a startlingly opposite position. Rarely mentioned by historians comparing Lorentz with Einstein is the peculiarity that they developed their theories from *Gedankenexperimenten* having precisely opposite observer positions; and if mentioned at all, this oddity seems

never to have been driven through to its consequences. Einstein, for whom no cosmic ether was to complicate his model—so he said—naturally chose his position as the "stationary" system *S*. He granted an equal right—at least in his initiatory statements—to any other observer in another system, in relative motion to his own, to regard himself as the stationary member, though in every case the observer was restricted to the necessity of gathering his data on the other system through an exchange of light signals. Einstein essentially sent Michelson and his interferometer on a space mission while he himself remained seated comfortably upon the cosmic substratum and calculated Michelson's experiences.

Lorentz, on the other hand, actually sat astride that very moving system *S'* which Einstein could only reach by light signals in his particular *Gedankenexperiment.* In fact, the problem of the Michelson interferometer, which had arrested the attention of Lorentz, lay precisely in this assumption that the instrument was in motion relative to an ethereal substratum—the cosmic absolute—which constituted the stationary system. It was just as impossible for Lorentz to be swept off the planet with the "ether wind" in order to share the experiences of an observer in this hypothetical stationary cosmic system, as it was for Einstein to enjoy a personal experience within his hypothetical moving system. The difference in their two models perhaps shows in the reversed usage of *S* and *S'*, at least in Lorentz's early work. The appended tabulation compares them on the basis of eleven points of epistemological analysis.

AN EPISTOMOLOGICAL ANALYSIS OF THE DERIVATIONS AND CONSEQUENCES OF THE LORENTZ AND EINSTEIN TRANSFORMATIONS

| | *Lorentz* | *Einstein* |
|---|---|---|
| 1. Physical model | Bidirectional | Unidirectional |
| 2. "Ether wind" | Openly admitted | Hidden assumption |
| 3. Position of observer | Moving System S' | Stationary system S |
| 4. Requirements for explaining the null datum | Contraction only | Contraction and time dilation |
| 5. Requirements for covariance | Addition of time dilation | Fully satisfied mathematically |
| 6. Velocity-dependence of time dilation | Observational only, from S | Actual, within S' |
| 7. Velocity-dependence of contraction | Real, due to ethereal pressure | Debated, but probably observational |
| 8. Symmetry S:S' | Symmetrical, based upon real motion relative to ether | Asymmetric, with ether presumed to be nonexistent |
| 9. Restoration of time dilation on round trip | Complete | None |
| 10. Restoration of contraction on round trip | Complete | Presumably complete, but issue usually avoided because of nonrestorational time-dilation |
| 11. Penalty of model | Overcorrection by $(1 - v^2/c^2)^{-\frac{1}{2}}$ when played back upon a bidirectional model | Permanent and asymmetric time dilation by $(1 - v^2/c^2)^{-\frac{1}{2}}$ |

Inescapable logic would then seem to require that a meeting with Lorentz would have a value for Einstein akin to meeting a being from another planet, in points of informational value. Did not Einstein have to calculate what went on in *S'*? Lorentz was actually there! That which Einstein declared to be an impossible personal experience of the stationary observer, subject to remote measurement only, was precisely that which fell to the lot of Lorentz. He was right there, traveling through Einstein's "empty space" in helical motion at approx. 160km/sec if cosmic, 30.2 km/sec if heliospheric.

So what did Lorentz with this priceless opportunity of real space travel in a hypothetical *Gedankenexperiment* observe?

Nothing that would not be predicted by Galileo and Newton. There was no measurable shrinking of the mirror arm; and all clocks continued to run normally. But because he had entered upon this situation with a preconceived notion that a certain something had to happen, he had to seek an explanation for a nonoccurrence; and the history of the efforts of science to tear away the veils of Nature may well come to regard as her prize technical retort that this nonoccurrence received its explanation in terms of a nondetectable nonexistence—the Lorentz-FitzGerald contraction.

As for Michelson, he always regarded his own inertial system as imperturbably consolidated with the foundations of his laboratory, whether in Berlin, Potsdam, or Cleveland; and he neither had trouble with his clocks, nor found himself celebrating birthdays less frequently than his friends. And the fact that he published his own record, upon his safe return, means that we now have three sets

of data at hand—from experiences and systems variously classified as stationary, or moving, or both at the same time.

The moral of this story would seem to be that there is something radically wrong with the construction of both the Lorentz transformation and the Special Theory of Relativity—at least in points of epistemology. For the reasoning consequent to the Michelson-Morley experiment does not now show in history as good reasoning; and that which is wrong in principle is likely to be found wrong in fact.

Elsewhere we shall argue more fully that which was briefly mentioned in our introductory remarks, namely that these founders of the chronometric branch of modern relativistic physics erred in their choice of physical model: Lorentz choosing a real ether or Maxwellian dielectric, but giving it heliocentric rest coordinates so as to produce an "ether wind" at the position of the instrument, while Einstein dismissed entirely the concept of any transmitting medium or field. No meteorologist mounts his anemometer to detect a wind, then judges a null datum as registering a nonresponsiveness of the instrument rather than a zero wind velocity; yet this is precisely the course that was followed virtually unanimously by the founding fathers. And they did this despite such things as the fact that the earth was already known to have a demonstrated magnetic field, which we now designate the magnetosphere; also that the Maxwell-Hertz field equations dictate the complete interdependence of magnetism and electricity, such that the two should always be regarded together as manifestations of a single electromagnetic field; and again that the Faraday lines of force extending from a planetary accumulation of mass and charge are probably as likely to generate a planetary Maxwellian field as that same mass is known to generate a geocentric gravitational field.

Furthermore, since we are primarily discussing fields rather than transmitting media in the case of electrodynamics, the field concept of gravitation should certainly provide as good an analogy as the medium concept used for acoustics. If a field, then the rest coordinates are just as geocentric for electrodynamics as they are for gravitation, whereupon the null datum of every one of the numerous experiments aimed at detecting "ether drift" then stands as a simple and direct criterion that, whether ether is present or not, it is *not* "drifting".

Precisely at this point did the founding fathers founder. The rest is the history of the annoying paradoxes of the Special Theory of Relativity.

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## Essay VI

# Einstein's Three Postulates and the Erroneous "Inertial" Frame

*A Sketch of Self-contradiction in the STR*

Einstein's two historic postulates, upon which modern relativistic physics is based, and specifically the Special Theory of Relativity, appear at first glance to be straightforward statements of a generally unambiguous sort. But they have come to mean different things to different people in points of physical model. The question should be immediately asked: Why? The purpose of the present discussion is to show that Einstein's postulates are actually not twofold but threefold, and that the "hidden postulate" attached to his Postulate I contains the source of all error and difficulties subsequently encountered with the Special Theory. To these three, other relativists have subsequently added still a fourth, again of erroneous sort and again attached as a "rider", though this time to Einstein's Postulate II. The effect of the original "hidden postulate" IA was to lead Einstein to a wrong choice of reference frame for the deriving of his transformation equations; and upon the playing back of those erroneous equations for an erroneous model upon situations of relative motion, there first developed the transition from the original purist position of true symmetry in relativity, and thereafter all of the objectionable paradoxes of the Special Theory. The time of that original transition can be tied to the very page in Einstein's 1905 paper[1], where he says in translation[2]:

> It is clear that the same results hold good of bodies at rest in the "stationary" system, viewed from a system in uniform motion.

This is the original and admirable purism in the ideology of relativistic physics. He even frames the word *stationary* in quotes to emphasize that the new relativity recognizes nothing but relative motions, and that each observer has the right to regard his particular system as the "stationary" *S*.

*On that same page* Einstein then proceeds to develop

the phenomenon of time dilation for an equatorial clock as compared to one at a Pole, giving for reasons a *real* planetary motion. No sequel remarks were offered by Einstein, nor successfully so by any of his proponents into modern times, to explain the relative *speeding* of the polar clock if the equatorial observer should choose to regard his as the stationary system *S*.

And since that strange and historic event, chaos has reigned within the chronometric branch of relativistic physics. As Einstein's unnoticed or unadmitted self-contradiction spread out into fields of multiple workers, relativists took just about every position open to the permutations and combinations among two good postulates, a disastrously erroneous third with still a fourth of like nature, and an erroneous physical model. To this last Lorentz added still another choice of model. Between the two of them—Einstein and Lorentz—they developed the only two wrong models among the three possibilities, duly enumerated by Michelson[3] in 1897 for all to reflect upon, but thereafter quickly forgotten.

Thus today the eminent Synge[4] is still found with firm belief in the original ideology of relativism:

> *. . . clock retardation, like the FitzGerald-Lorentz contraction, works both ways . . .*

and the italics are his. Again

> *. . . because, of course, the FitzGerald-Lorentz contraction occurs (with the same contraction ratio) whether the two rods are viewed by S or S'.*

Note the cute and probably appropriate salute to his fellow-countryman, who did share with Lorentz the proposal of contraction, and perhaps preceded him.

*Contra* Rindler[5], who also has stature in the field:

> The relativistic length contraction is no "illusion": it is real in every way . . .
> Time dilation, like length contraction, is *real.*

Hafele and Keating[6], of course, interpreted their experiment with the circumnavigating cesium clocks specifically on the basis of a real and permanent time dilation; and the consensus of modern relativists is with them. However, Sachs[7,8] has developed powerful arguments against asymmetry in time dilation; Isaak[9] has brought in the Mössbauer effect to argue that clock behavior is symmetric on an outbound trip, but becomes asymmetric on return; Hall[10] ascribes all claims of symmetric chronometry to a "naive use of relativity", proceeds to put a pair of the famous relativistic twins into free fall, and then with use of the spherically asymmetric Kerr metric arrives at asymmetric aging. Still others such as Wu and Lee[11] continue to search the GTR for explanations of STR paradoxes, but in a probably never-ending debate. Gautreau and Stevenson[12] find that even the twins themselves, and when performing identical actions, will draw asymmetric conclusions. Fu[13] simply invokes Mach's principle and dismisses the argument as a "cosmological problem".

Others take the approach of direct attacks upon the (a) postulates, (b) the Lorentz transformation, or (c) restoration of the historically disgraced "ether"—again always ending in deadlocked debate. Kantor[14] finds an "internal logical contradiction" which makes the equations kinematically inconsistent, but proposes no solution.

Regarding Einstein's two Postulates, the consensus has long been that the transform equations follow from imposition of the Second Postulate. Yet Lee and Kalotas[15] find the First Postulate sufficient in itself for the derivation, while Kingsley[16] shows with some telling arguments that the two are inconsistent, and that if I is correct, then II must give way to $c \pm v$ velocities.

Palacios[17, 18] has run a long and hard campaign against the transformation, watering it down to equations which are just short of Galilean. Dingle[19, 20] has waged the most tremendous warfare of all, essentially standing for nothing short of a full return to the Galilean transform. Podlaha[21] has come up with a compromise combining equations of Palacios and Gordon with the pre-Lorentz work of Voigt[22] in 1887. And so on. The ethereal restoration traces back to some fine minds such as deBroglie and Lorentz himself in the 1920's, with deBroglie using an undefined "subquantic medium" for his nonlinear quantum mechanics in the 1950's, a similar "hidden variable" being used by Bohm and Vigier; and to these "substitute ethers" there has recently been added the possibility of some related role being played by the $3^0$K background radiation, and more particularly by the generalized neutrino-antineutrino flux or "neutrino sea", which is apparently capable of transmitting electromagnetic radiation[23]. Wallace[24] finds interplanetary data from the "radar bounce" experiments so out of keeping with the STR as to require a "dynamic ether hypothesis". Sokolow[25] at this very moment of writing is pushing his own restorational model of a "dual ether universe", reviving an old idea of Cassirer[26] that the field is a more basic concept than matter, and that matter can be considered merely as specially distinguished places in the field, or as outgrowths of it. Meantime nuclear physics remains confronted with the contradiction of Lorentz-invariant cross sections, for which McCarthy[27] has sought an answer in adopting an alternative "intuitive cross section" rather than contest the Lorentz transformation.

Such illustrations and references should suffice to carry the point regarding self-contradiction in the field of the STR; no author of a text on the subject has yet escaped the need for a labored apologetics; and the literature on the annoying paradoxes is now too immense even to catalog their variations, let alone distinguish proper credits among the objectors. But we shall quickly pick up this self-contradictory thread again when discussing the postulates.

### *Einstein's First Postulate*

Tracing the evolutionary unfoldment of the Lorentz-Einstein transform, and the physical models which these equations imply, discloses as one might expect a coeval evolution in the interpretation given the two postulates. The Special Theory appears in history as the child of the

Twin Postulates; yet the child has assuredly put its stamp upon the father. Let us now expand upon that introductory remark on the nucleation and subsequent growth of self-contradiction in the Special Theory. Einstein's own wording in 1905 was as follows[1]:

> I. . . . dass dem Begriffe der absoluten Ruhe nicht nur in der Mechanik, sondern auch in der Elektrodynamik keine Eigenschaften der Erscheinungen entsprechen, sondern dass vielmehr für alle Koordinatensysteme, für welche die mechanischen Gleichungen gelten, auch die gleichen elektrodynamischen und optischen Gesetze gelten . . .
>
> II. . . . das Licht im leeren Raume stets mit einer bestimmten, vom Bewegungszustande des emittierenden Körpers unabhängigen Geschwindigkeit $V$ fortpflanze.

Both seem adequately translated in the classical rendition by Perrett and Jeffery[2]:

> I. . . . the phenomena of electrodynamics as well as of mechanics possess no properties corresponding to the idea of absolute rest . . . the same laws of electrodynamics and optics will be valid for all frames of reference for which the equations of mechanics hold good.
>
> II. . . . light is always propagated in empty space with a definite velocity $c$ which is independent of the state of motion of the emitting body.

These have recently been slightly altered by Schwartz to read[28]:

> I. . . . No properties of phenomena attach to the idea of absolute rest, but rather that the same electrodynamic and optical laws hold in all coordinate systems in which the equations of mechanics are valid.
>
> II. Light in empty space always propagates with a definite velocity $c$ which is independent of the motion of the emitting body.

Immediately one's attention is arrested by the fact that the First Postulate actually comprises two: (1) The purist ideology of relativism, and (2) the presumed identity of inertial and electrodynamic frames of reference. The first is unobjectionable because it follows naturally from the geometry of the General Theory, and traces back to the early philosophers of physics and cosmology such as Bishop George Berkeley[29], who put it this way in 1710:

> It does not appear to me that there can be any motion other than *relative* . . .

Just as there is no "center" on the face of a 2-space World globe embedded in 3-space, so is there none within a 3-space embedded within another of 4 or more dimensions—whether Riemannian and closed, or hyperbolic and open. Even if the $3^0$K background radiation were ultimately to prove a cosmic reference frame, it would still lack the absolutism of singular rest coordinates.

But the equating of inertial and electrodynamic frames at once introduces a concept that is not only entirely distinctive from the opening statement, but is almost certainly erroneous. Suitable as an inertial frame may be for mechanics and the phenomenology of the gravitational field, it is not necessarily appropriate for describing electrodynamic phenomena. For these have their own distinctive lines and fields of force, which need not relate directly to the mass aspects of inertial mechanics. The "inertial frame" of Einstein was without relation to any such embedding and signal-transmitting matrix, whether field or ether. Indeed, he carried his definition so far as to presume it did not exist. To this model, we will recall, Lorentz then added the alternative model of an inertial frame having a relationship to such a matrix, which he presumed to be the luminiferous ether of classical physics, but chose to give it heliospheric instead of magnetospheric rest coordinates. We say heliospheric rather than cosmic because the calculations for his "ether drag" were based upon the 30.2km/sec helical velocity of local orbital-rotational motion rather than the value for galactic or cosmic motion, now variously given as 160 km/sec[30], or 208-227 km/sec[31, 23].

*Three Tools of Epistemological Analysis*

At this point let us introduce the three concepts of (1) *autonomy* over natural law, (2) the *closed* reference frame, and (3) the *open* reference frame. By the first is meant that which Einstein intended by the first part of his First Postulate—those laws of physics which are found to apply in any past of the universe will be found equally valid in all other parts of the universe as well. The second is a properly chosen reference frame within which this First Postulate of true autonomy over natural law applies—an inertial frame for laws of mechanics, but an electromagnetic frame for laws of electrodynamics. Even acoustics needs consideration separate from the inertial frame. For the flat car and the closed passenger car are equally autonomous over laws of mechanics, but the flat car is not so for acoustics. There is a difference between holding a conversation within the cabin of an airplane or attempting to do so out on the wing. The flat car and the wing then illustrate the third tool—the "open frame". None of the founding fathers, and specifically Einstein, recognized this fundamental distinction. The result was the unfortunate hanger, the "hidden postulate" IA. The ground for its acceptance was laid by the strange and arbitrary insistence upon a physical model having cosmocentric or heliocentric rest coordinates for its signal-transmitting matrix. The result in turn was to regard the null datum in terms of either (a) nonresponsiveness of the instrumentation to the signal-transmitting field, or (b) an absence of that field altogether. No consideration was paid the equally valid alternative hypothesis that (c) the signal-transmitting field had the same geocentric rest coordinates as the instrument itself. As Lanczos later succinctly and authoritatively put it[32]:

> . . . the motion relative to the aether was contradicted by the Michelson-Morley and many similar experiments, which led to the enunciation of the principle of relativity. This demanded new transformation equations between uniformly moving systems.

By the time of the 81st *Naturforscherversammlung* at Salzburg in September 1909, Einstein had his First Postulate in this form[33]:

> The Principle of Relativity states that all natural laws belonging to a system of coordinates K′, in motion relative to the ether, are identical with those belonging to a coordinate system $K$ at rest relative to the ether:

$$x^2 + y^2 + z^2 - c^2t^2 = x'^2 + y'^2 + z'^2 - c^2t'^2$$

But it was in reality a double postulate.

*Einstein's Second Postulate*

As for the Second Postulate, what wavelike transmission of energy, whether within the body of lithosphere, hydrosphere, atmosphere, or the confines of an anonymous "field", has even been known to physics as having its longitudinal velocity altered by motion of the source? The velocity of transmission depends entirely upon the characteristics of that which does the transmitting—whether given the name of medium, dielectric, ether, or field. The value of *c* arises from, and stands for, the ratio between the electrostatic and electrodynamic units, as well as expressing the transmission velocity of a field disturbance. Therefore classical physics already carried both ideas which stand as expressed statements in the Second Postulate, namely (a) the velocity of light is a constant wherever impedance from matter is absent—*i.e.,* "in empty space", and (b) this velocity is "independent of the motion of the emitting body". One will search the wording and content of Einstein's original statement in vain for anything that goes beyond these two points. All else, and specifically the "everywhere constant" *c* as understood today, is adventitious, another or "fourth postulate" appended to Einstein's Second Postulate.

*For not until the Michelson-Morley experiment produced a null datum for a presuppositious* "ether wind" did any reason ever arise for presuming that electrodynamics differs from either acoustics or ballistics in points of relativistic physics. Since that time, and only for that one reason, has the Second Postulate received the "built-in" extrapolation which is now commonly referred to as the "absolute velocity" *c* or "everywhere constant" *c,* based upon the exceedingly novel idea that the motion of the electrodynamic pulse is not subject to the space it traverses, but only to the observer. As Rindler puts it in his presumably authoritative text[5]:

> No matter how one "chased" a light wave, one could apparently not alter its speed relative to oneself.

This is a far cry from a signal transmission that is independent of the motion of its *source.* Rindler adds that: "Such behavior is totally unlike that of any other wave phenomenon that had ever been known"; and with this at least we assuredly agree.

That is, the pulse must display its velocity *c* not only regardless of the motion of the *source*—with which classical physics agrees—but also regardless of the motion of the *observer* relative to that same spatial distance *x* which the beam is traversing. A light beam has two termini, not just one—namely the emitter and the receiver. Natural law has no contest with signal transmission that is independent of the velocity of the *emitter*; for as just given, sound waves and seismic disturbances travel through gases, liquids, or solids with velocities solely dependent upon the transmitting medium, and "independent of the motion of the emitting body"; and the same thing is true for Fick's law of diffusion, Liesegang rings in chemistry, and the through-hardening characteristics of the austenite-martensite transformation in alloy steel. In the entire history of physics, none but the modern relativist has ever seriously considered that a signal, declared on the one hand to have a constant and limiting velocity *c,* could on the other hand cover an entire spectrum of actual distances t $(c \pm v)$ as though $\pm v$ did not exist, and with the velocity of the *receiver* merely limited to $v \not> c$. This is a necessary corollary, of course, to the elimination of $c \pm v$ values by Einstein's peculiar interpretation of the Lorentz equations. But the penalty is intellectual chaos.

Consider the remarks of one of the finest minds in physics—Feynman[34]:

> If something is moving at the speed of light inside the ship, it will appear to be moving at the speed of light from the point of view of the man on the ground too!

Feynman put the exclamation mark there, or we might have done it ourselves. In his further discussion of various situations with both space and ground vehicles, in which light obeys the Lorentz transformation and travels any distance t $(c \pm v)$ in time $t=x/c$, he confirms the position taken by Lanczos on origins of the Special Theory:

> A number of experiments . . . were performed to determine the velocity of the Earth, but they all failed . . . they gave *no velocity at all* . . .

Again the underscoring is his. No thought is given to the alternative criterion that the thing that failed was the assumption underlying the experiment. The testing for geocentric rest coordinates of the electromagnetic matrix embedding the signal carrier was a resounding success. Feynman continues:

> When the failure of the equations of physics in the above case came to light, the first thought that occurred was that the trouble must lie in the new Maxwell equations of electrodynamics . . . it seemed almost obvious that these equations must be wrong . . . Then it gradually became apparent that Maxwell's laws of electrodynamics were correct, and the trouble must be sought elsewhere . . .

Sears and Brehme[35] began their modern popular text with this statement on the first page, concerning the velocity of light:

> All experimental evidence leads to the conviction that this speed is the same for all observers, regardless of their motions relative to each other or to the sources of light. This fact is the basis of the theory of relativity.

Certainly this brings to a fine head the cause of the present criticism. The phrase "all observers" discloses still another short-sighted hiatus in the epistemology of the Special Theory, since no observer has yet made such measurements outside the terrestrial magnetosphere. Yet on the basis of ground-based *intra*magnetospheric testing, the modern relativist has felt free to extrapolate himself into flights of fancy far into outer space. One cannot resist the analogy of a fish within his hydrosphere lecturing on life in the atmosphere. Sears and Brehme then point up their definition by reducing it to a ballistic

analogy, which can perhaps be described like this: A train moving at v=5 m/sec; a burglar running a flat-top at c=10 m/sec; the policeman can only run 12 m/sec, but succeeds in overtaking the burglar and clubbing him off the train by running alongside him on the platform, since the burglar's relativistic velocity can be no greater than *c*! They explain this by saying:

> That a speed is invariant means that its value does not depend on the observer measuring the speed.

Certainly they must mean that it does not depend on "the velocity of" the observer, otherwise we are right back with Einstein's Second Postulate, whereas their illustrations all play upon the so-called "fourth postulate". This shows more clearly in their *Gedankenexperiment* with the classical train model. When the Conductor flashes his light:

> . . . The light travels over the train and over the ground at the same speed, regardless of the speed of the train over the ground.

Here they must mean "through" the train. They next proceed to bring in a second train, traveling in the same direction but at a different speed, whereupon a given light signal travels 150 meters in the one, while only making 90 in the other. The shocking paradox of this happening to a signal defined as having a universally constant velocity *c* is explained, as usual, on the basis of time dilation. The slow travel occurred in the fast train because its clocks ran more slowly (!).

Little wonder that one of the most brilliant minds in Russia, Lev Landau[36], becomes confused in following the strange distortions of the famous train experiment with its consistent failure to distinguish "open" and "closed" frames. Landau actually uses a purely classical Galilean model to accomplish what he regards as an Einsteinian exposition. The setting is a bit unrealistic, an extremely long train racing by a platform where a light signal, emitted at precisely the mid-train position, simultaneously triggers door openings both fore and aft when the light reaches the respective receptors 9 seconds later:

> Relative to the station platform the light also travels at a speed of 300,000 km/sec, but the rear carriage moves to meet the light beam. Therefore the beam of light will reach the rear carriage after . . . 5 seconds. The beam must catch up with the front carriage and, therefore, will reach it 45 seconds later. It will seem to people on the platform that the doors open at different times—the rear door first and the front door 40 seconds later. Thus, two absolutely identical events—opening of the front and rear doors of the train—will happen at the same time for the people aboard the train, but with a 40-second interval for those on the platform.
>
> Is there any contradiction in this? Perhaps the fact we have discovered is as absurd as saying that an alligator measures 2 meters from head to tail, and 1 meter from tail to head . . . Our conclusions are a howling contradiction to "common sense", that is the only thing we can say to console ourselves.

But this is a contradiction of the STR rather than common sense. For Landau has merely developed an ordinary situation of signal delay with which classical physics is perfectly familiar; and even the layman knows that the thunderclap is simultaneous with the lightning at the point of strike, but not so across the prairie or lake.

At the opposite extreme is Rucker[37], who has published the following description in the very year of the present writing:

> It doesn't matter if you're moving toward or away from the source of light, and it doesn't matter if the source is moving toward or away from you . . . The principle of relativity says that your moving away from the source is no different from the source's moving away from you . . .

Rucker then goes on to pressing the extremes of Einstein's old *Gedankenexperiment* regarding riding the nose of a light ray on a trans-Galactic trip with return:

> To you those 200,000 years would have seemed to consist just of walking back and forth through a booth. Going back and forth like this 5 times would put you a million years in the future, and so on . . .

Certainly future generations will look upon this kind of thing as the Great Nadir in the evolution of the human intellect—the point where knowledge becomes totally separated from wisdom. But even from intellectual standpoints, one should inquire: Just why should time itself stop in a 3-dimensional universe because an observer moves along one of the 3 dimensions of a tri-dimensional $f(t)$? What of the continuing time-dependent spreading of the bilateral wavefront $d(y,z)/dt$, and the angle of tangency? A fish following an oil drop as it rises to the surface of the pool does not become timeless and lose all further timelike experiences when the drop reaches the surface and continues with its spreading at $dA/dt$.

Harnwell and Legge[38] in their fine modern text reversed the order of Einstein's Postulates, but do give an authoritative definition of what we have been calling the "fourth postulate", or Postulate IIA:

> An observer always measures the velocity of light to be the same in any direction, regardless of his apparent motion with respect to other bodies . . .

No attempt will be made to run this "fourth postulate" into the ground on the basis of the usual argument working backwards from applications and extrapolations, from effects to causes, since it falls instead before an onslaught from the causal end, namely epistemological analysis. But these three aspects of the relation of the light beam to the space it traverses should perhaps be noted in passing: (1) The covering of space $t(c \pm v)$ in any time other than $t=x/(c \pm v)$ is a violation of the Second Postulate: (2) the covering of a $\pm vt$ increment without $(c \pm v)t$ equations introduces an outright mystique into optics which can only be said to move optics from physics to metaphysics; and (3) this mystical hiatus of the $x[1 - (1 - v^2/c^2)^{1/2}]$ increment of space conflicts with the fixed and real coordinates of the gravitational metric of the GTR.

In short, we adopt the position here that, to pass from point A to point B, a light beam—like anything else—must traverse the distance A—B. Those relativists who read more into Einstein's Second Postulate than stands in the written word do so by making the additional assumption that rest coordinates do not exist for that which transmits the optical wave, whether a yet unidentified

medium or a field; and the extrapolation of the "everywhere constant" $c$ to cover *motion of the rest frame itself* relative to the observer is unwarranted by any experiment in physics to date. Until some compelling observation arises out of experimental physics to regard electrodynamics as being independent of rest frames, the Galileian transform should hold there as well as for acoustics, velocities being vectorially additive. Neither the Michelson interferometer nor any other test based upon a presumed "ether wind", due in turn to a presumed cosmic or heliocentric rest frame, fulfills this requirement.

*Restatement of the Postulates of Relativistic Physics*

Without spending further time on these unending debates over the chaotic structures of the STR, let us turn instead toward the more constructive matters of evaluating, salvaging, and then revising some of the vastly important matters buried within these long struggles over the foundations of the new physics.

Here is what might be regarded as the Basic Postulate of Relativistic Physics:

> POSTULATE I: **Cosmocentric rest coordinates do not exist, all motion being relative motion only; and for all observers the laws of the natural order are identical and equally valid.**

This fundamental concept of a puristic relativism, bridging the finest philosophy of classical physics to the General Theory and without disruption by the Special Theory, has the least likelihood of suffering anything but minor changes, and not only for its sound philosophical reasons, but for the specific fact of the protective bulwark of the hyperdimensionalism of the General Theory of Relativity. An n-dimensional universe, embedded within some (n+m)-dimensional hypersystem, and therefore finite and curved with respect to that hypersystem, has no physically definable "center" within its own frame, and is therefore without cosmic rest coordinates of singular location. The relativism, however, then becomes in itself quasi-absolute, rather than an absolute space, such that every point A is in definable measure and relationship to points A, B, C . . . *ad infinitum.*

Second only to this is Einstein's Second Postulate, which preserves essentially the same concept which he outlined *before* setting out upon the faulty reasoning that gave birth to the STR:

> POSTULATE II: **Within the natural order the limiting velocity is that of light traversing space free of matter, and the numerical value for that velocity is both constant and independent of the motion of the source.**

Compared to the First Postulate, this is probably more postulational, lacking a backup such as the GTR provides for Postulate I. Certainly it has a vulnerability to tachyonic inquiry, which is currently proving fruitfully interesting even if not successfully destructive. But otherwise it has a soundness which deserves the rank that Einstein attached to it.

Let us now turn to the defective "postulates" grafted to these two during the past seven decades of their history. The first, we recall, was appended by Einstein himself in 1905:

> *Postulate IA*: The same laws of electrodynamics and optics will be valid for all frames of reference for which the equations of mechanics hold good.

Our reasons for discarding this on the basis of improperly selected reference frames have been given. Next comes our so-called "fourth postulate" which, taking gradual form over the years, through pressure of inherent features of the Lorentz transform, stands today as a consensus, though not by unanimous vote:

> *Postulate* 2A: The velocity $c$ for light is not only a constant, independent of the motion of the emitter, but is also independent of the motion of the receiver.

This not only becomes inadmissible on its own grounds, but it does not even arise from a relativistic physics grounded upon appropriate reference frames, which we shall next discuss.

*The Reference Frames of Relativistic Physics*

Since much that need be said has already been given on distinguishing "open" from "closed" reference frames, inertial from electrodynamic and even from acoustic, and the key word *autonomy* has been urged when speaking of natural law, only these brief summarizing statements need be made here:

First, the principal features of the new physical model are (a) the abandonment of all ideas of "empty space", and (b) the complete and contiguous structuring or compartmenting of space into locally autonomous units of either gravitational or electromagnetic sort, depending upon whether inertial or electrodynamic phenomena are under consideration.

Second, bodies having mass are not regarded as "dragging" a cosmic field or ether with them, but rather *generating* what might be called the Maxwellian dielectric or field just as the mass itself generates its gravitational field. An electrodynamic structuring of space then ensues when activated fields such as those of our magnetosphere and the heliosphere interact to produce the boundaries known as the magnetopause or magnetosheath. A gravitational structuring of space carries the boundaries of the gravitational equipotentials. *Inertial* frames of reference for Earth-based experimentation in mechanics are chosen with respect to the geocentric gravitational field. The geocentric *magnetospheric* frame must similarly serve for experimentation involving electrodynamics. Autonomous situations for other laws, such as those of acoustics, must be similarly sought within the "closed frame" concept of natural rest coordinates in a system which does actually enclose and incorporate that which controls the signal or force.

Third, the Earth in particular is accordingly viewed as a totality comprising lithosphere, hydrosphere, atmosphere, ionosphere, and magnetosphere, all equally disposed with geocentric rest coordinates, such that any instrumentation, itself at rest with respect to these co-

ordinates, will register a null datum in tests for relative motion.

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# Essay VII

# A Proposed Model and Terminology for the Structuring of Space

Presuming that the reasoning and arguments of the preceding essays have succeeded in negating (1) the Lorentz transformation, (2) Einstein's Special Theory of Relativity, and (3) Minkowski's space-time continuum insofar as it involves $(1-v^2/c^2)^{-½}$ we shall now move the chronometric branch of relativistic physics back 159 years and start out all over again.

For it was in 1818 that Augustin Jean Fresnel, in a letter to Dominique Arago of the French Academy of Science, made this statement[1]:

> If one were to admit that our Earth transfers its movements to the surrounding ether, it would be easy to see why the same prism would always refract light in the same way, whatever direction it came from. But it appears impossible to explain the aberration of stars by this hypothesis.

Stokes [2] several decades later gave mathematical proof that this widespread assumption about aberration is wrong,

and that it can indeed be explained by presuming

> . . . that the Earth and planets carry a portion of the aether along with them so that the aether close to their surfaces is at rest relatively to those surfaces . . .

This was Stokes' choice of a physical model—the only correct one in the history of relativistic physics thus far; and those modern relativists who still occasionally author works in which aberration is listed as a factor in favor of the Special Theory would do well to read his paper.

In 1897 Michelson[3] looked back upon his already classical interferometric experiments of the preceding decade, and listed the Stokes' proposal as a third hypothesis; but meantime Lorentz, Poincaré, and Larmor—and finally Einstein—proceeded, without its further consideration, to formulate what is now known as the Lorentz transformation, and from this the Special Theory of Relativity based upon two profoundly significant postulates.

In Essay VI we dissected, analyzed, and revised Einstein's two postulates to read now as follows:

> POSTULATE I: **Cosmocentric rest coordinates do not exist, all motion being relative motion only; and for all observers the laws of the natural order are identical and equally valid.**
>
> POSTULATE II: **Within the natural order the limiting velocity is that of light traversing space free of matter, and the numerical value for that velocity is both constant and independent of the motion of the source.**

We will recall that the first has been purged of its erroneous sub-postulate equating inertial and electromagnetic frames in the handling of electrodynamics, and that it now restores relativistic physics to its original and admirable purism, based quite securely upon the centerless hyperdimensionalism of the General Theory, and with all the desirable attributes of symmetry and reversibility characterizing signal-delay conditions under a Galileian transformation.

As for the second, this still retains a duplex nature despite its cleansing of the "fourth postulate", or that given as Postulate II-A in the foregoing essay concerning the foolishiness of *c* being independent of the motion of the observer as well as motion of the source. Because of the real threat of possible tachyonic means for signal exchange, this postulate should be broken up to read as follows:

> POSTULATE II: **The numerical value for the velocity of light is a constant which is independent of the motion of the source.**
>
> POSTULATE III: **Within the natural order, the limiting velocity is that of light traversing space free of matter.**

Thus the second approaches the stability of a statement of fact, no longer subject to demolition by tachyons, while the third stands as a postulate in the true sense of challenging its disproof.

Also we will recall that the basic error in Einstein's work—and that of other founders of relativistic physics working with the Lorentz transformation—arose out of an undiscerning equating of the rest frames for mechanics and electrodynamics. In the following discussion we shall first (a) labor this important matter of the appropriate reference frame a bit further, (b) next proceed with development of a special terminology for this new approach to relativistic physics on the basis of a magnetospheric structuring of space, (c) then take a few moments to play the new approach back upon the Special Theory, and finally (d) present certain illustrations from unpublished manuscripts which depict the principal features of the phenomenology of time—the chronometric branch of relativistic physics.

As for the tremendously useful and seemingly indisputable mass-energy equivalence $E = mc^2$, we have broken this loose from its long fixation on the Special Theory by referring to Einstein's own admission in later years[4] that it derives as well from purely classical principles of conservation of momentum, the Maxwell equations, and the aberration constant. The famous equation is therefore seen to be merely adventitious to the Special Theory, having first disclosed itself historically in conjunction with that argument, but of such independent nature that it need not fall with the STR.

*The Matter of Reference Frames in Electrodynamics*

Magnetospheric boundaries of the planets—already found on Mercury, Venus, Mars, and Jupiter and presumed to exist for still others—are usually discussed in terms of phenomena of interaction between the planetary magnetic field and the heliosphere. Similarly the spectroscopic data for more distant bodies are studied from such standpoints as Faraday rotation and Zeeman splitting due to solar, stellar, or galactic *magnetic* fields. But consider the Maxwell field equations, in terms of the electric charge density $\rho$, the electric current density $\mathbf{j}$, and the differential operator $\nabla$:

$$1. \quad \nabla \cdot E = \frac{\rho}{\varepsilon_o}$$

$$2. \quad \nabla \times E = -\frac{\delta B}{\delta t}$$

$$3. \quad \nabla \cdot B = 0$$

$$4. \quad c^2 \nabla \times B = \frac{j}{\varepsilon_o} \frac{\delta E}{\delta t}$$

First, these instruct us that magnetism and electricity are not independent phenomena in themselves, but rather an interrelated pair of modes in which the Maxwellian or electromagnetic field may manifest itself. The phenomena are distinctive only when charges and current are static, in which case

$$1'. \quad \nabla \cdot E = \frac{\rho}{\varepsilon_o}$$

$$2'. \quad \nabla \times E = 0$$

$$3'. \quad \nabla \cdot B = 0$$

$$4'. \quad \nabla \times B = \frac{j}{\varepsilon_o c^2}$$

Here the vector field of electrostatics has zero curl and a given divergence, while the magnetostatic field has zero divergence and a given curl.

Second, the curl equations in their expanded form:

$$\text{curl } E = -\frac{1}{4\pi c^2}\left(\frac{\partial B}{\partial t}\right)\left(4\pi c^2\left(\frac{\partial g}{\partial z} - \frac{\partial h}{\partial y}\right) = \frac{\partial \alpha}{\partial t}\right), \ldots, \ldots$$

$$\text{curl } B = 4\pi\left(\rho v + \frac{\partial D}{\partial t}\right)\left(\frac{\partial \gamma}{\partial y} - \frac{\partial \beta}{\partial z} = 4\pi\left(\rho v_x + \frac{\partial f}{\partial t}\right)\right), \ldots, \ldots$$

tell us that the coordinates of the magnetic vector are also those of the associated electric vector. Therefore a magnetosphere is more properly regarded as an *electromagnetosphere*—a planetary Maxwellian field made evident primarily through the phenomenology of the magnetic mode. This has received ample proof—though not generally recognized so—in the historic series of researches incident to development of the Special Theory of Relativity. We refer to those beginning with the French *savants* Arago and Fresnel[1] as early as 1818, extending through the Michelson and Morley experiments of the 1880's[5,6], and on to the work of Rayleigh[7] and Brace[8], Trouton and Noble[9], Miller[10], Joos[11], Kennedy and Thorndike[12], Ives and Stilwell[13], Cedarholm and associates[14], Mandelberg and Witten[15], and many others. For whether these investigators were testing the optical behavior of prisms, the electrical behavior of condensers, transverse-beam or split-beam interferometry, canal rays, or maser beams, in every case their instruments were at rest relative to both the Earth's inertial frame and its magnetosphere. And in every case their data were *null,* confirming the rest position. Similarly experimentation with probes in motion relative to the planetary field—elementary particle decay [16,17], the Mössbauer effect [18], and the circumnavigating cesium clocks[19] —all showed *non-null* responses in conformity with their non-rest condition.

Furthermore, there is the striking "experiment" that Nature herself provides millions of onlookers year in and year out, making abundantly clear the geocentric rest coordinates and the generally co-moving nature of the electromagnetic envelope embedding the Earth's inertial frame—namely the *Aurora borealis* and *australis.* For both the motions and the symmetry of the luminescent streamers obviously define geocentricity.

Therefore the total planetary body is properly described in terms of a unity comprising not only the mass or inertial aspects of lithosphere, hydrosphere, atmosphere, and ionosphere, but also the energy or field aspects of the magnetosphere. Furthermore, these inertial and electromagnetic rest frames are identically geocentric, and presumably so for other planetary and celestial bodies as well. Only in regard to shape and extent of the field do the two vary, the inertial frame belonging to the gravitational field which is bounded by the gravitational equipotential, while the electromagnetic field is bounded by the magnetosheath. The dimensions of any locally autonomous Maxwellian field then perhaps depend upon the strength of its electrical or magnetic components relative to those of the embedding field or fields. The fact that the field equations are built upon scalar components and vectors of so fundamental a sort as the charge on the individual electron, also the velocity of light, would seem to suggest that a generalized concept of an enveloping magnetosphere or Maxwellian field is in order, belonging to and projecting as a field from the energy aspects of matter much as its mass aspects project a gravitational field, and applying to mass ranging from the elementary particle to the galaxy and beyond. The streaming-water experiments of Fizeau[20] would appear to support the concept that a moving mass has aspects of a co-moving field even when swamped within the field of the planetary body, though the experiment of Lodge[21] using a spaced pair of rotating disks confining a light beam would seem to indicate limitations. Physics very likely has yet to learn something about the generation and behavior of Maxwellian fields attendant upon mass irrespective of charge, about the flux of energy $E$ beyond the inertial frame of mass $m$, about the nature of a "magnetosphere" when not supported and delineated by magnetic components, and perhaps even about the old problems of "action at a distance" and the historically disgraced "ether".

For the Lodge experiment, cleverly devised as it was, may not have been clever enough. If one analogizes the field concept of electromagnetics with the known field behavior of gravitation—which certainly seems as logical as the acoustical analogy which led the founding fathers to require a medium for wave transmission—one might expect the terrestrial field to swamp and align the field of the rotating discs much as the gross terrestrial gravitational field swamps the lesser gravitational fields of its component parts. Would a pair of rotating discs change the gravitational forces acting upon a mass placed between them?

Perhaps the Lodge experiment should be repeated using discs having their electromagnetic potentials activated either electrically or magnetically, to search out the possibility that a magnetospheric analog might actually manifest, in the form of a locally autonomous electromagnetic frame. For the planetary magnetospheric behavior seems to tell us that the domain and extent of an autonomous electromagnetic field depends upon the electrodynamic development of one or the other of its field components—electric or magnetic. But again, a negative result—a null datum—should be carefully viewed as revealing something about the nature of the lesser embedded field, rather than negating the existence of that overriding rest frame which does the embedding—as did the founders of modern relativistic physics.

Meantime the electromagnetic or electrodynamic compartmenting of the interplanetary and larger reaches of space, into cosmographic domains which truly do exert autonomy over the particular laws of physics involved with the Lorentz-Einstein transformation, does seem to be real enough to permit our proceeding with the developing of a terminology to fit the concept.

*Proposition I: Spheres*

As just indicated, an objection immediately arises with

regard to the term *magnetosphere*. The prefix carries the inappropriate restriction to magnetic fields, while the suffix represents a wrong geometry in two different respects: First, the shape is cometary or parabolic rather than spherical; second, the zone in question is a shell rather than a sphere. As for the argument that the field perhaps extends throughout the inertial body of the planet as well, usage sustains the objection: A shell and not a sphere is in mind. This is particularly clear in regard to the heliosphere, which is always distinguished from the chromosphere and lower layers belonging to the inertial body of the sun. In short, we need either to modify or to replace both the prefix and the suffix of this compound word.

On the other hand, *electromagnetosphere* becomes too clumsy, even if more appropriate. But an attractive possibility arises in forming a prefix *emo-* from the initial letters of *e*lectric and *m*agnetic, rather than continuing with classical orthography based upon Latin or Greek roots. In fact, this acronymic type of approach is a mark of our modern culture. This then permits us to use the generalized term *emosphere* for the total mass-energy structure of any unit, particle to galaxy, within whose boundaries the laws of physics conform to Einstein's First and Second Postulates. And we will note in prospect of what we have to say later that it is *only* within this type of spatial structuring that the Postulates do truly apply.

Confining our attention to largescale bodies of the planetary and celestial order, we can particularize them as follows, still retaining the *-sphere* suffix:

geosphere
heliosphere
stellosphere
galactosphere
cosmosphere

Further individualizations for moon and planets might be rendered *lunasphere; mercurosphere; venusphere,* or the more formidable *cytherosphere; martiosphere* or *ariosphere,* or perhaps simply *marsphere,* and so forth. Even the galactospheres could perhaps be further identified as the *Magellanosphere,* and so forth, leaving Galactosphere for reference to our own Milky Way.

Finally, we turn our attention upon this questioned suffix *-sphere*. The term *geosphere* in the foregoing list immediately suggests another reason to change; for this already has usage in geophysics, and not in the sense intended here. Needless confusion would result from an attempt to refer to what we now call the magnetosphere as the geosphere. In fact, the entire listing would be better suited if it were defined in exactly the sense that the presence of the suffix *-sphere* suggests—namely the *total mass-energy body* for whatever mass unit or member is in question. Thus the geosphere would be the total earth body extending out to the magnetopause; and the heliosphere would similarly extend from the inertial or mass body of the sun throughout that entire "solar stellosphere" which embeds the planetary bodies and comprises the mass-energy body of the Solar System. The *Galactosphere* would in turn represent, and specifically, the entire emosphere of the Milky Way, while the uncapitalized galactosphere would apply to whatever galaxy might be in question. The *cosmosphere* would then be that mother field embracing the intergalactic background radiation and such things as the neutrino-antineutrino flux or "sea", which perhaps bridge in turn the 3-space physical creation with the hyperdimensional space-time models of cosmology.

In Figure 1 a crude representation of the concept is offered, showing emospheres embedded respectively one within another in a hierarchical structuring of space, this space being continuous though warped by the ten potentials $g_{\mu\nu}$ describing the gravitational field of the General Theory of Relativity:

$$ds^2 = g_{\mu\nu}\, dx^\mu\, dx^\nu$$

*Proposition II: Fields*

Because there remains a need for referring specifically to the electromagnetic field or envelope which extends beyond the mass body, currently covered by such terms as magnetosphere and heliosphere in an implicatory sort of way, we next turn our attention upon replacing the suffix *-sphere*. If "ether" had not fallen into disgrace as a reliable technical term, it would serve ideally because of its original Maxwellian definition as the dielectric of "empty space". But "field" has probably replaced it irrevocably; and one may as well adjust to constructions of the following type:

emofield
geofield
heliofield
stellofield
galactofield
cosmofield

Again *emofield* would be the generalization for the energy envelope, while the succeeding terms would identify the individualized planetary or celestial bodies. We could then consider such further extensions as *lunafield* for the moon, *martiofield* or simply *marfield* for Mars, and so forth, following the orthography just outlined for the group suffixed *-sphere*.

In summary, this gives us a terminological basis for discussing either (a) the total sphere of influence of any given body over the laws of physics in the true sense of Einstein's "inertial frame" and First Postulate, or (b) only the outermost shell or envelope dominated by phenomena of the electromagnetic field. The basic terms are *emosphere* for the total mass-energy body, and *emofield* for the primarily electromagnetic sheath; and these are then individualized by suitable choices of a stem prefix as indicated by the several examples. In fact, even the customary terminological progression of lithosphere, atmosphere, stratosphere, and ionosphere can be retained by replacing the term "magnetosphere" with "emosphere"

for generalized reference to any planetary body, or "geosphere" in specific reference to Earth—in the sense of it containing that portion of the total mass-energy body which extends beyond the outer limits of the physicochemical shells or zones. Nevertheless, the primarily electromagnetic phenomena would be better described and more properly located as taking place within the *emofield* or *geofield,* rather than the emosphere or geosphere.

*Reflections on the Special Theory of Relativity*

While most or all of the following points and arguments have been developed in the preceding essays, it will not be amiss to go over them again, now in hindsight as we look back upon the concepts of the Special Theory and compare them with those of a field-structured and electromagnetically compartmented space.

Immediately one sees that both of Einstein's original postulates actually do apply *within* any given *autonomous* domain, though *only* within, and that his error lay in failing to make these two distinctions: (1) The historic experiments which he regarded as tests for a hypothetical "ether wind" were equally definable as tests proving the now-known fact of geocentric rest coordinates for the *geofield,* and (2) an *inertial* frame is not necessarily identical with, and may not be suitable for, the rest coordinates to be used for signals of *electromagnetic* type.

An acoustical analogy is more readily grasped: There is a marked difference between holding a conversation within a jet aircraft—which certainly qualifies as an inertial frame—and attempting to do so out on the wing. Here the autonomy of the First Postulate, so far as mechanics and *inertial* frames are concerned, holds both within and without; but even for acoustical wavelike signal transmission, this autonomy stops with the cabin walls. Therefore, and as remarked earlier, the historic tests for "ether wind" actually demonstrated with great clarity—not that the instrumentation of experimental physics is nonresponsive to an "ether wind", neither that ether does not exist—but rather that the surface of this planet lies *within* the autonomy provided by the protecting walls of the magnetosphere—presumably the magnetopause or magnetosheath.

That Einstein failed to recognize both of these epistemological requirements and distinctions shows in the very introduction of his classical paper of 1905, second paragraph[22]:

> Examples of this sort, together with the unsuccessful attempts to discover any motion of the earth relatively to the "light medium", suggests that the phenomena of electrodynamics as well as of mechanics possess no properties corresponding to the idea of absolute rest. They suggest rather that, as has already been shown to the first order of small quantities, the same laws of electrodynamics and optics will be valid for all frames of reference for which the equations of mechanics hold good.

Strange that the man who discovered $E=mc^2$ should fail to distinguish mass from energy when launching the "rigid rod" of his famous *Gedankenexperiment* from an *inertial* base into the *electromagnetic* fields of space. Thus Einstein begins properly with reference to the truly relative motion of magnet and electrical conductor in electrodynamics, but then immediately biases his interpretation of the null-datum experiments by arbitrarily presuming that their nonreaction meant nonsensitivity to an "ether wind" which did not, could not, and does not obtain for instrumentation at rest within the planetary emofield.

From this he proceeds with the erroneous conclusion that a mechanical frame of reference equates with an electromagnetic frame. It does not.

As with the acoustical analogy, there are obviously frames and subframes, or frames and embedding frames, that must be carefully distinguished, and of both inertial and Maxwellian types; such that an inertial vehicle exampled by a man-made satellite— and the same would be true for a light wave itself—may travel *within* the terrestrial electromagnetic field, or *within* the Maxwellian field of the heliosphere, or the fields of other planetary bodies; and while physics has not yet defined the limits of lesser mass-associated fields, such as was attempted by Lodge and perhaps measured by Fizeau, the largescale example of a Maxwellian Earth frame traversing an embedding heliospheric frame is well established.

For to this day, and contrary to the implications carried in many writings on the Special Theory, experimental physics has yet to demonstrate a *null* datum, of interferometric or any other sort, in which an Einsteinian "rigid rod"—in short, a "flying interferometer"—is in *real* motion relative to the rest frame of the terrestrial field.

For these and related reasons the conclusion has been drawn that the Special Theory of Relativity—the present chronometric branch of relativistic physics—is an erroneous construction; and with its dismissal, of course, must go both the Lorentz transformation and those aspects of the Minkowski space-time continuum which involve time as velocity-dependent, a function of $(1-v^2/c^2)^{-½}$. Only *within co-moving* inertial and electromagnetic rest frames would Einstein's First Postulate hold good; only *within* any given electromagnetic rest frame does his Second Postulate truly apply; and light does *not* make the magical $x[1-(1-v^2/c^2)^{½}]$ skip through "empty space" merely because an observer has a velocity $v$ relative to the wave front. Rather does it methodically and continuously move from point $A \rightarrow B \rightarrow C \ldots \rightarrow$ *ad infinitum* throughout a space which is also measured by the gravitational metric of the General Theory.

Transformation equations accordingly need only consider Galileian passage from domain to domain, in an electromagnetically compartmented space, each individual domain exercising autonomy over Maxwellian field disturbances and having its own rest coordinates.

*The Phenomenology of Time in Relativistic Physics*

In bidding our fond farewells to seven decades of that delightful intellectual madness known as *time dilation* (or "dilatation" for those who prefer syllabic redundancy) and the Lorentz-FitzGerald contraction, let us enter a few illustrations taken from unpublished manuscripts, along

with necessarily abbreviated discussion.

Figure 2 presents an algebraic analysis made jointly for Michelson's interferometer and Einstein's "rigid rod", though under the specific and *real* conditions of signal travel within *either* a "closed" or an "open" reference frame. You can't have both at once. Those "magical skips" of $x(1-(1-v^2/c^2)^{1/2})$ and $t(1-(1-v^2/c^2)^{1/2})$ for space and time, due to Einstein's peculiar interpretation of the null datum, are *ganz verboten*. Thus Situation 1 begins with the interferometer as the moving system S′ (Greek sigma) in the best Lorentzian sense. The tranverse arms are of identical length, designated respectively $X_o$ and $Y_o$ for this standard instrument, while the forward or longitudinal $X_o$ arm serves equally for Einstein's "rigid rod" but without the subscript. A light signal is then emitted at the origin, and the instrument(s) take off in conventional manner at velocity *V*.

In Situation 2 that position is indicated where the beam within the *closed* frame of the interferometer—and in keeping with the actual Michelson-Morley experiment where the rest frame was in motion rather than the instrument—has reached the forward mirror. We will recall that Lorentz was riding with this instrument, while Einstein stayed behind in the embedding cosmographic system *S* with his own rest coordinates. Einstein's signal, accordingly, travelling alongside Lorentz's in this scheme but not enjoying his closed frame, travels the same direction $X_o$ in that same interval of time $T_o$, but lags by a distance $VT_o$. The formulations for "bar D" $\overline{D}$ refer to distances not actually covered—in this case to where the Einstein beam *should* have been if the optical course were truly unaffected by the motion relative to the observer as well as relative to the source, as so weirdly prescribed by that extrapolation of Postulate II called the "fourth postulate". The dotted traverse shown for the tranverse arm, of course, has nothing to do with Einstein's "rigid rod", neither with the actual travel of the beam within the closed Lorentz system, but merely shows instead the projected distance travelled by the beam in terms of the rest coordinates of the larger embedding space. The dragside superscripts 1,2 which now begin to show refer respectively to the outbound and rebound traverse of this to-fro beam.

Situation 3 defines the time ${}^1T_x$ when Einstein's beam finally overtakes the forward mirror, now at distance $X_o\ (C/C-V)$. The S′ system is not shown here, since its beam is only midway in the rebound travel. Situation 4 then brings it home, with the Einstein beam now in midway travel. The total projected distances of the S′ travel of the tranverse arm in terms of S coordinates are shown, along with the present position of the forward mirror. This therefore is the situation of the famous "null datum". Meantime the lag of the Einstein beam—which has followed an identical time-space programming except for being required to ride an "open" frame having real motion relative to the transmitting field—is indicated by the large open star. The nearby arrow with the small black star gives the position of the continuously advancing instrument when the Einstein rebound beam finally makes it to the beam origin; the pointer just beneath shows the distance of travel—and the associated timing—necessary to bring this open-frame beam to that position where the beam origin was at the time that the closed-frame beam completed the circuit; and the equations and designations of Situation 5 then call attention to how much travel still remains before the signal gets back to Einstein. At far left, meantime, one reads some four different values that might be derived for c if presumptions of the STR were taken seriously, and worked back upon these several relationships.

Figure 3 picks up the problem of the "bifurcating spheres", more properly referred to as the infinitely reproductive spheres, since the alleged phenomenon is by no means limited to the conventional pair of observers. We will recall that the STR—specifically the "fourth postulate"—has any given light source obligingly reconstituting or replicating itself, and any number of times as may be required for the number of observers, such that each finds himself at dead-center of the symmetrically and spherically expanding front, and regardless of either his own motion or that of the source. The present illustration might be called a 2-dimensional representation of a 3-dimensional cross section through a 4-dimensional system of the sort under consideration. The three vertically layered schema are time sections; the mirror-image primed and doubly-primed sections to right and left are two identical closed frames, of length indicated by the starred representation at lower right, each of which is moving at numerically equal velocities $-V$ and $+V$ relative to the rest coordinates of the embedding frame; and the signal is then fired in the usual manner when all frames are in zero conjunction. The principal reason for using two moving frames is merely to develop the full symmetry of the unprimed spreading sphere, for the main thesis develops equally out of only half of the diagram, and either half, as well as the whole.

Thus in the bottom sketch, a signal initiates at the starred position at time $T_o$ exactly as the tailing ends of the moving frames pass, or set out from, $X = O$. As time $T_o \rightarrow T_1 \rightarrow T_2$ in the upper sketches, the signal sphere spreads at radial velocity c within each of the three frames in accord with both of Einstein's postulates, at least in their reworked form of Essay VI. Because the moving frames carry their own transmitting field or medium, the original focal position bifurcates, of course, to produce two pseudo-foci in the form of rearward radial projections perpendicular to the advancing wave front. Meanwhile the external focus within the unprimed embedding system remains in its original unmoving position. The signal within each of the two moving frames accordingly covers a distance $T_2\ (c+V)$ during the same time interval which finds the external signal advanced only $T_2\,c$. The model is seen to apply equally to either sonic or electrodynamic models, just so long as the two

moving systems exert autonomy over their respective transmitting field or medium. Consider, for example, two airplanes in a near-collision course such that they experience a slight tail-shock—or perhaps they pick up a thunderclap from a bolt of lightning striking between them. This sketch portrays the spreading sphere of sonic vibration, insofar as the arc of that sphere is subtended by the cabin geometry. The same holds for electrodynamics, whether one can properly theorize autonomous frames for so small a model, or must use instead the planetary magnetospheres. Obviously there is neither place nor reason for a Lorentz transformation, the relationships all being Galilean with vectorially additive signal velocities.

In fact, Figure 4 carries the algebraic-geometric approach of the preceding two figures right down to the plebeian level of ballistics, let alone sonics—somewhat after the manner of Essay IV. To quote from a manuscript politely rejected by the editors of *Physics Today:*

> The setting is a basic training camp in the Marine Corps; the signal-carriers are highly trained drill sergeants whose velocity under full pack is generally regarded not only constant, but definitely a limiting value; and the occasion is the training of a raw recruit who, for purposes of enlivening the train of thought, will be described as recalcitrant to a point of considerably annoying the staff. In short, it could happen—unlike most STR *Gedankenexperimenten.* A 100-meter course is laid out, sufficiently replete with obstacles to reduce the limiting velocity under full pack to $c_b = 2\text{m/s}$ . . . . .

The personnel, of course, carry historically great monickers; and as they go through the carefully measured and timed course schematized in Figure 4, there soon develops every self-contradiction incident to the superb misconceptions of the Special Theory of Relativity regarding what goes where and when. But we shall spare the reader from wading through the rather lengthy scenario since it has already been judged by experts as unfit to publish.

Figure 5 is merely a self-explanatory schematic reminding relativists that informational offsets, in judging simultaneity due to signal delay when using carriers of finite velocity, are not unique with the Special Theory. Clocks simply have an *apparent* lag due to distance, and *apparently* altered rates due to relative motion. The present thesis argues that both are apparent rather than real, that any alteration of either space or time is fully reversible, and that such alterations are also completely symmetric with respect to systems S and S′—this being the original intent and honorable purpose of *relativistic* physics.

Figure 6 redevelops the Minkowskian "time cone", but now in the form of a whole set of cones depending upon whatever the velocity $c$ of the particular signal in question may be. The model is again a 2-dimensional representation of a 3-dimensional (x, y, t)– section orthogonal to the z-axis in a 4-dimensional (x, y, z, t) space-time continuum. As usual, the Riemannian line element for the limiting velocity in this hyperboloid of two sheets

$$ds = g_{mn}\, dx^m\, dx^n = 0$$

separates the "imaginary" spacelike vectors

$$g^{mn} V^m V^n > 0$$

from the "real" timelike vectors

$$g^{mn} V^m V^n < 0$$

However, abyssal oceanographers—to cite one example—might well come to depend upon submarine sonics just as much as surface dwellers depend on electromagnetics for informational exchange; if so, the transform between bathyspheres S and S′ will assuredly be Galilean, and with careful distinctions made for the *autonomous frames* and respective rest coordinates of (1) bathysphere S, (2) bathysphere S′ and (3) the embedding hydrosphere —which is the present model proposed likewise for interplanetary electromagnetics.

Figures 7 and 8 arise out of a hard-core engineering approach to space travel, along the lines of Essays II and III, in which enumerated light waves or photons in specified number are followed in relation to the famous "traveling twin". The launching pad is $A$; the destination, $B$. And to add realism and drama to engineering accuracy, we have the launch set the pad on fire, not to be extinguished until the traveler himself returns and puts it out. In this manner an emission of some definite total number $n$ of photons ensues, beginning with photon $e_o$. The spaceship X is overtaken by photon $e_i$ just as $e_o$ reaches the destination $B$; and during the remainder of the outward voyage, and the return, every photon up to the final $e_n$ must be similarly encountered and accounted for. With a known and measurable distance under study; with velocities $c$ and $v$ both fixed; and knowing this exact count $n$ from data kept at the launching site, one can easily show for STR calculations that either (a) the distance $x$ shrinks for the traveler only— which is patently ridiculous—or that (b) he doesn't go the whole way to the target and back as claimed.

In fine, the STR is not the tool for programming space travel.

Figure 8 then shows such a trip as a 2-dimensional $(x_3\, x_4)$ space-time section through $(x_1\, x_2\, x_3\, x_4)$, with simultaneity which is now seen to be real, though not apparent to one in motion relative to the embedding frame. The vertical rows of stars $\Phi \ldots \Sigma$ merely denote world lines of essentially fixed objects. The launch is from local "now" space, aimed at a fixed target; and the lower right-hand diagonal is not a direction of sighting, but a time-condition of sighting due to the finite signal velocity. Remaining features of the diagram are self-explanatory, since they belong to ordinary classical physics. By similar description the "now" problem with the supernova explosion producing the Crab Nebula, not observed here until 4 July 1054 A.D. after nine centuries of optical signal transmission, is straightforward, easily understood, and requires no Lorentz transformation in reporting it to other potential observers in other planetary systems.

Finally, Figures 9, 10, and 11 press this liberated

concept of time, freed from its long nightmare of time dilation, to develop an idea that perhaps time $t$ is an n-dimensional scanning phenomenon of an (n+1)-dimensional reality. We say "n-dimensional" because of the possibility of different time scales existing for different dimensional states of being, among which the presently experienced 3-space might be but one example. Figure 9 begins with potential cosmological 1-dimensional spaces of variously Euclidean or non-Euclidean sort, within one of which an "event" $e$ occurs. The birth of a 1-dimensional child? Figure 10 develops this possibility by observing progressive changes in event $e$ as $e_1 \rightarrow e_2 \rightarrow e_3 \rightarrow \ldots e_i$, finally summing them as integrated chronometric sections along the hyperdimensional (n+1), and thereby obtaining a 2-dimensional disclike "hyperbody". If the procedure were to be reversed, letting a pre-existing (x, t)-hyperdisc descend through the subspace $x$ for differentation instead of integration, the same observed series of events $e_1 \rightarrow e_2 \rightarrow e_3 \rightarrow \ldots e_i$ would obtain within that infra-dimensional system.

Figure 11 lessens the mental strain—and possibly also the incredulity—by developing the same concept for that 2-dimensional "flatland" made so famous by E. A. Abbott in the last century. Now we begin with a local section of some cosmological 2-space, essentially Euclidean for such short distances, and observe the birth of a circular "infant". A carefully kept biography—time slices through (x, y, t)—shows the child growing to maturity, but then rapidly failing, and finally disappearing entirely. Built of "flatland dust", to dust it has returned. Integration—or perhaps we should say summation if the time-slice proves to be particulate or discrete in structure with respect to (n + 1)—of the events $e_1 \rightarrow e_2 \rightarrow e_3 \rightarrow \ldots e_i$ now discloses the hyperdimensional form of a 3-space cone which, if it had descended as a pre-existent hyperbody along $x_3 (\equiv t)$ into and through the infra-dimensional (x, y) 2-space, would have reproduced that which was actually recorded.

Of course, the inference from these models is that the next step in extrapolation brings one to the hypothesis that our own 3-space creation might have the nature of an advancing "time wave", which either builds or discloses—or both—a higher reality. As embarrassing as it must be to the modern relativist, a return to Newton's *Principia* seems inescapable:

> Absolute, true, and mathematical time, of itself and from its own nature, flows equably without relation to anything external . . .

If so, might one find within this temporal motion along (n+1) some striking answers to problems with electron-positron relationships? Matter and anti-matter? "Time-reversal" phenomena in elementary-particle physics? "Dirac holes", "black holes", and "white holes"—as "events" $e_1 \rightarrow e_i$ . . . pass in and out of detectability within the 3-D time slice? For a pulsation along $x_4$ would show in the orthogonal 3-flat as a succession of existence-nonexistence. What if the long-fugitive "ether" were a 4-dimensional "substance" pulsating along $x_4$, hence having only evanescent effects within 3-space? Could it be that such a hyperdimensional pulsation would show as a *particulate* structure in 3-space while advancing *wavelike* in 4-space, with a corresponding wavelike corpuscular progression in 3-space, thus explaining the wave-particle duality of optics? In fact, could it be that the velocity of the time wave along $x_4$ is itself $c$?

No answers to these questions will be attempted here, though their implications are certainly attractive. But since the subject at hand has been chronometry in relativistic physics, this necessarily leads one back to these ancient and challenging discussions on the nature of time itself, as well as light and the alleged "ether". Here is where Lorentz, Larmor, Poincaré, and finally Einstein came in. Perhaps the debate is not yet over.

In any event, time is assuredly not altered by a mere rushing around in space, as currently so widely believed.

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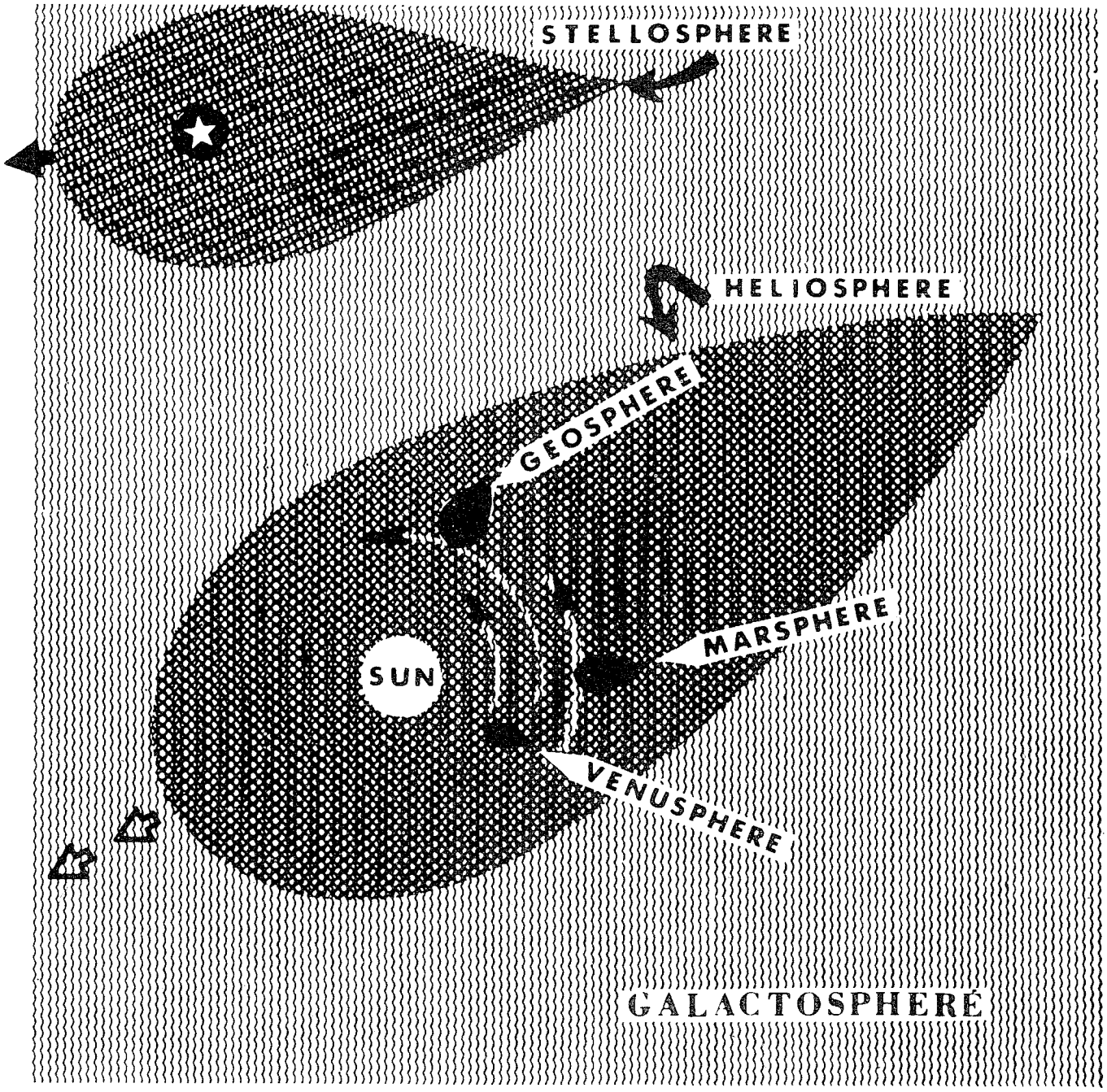



**FIGURE 1:** Schematic diagram for a tentative model of autonomous electromagnetic reference frames, each carrying its own Maxwellian rest coordinates, and giving cosmic space a quasi-absolutism in the sense of an absolute continuity of contiguous magnetospheric fields. The departure from Newtonian absolutism lies in the lack of a geometric center in a non-Euclidean 3-space—this lack being a main thesis of the hyperdimensionalism of the General Theory, and a good source of true relativism. The boundaries of these individualized electromagnetic autonomies are presumably the magnetopause or magnetosheath; and this continuous-contiguous mode of Maxwellian field-structuring—though not in points of actual shape or form, of course—is believed to be comparable to gravitational field-structuring with its boundaries arising from gravitational equipotentials.

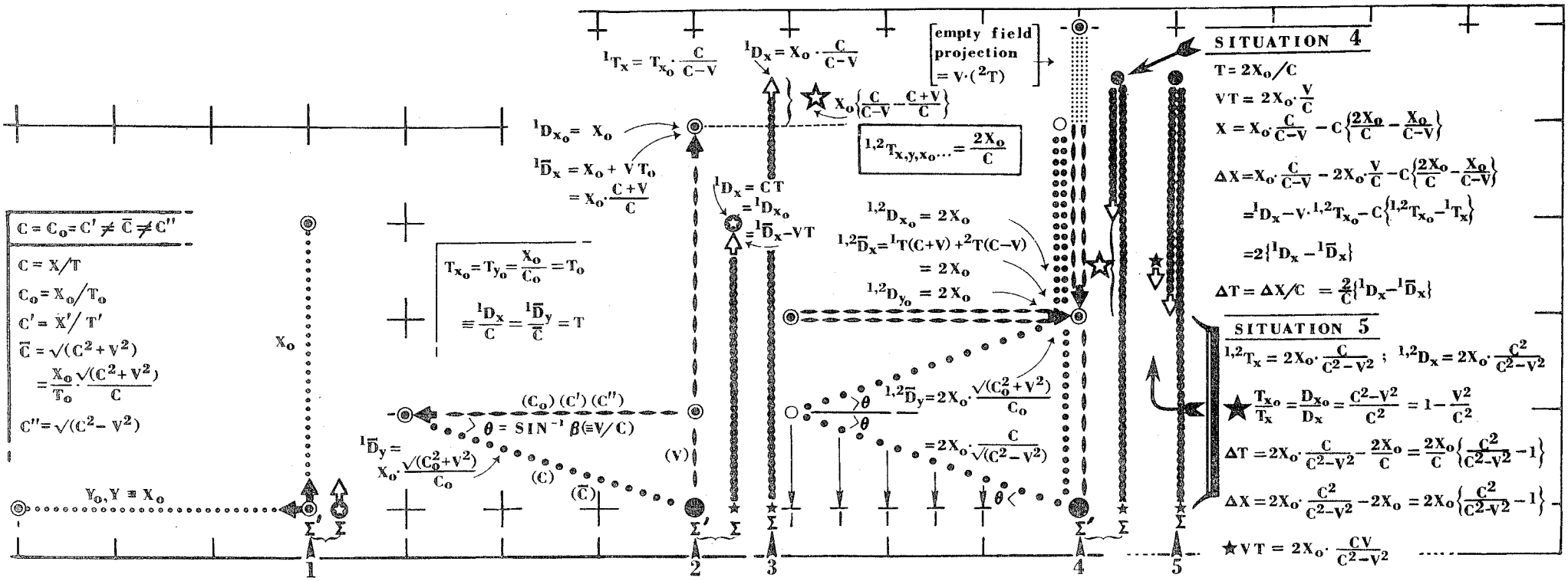



**FIGURE 2:** This algebraic-trigonometric schematic analyzes the details for both real and presumed motions involved with both the Michelson interferometer of the Lorentzian model and the "rigid rod" of the Einstein *Gedankenexperiment.*

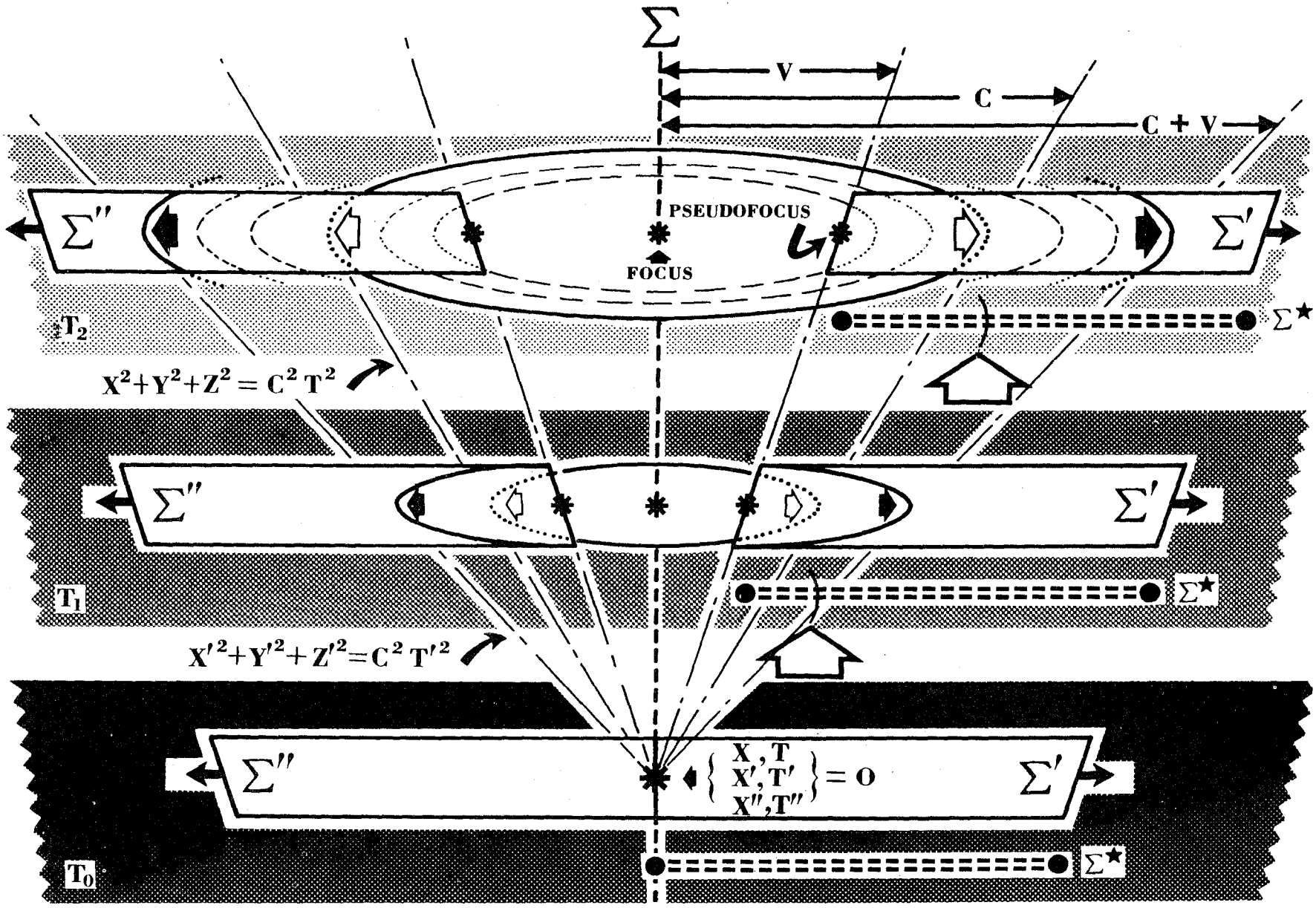



**FIGURE 3:** An analysis of the spreading of the "bifurcating light spheres" involved with the "everywhere constant *c*" concept in the Special Theory, but now worked instead in proper terms of "closed" as distinguished from "open" reference frames.

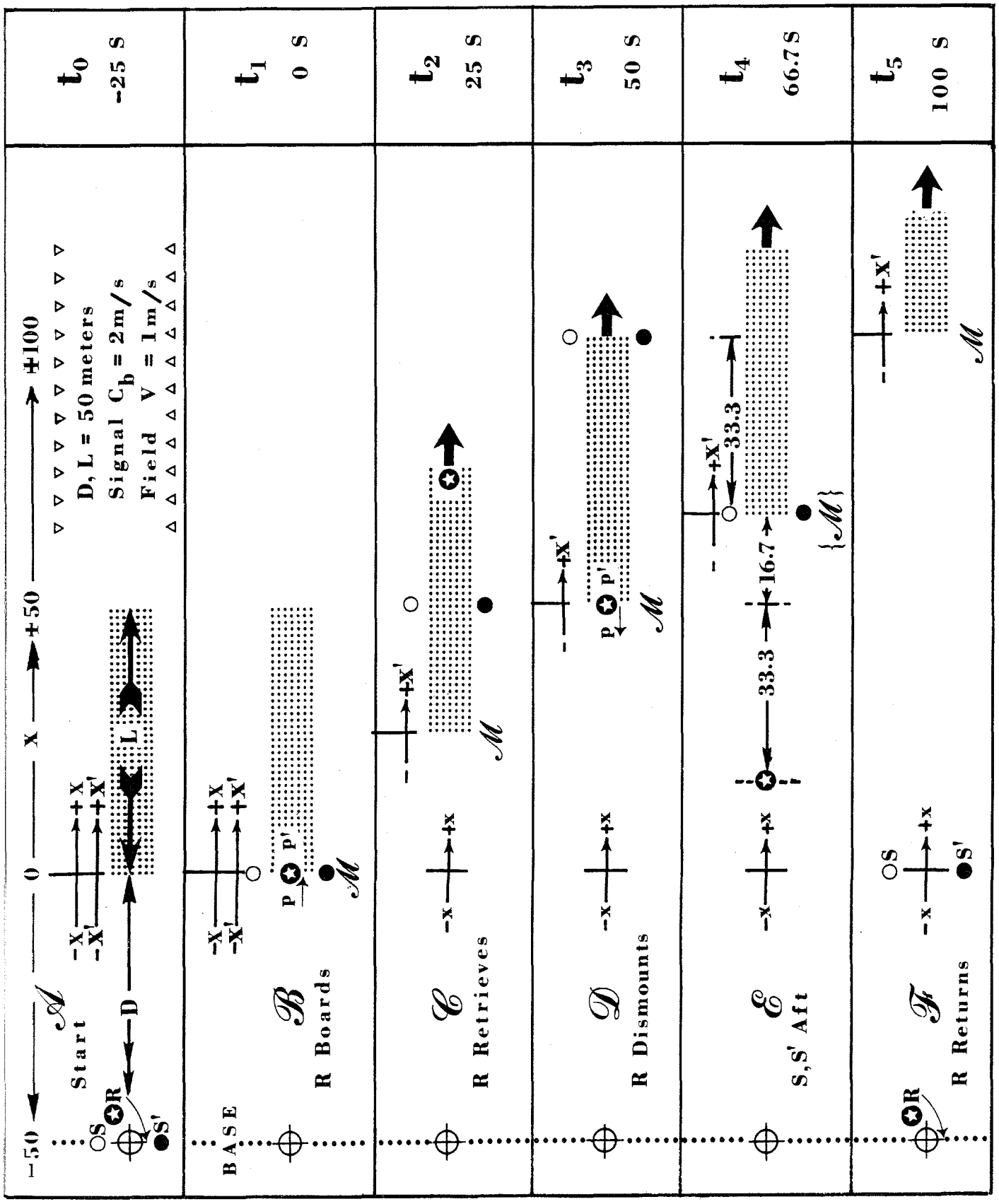



**FIGURE 4:** Algebraic analysis applied to a ballistic model for purposes of reducing the hypothetical and unreal behavior of signal-carriers in the Special Theory of Relativity to real hard-nosed engineering values, worked out along a known course not liable to Lorentz contraction—unless subjected to the ridiculous $(1 - v^2/c^2)^{-\frac{1}{2}}$ "fudge factor".

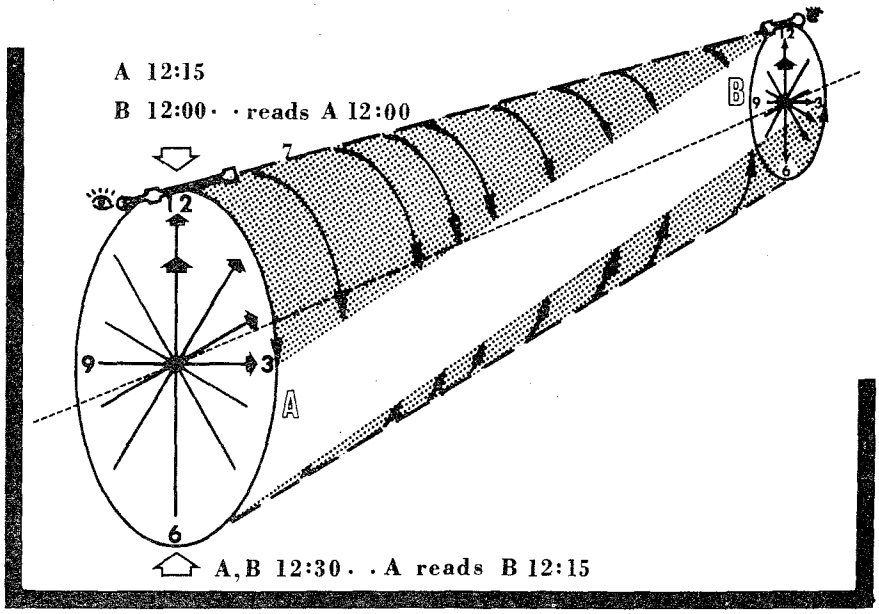



**FIGURE 5:** A simplistic sketch of apparent clock behavior as a function of distance and/or relative motion for optical or any other type of signal of constant and finite velocity *c*.

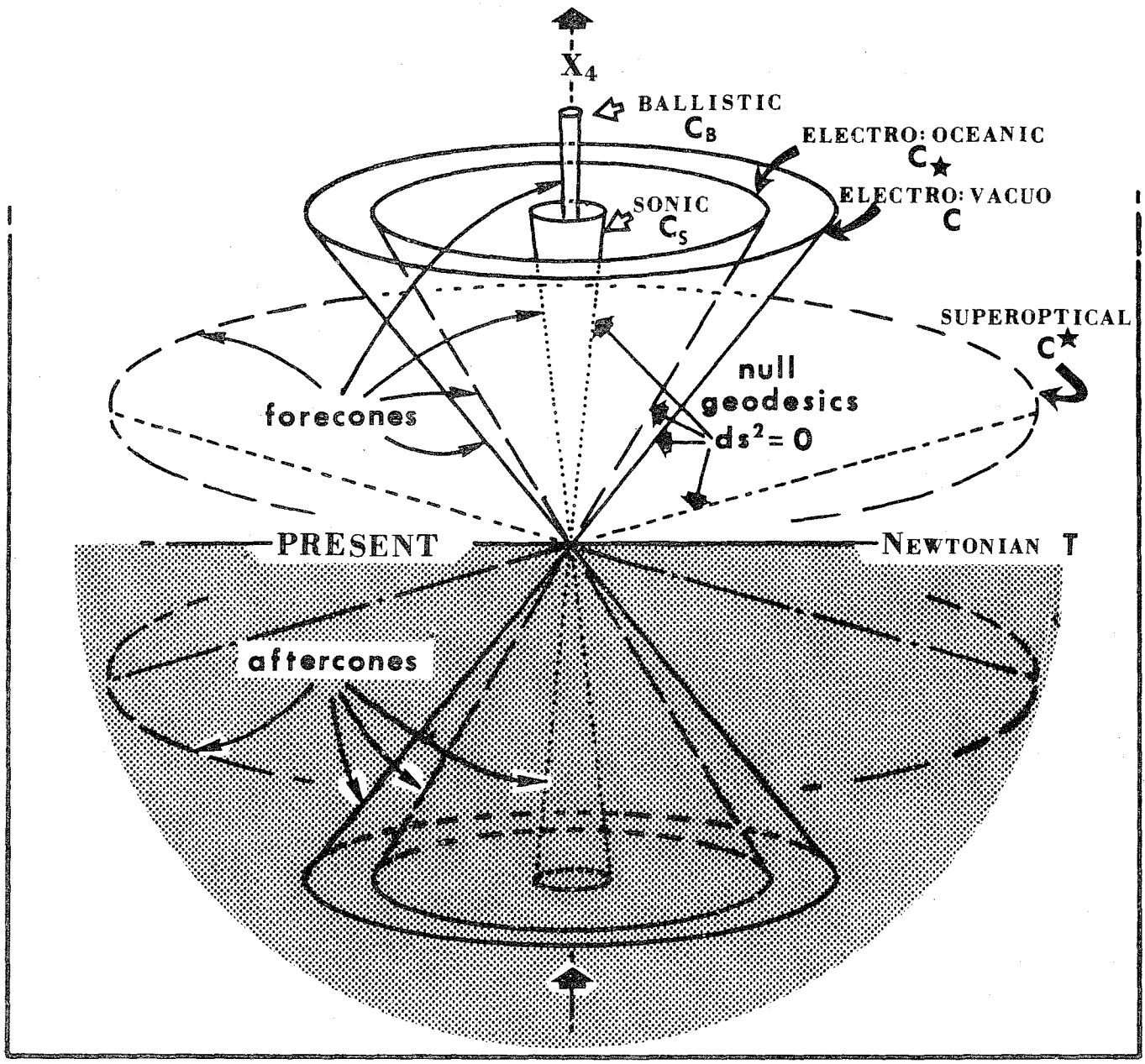



**FIGURE 6:** Minkowskian time-space relationships reworked in generalized terms of signal delay for any type of informational exchange by signals of finite velocity, of which electromagnetic waves are but one example, and not regarded as unique in manners of traversing space.

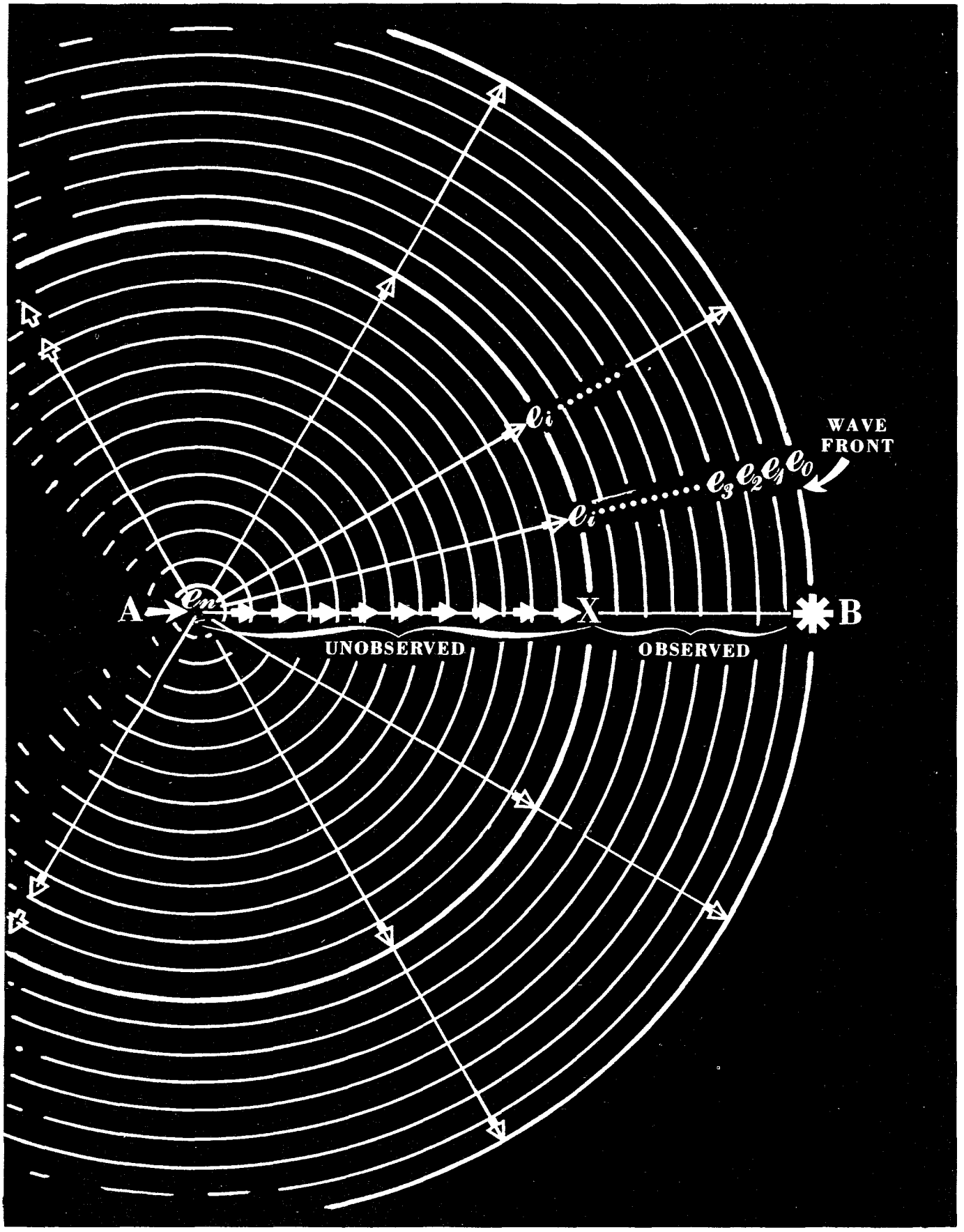



**FIGURE 7:** Model for keeping an actual count on light-wave or photon intercepts during space travel, leading to impossible contradictions if based upon the Special Theory.

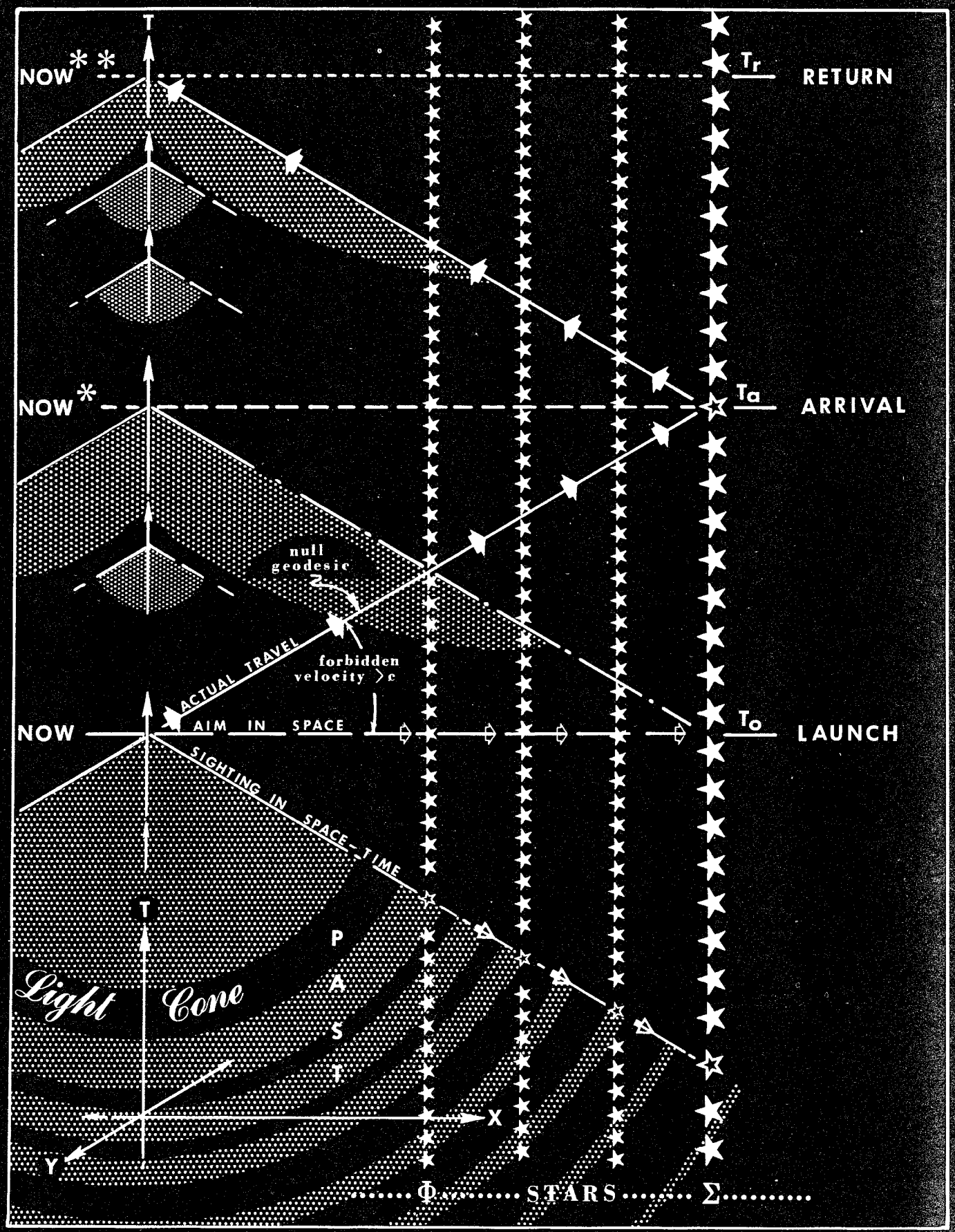



**FIGURE 8:** Space travel to some stellar designation Σ and return, showing by a modified Minkowski-type diagram the nature of *real* simultaneity as compared to apparent or "observer" simultaneity.

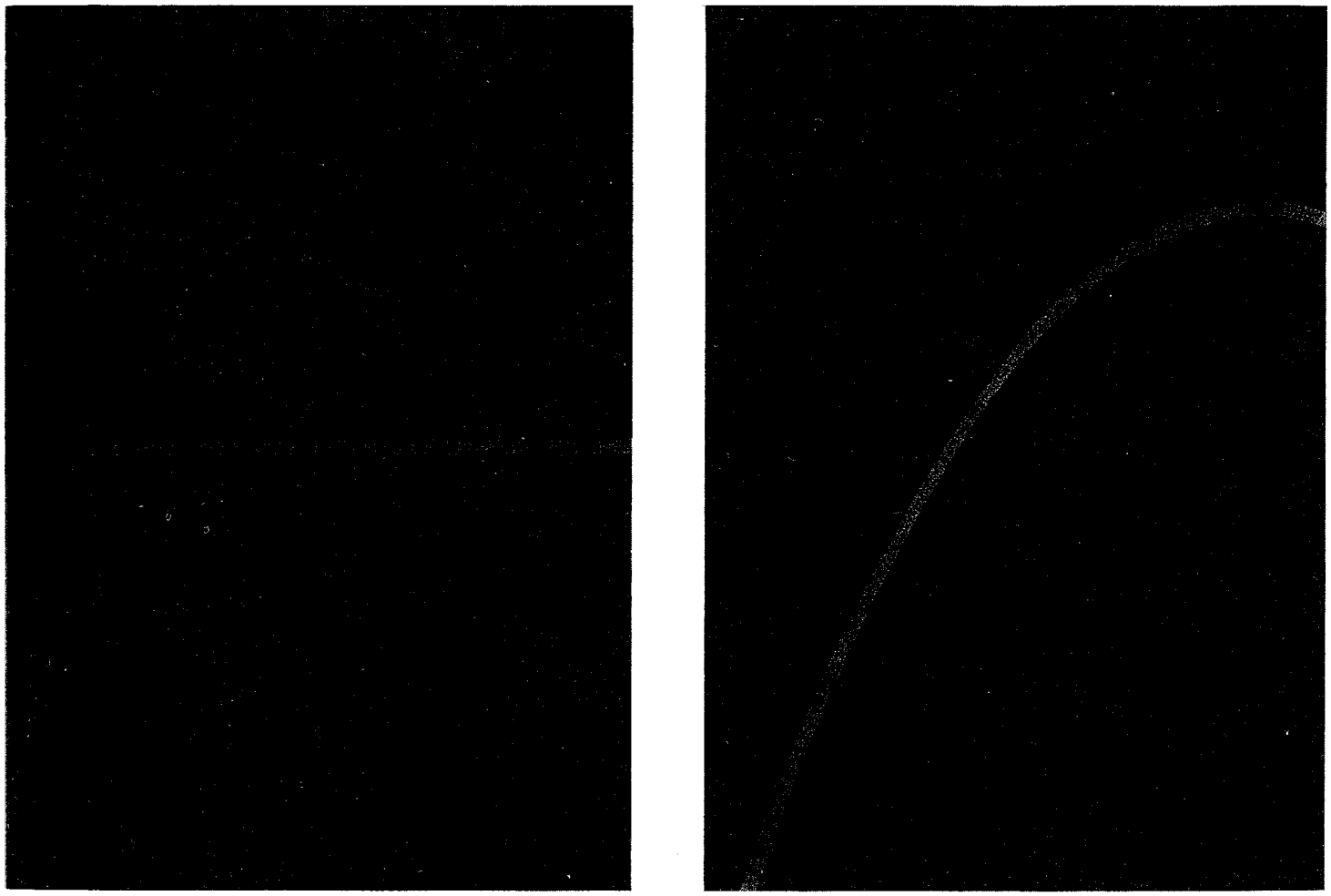
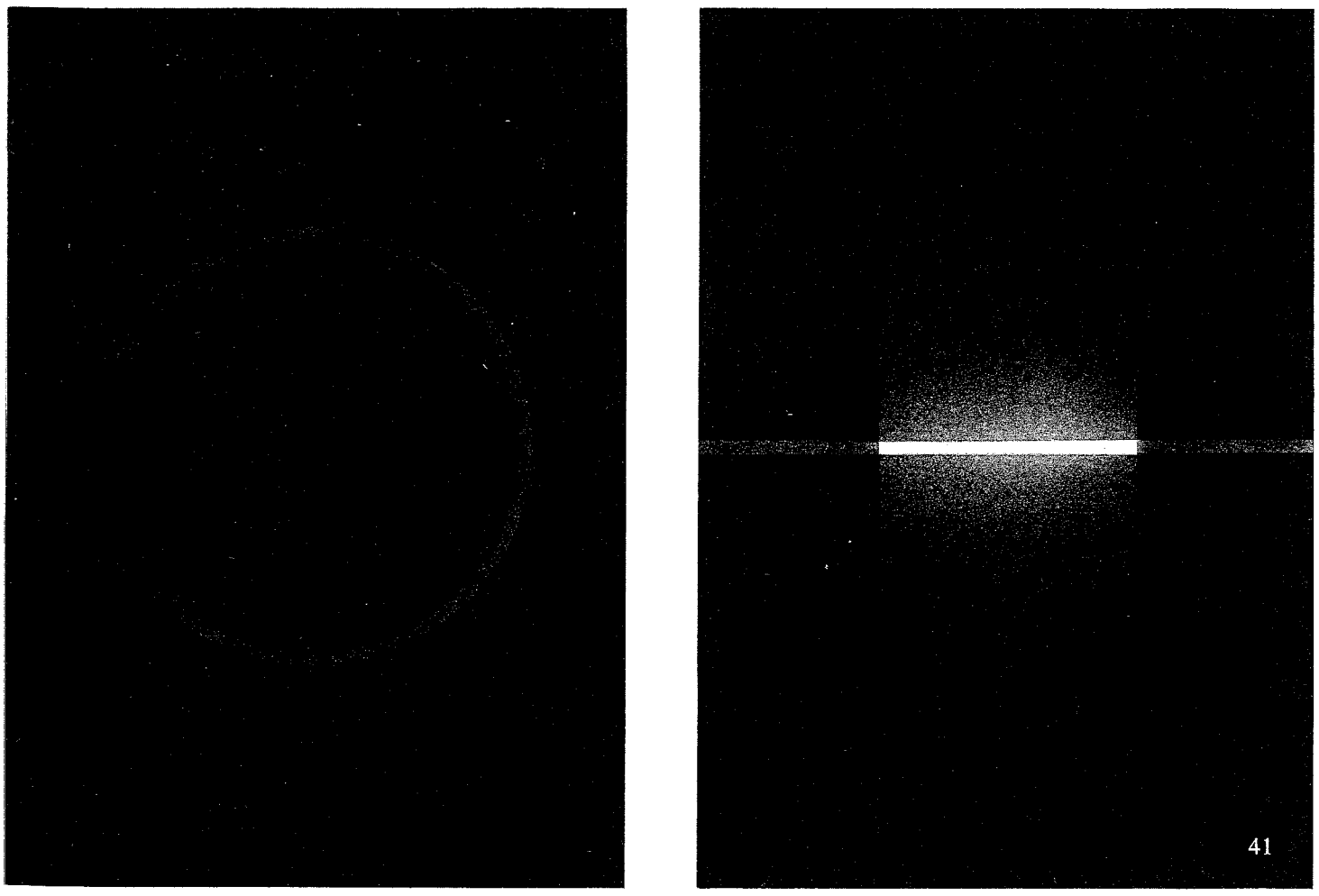


FIGURE 9



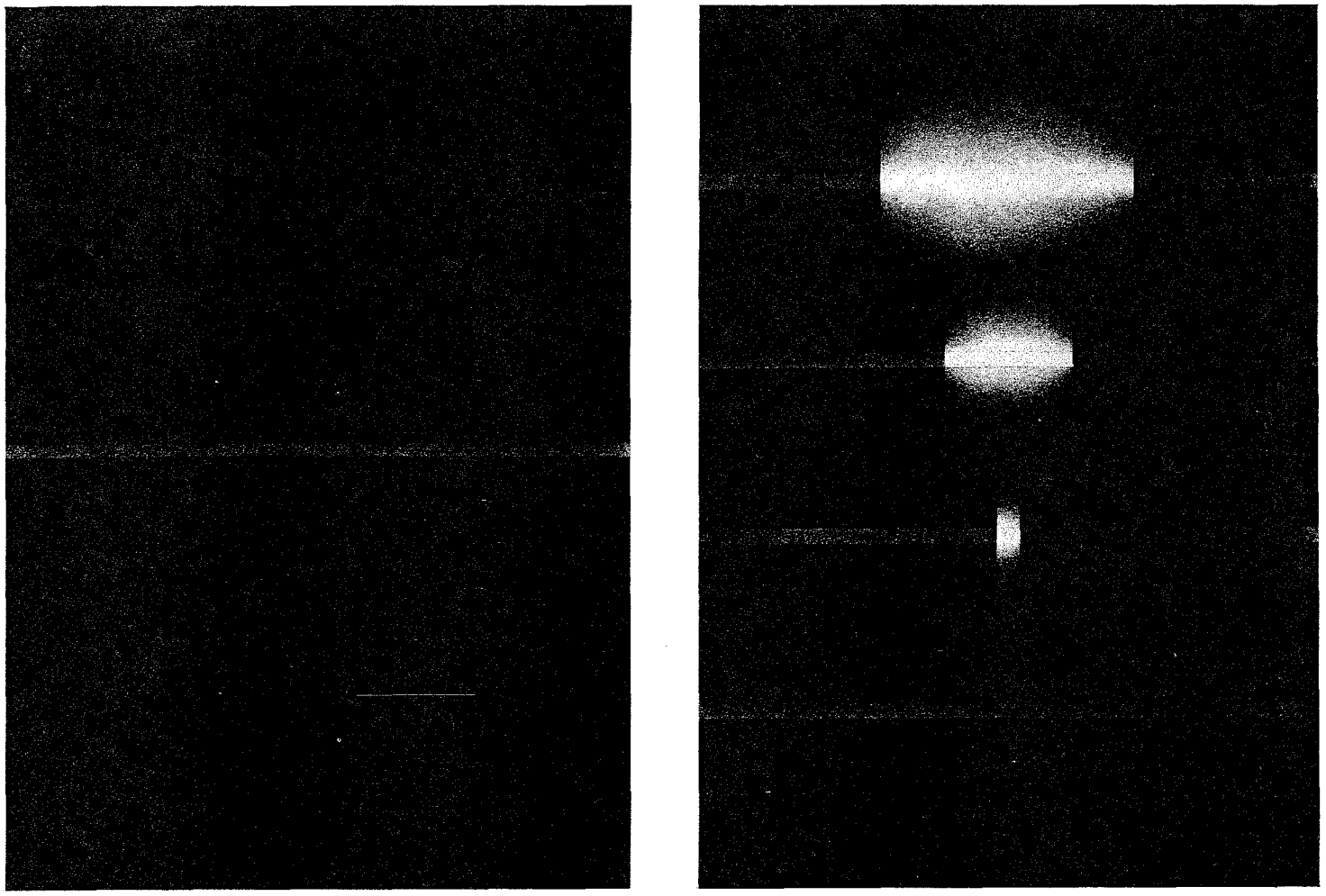
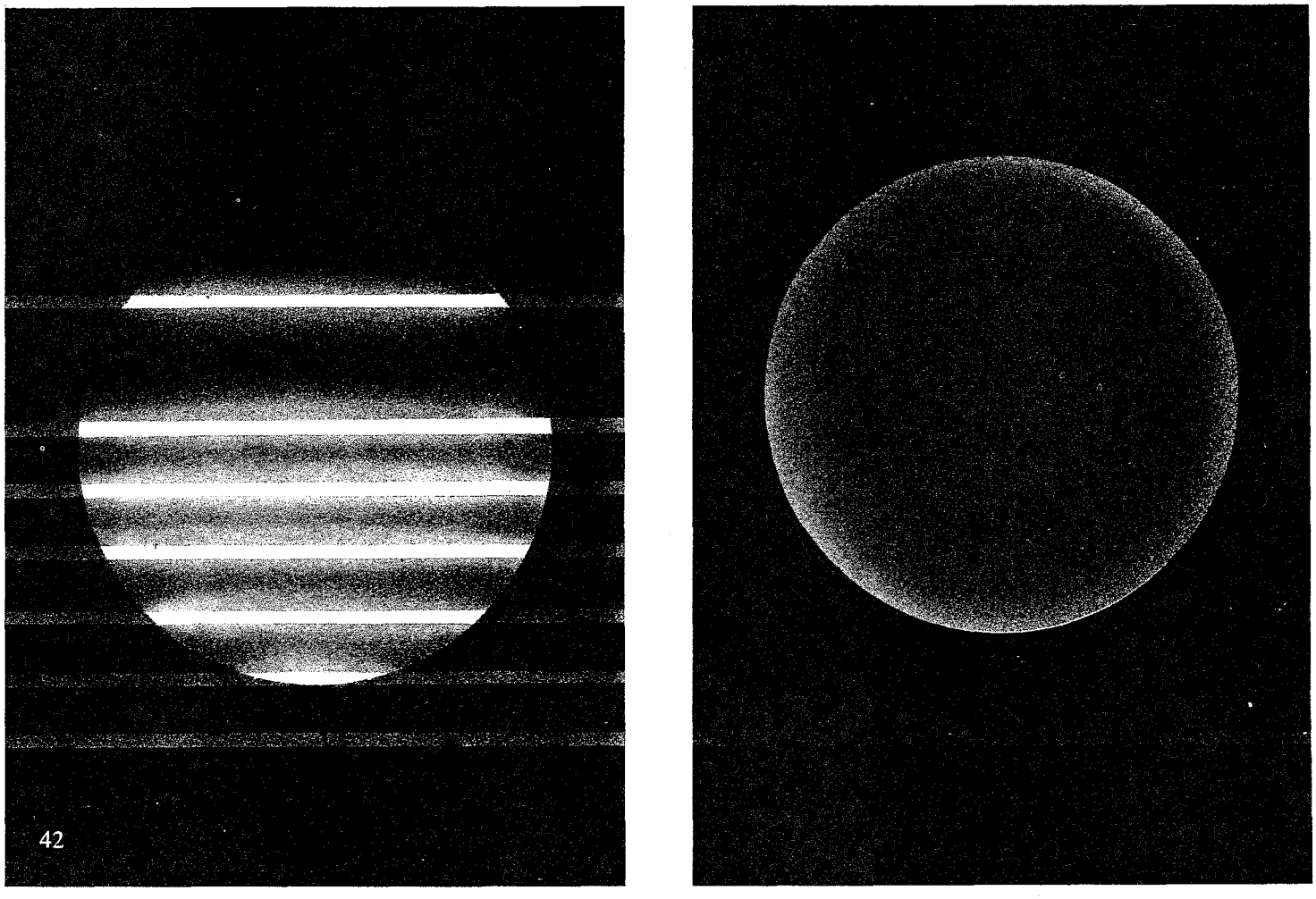


FIGURE 10



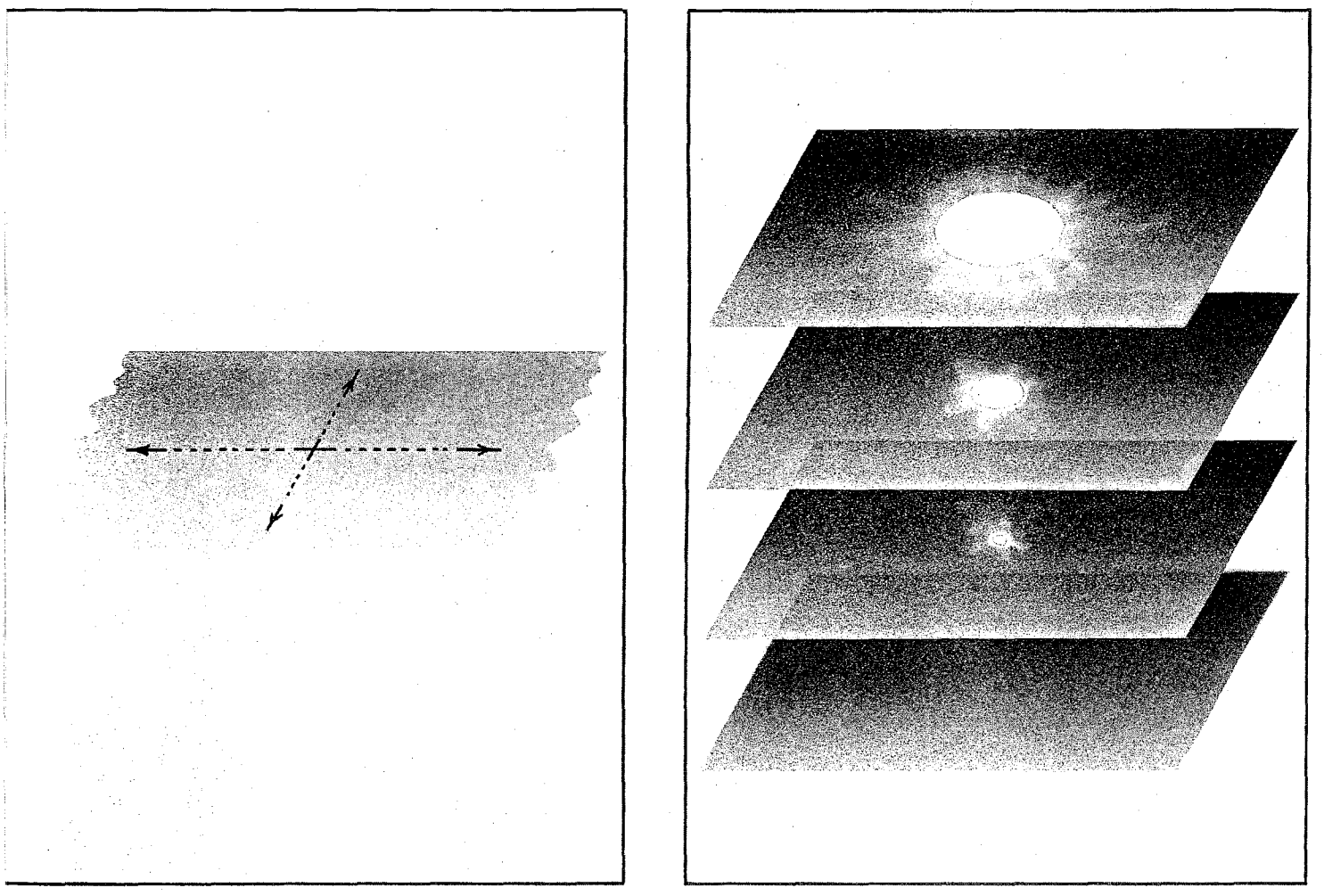
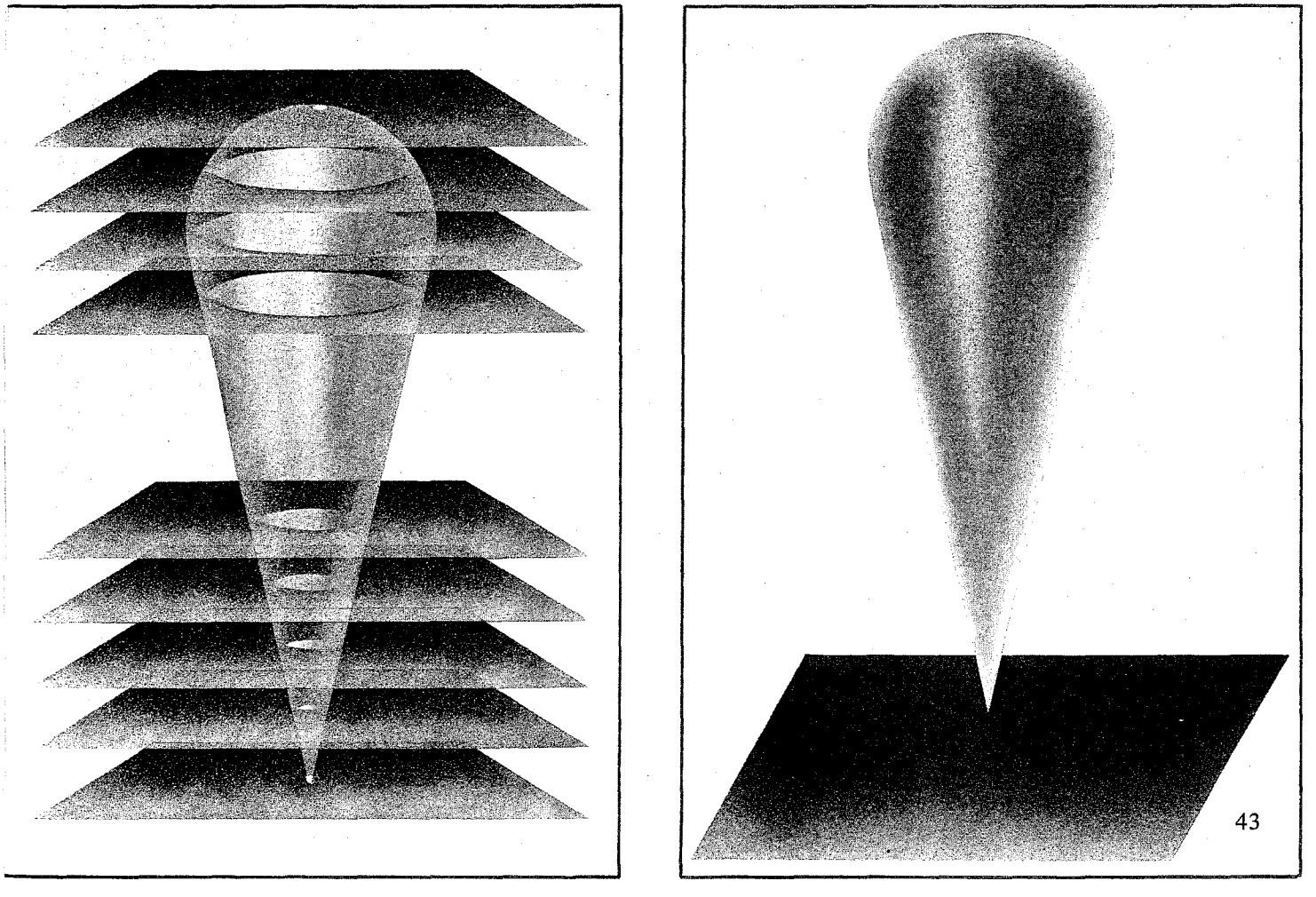


**FIGURE 11**



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**Autobiographical Sketch**

The author is Charter Fellow and Honorary Life Member of the American Society for Metals; Fellow of The American Institute of Chemists; member of the American Physical Society, American Geophysical Union, Astronomical Society of the Pacific, and the International Committee on General Relativity and Gravitation; Historian of Historic Heartland Association, Inc. and Past Commodore of the Gull Lake Yacht Club, Brainerd, Minnesota; Past President of the Rotary Club of Baltimore, and since 1955 Scoutmaster of Troop 35, Baltimore, Maryland, U.S.A.

# Albert Einstein

ALBERT EINSTEIN (1879-1955) holds a position in the history of the intellectual evolution of mankind not likely to be shaken, let alone toppled, even by complete demolishment of his Special Theory of Relativity. Two great reasons stand behind this confident statement, the second of which seems to have escaped the notice of historians of present record.

First is the obvious and irreducible fact that, right or wrong, Einstein's derivation of the Lorentz transformation directly from simultaneous equations, and based upon two highly logical postulates, with its subsequent adaptation as a universal mathematical tool for problems of covariance between systems in relative motion, was an act of such intellectual brilliance and boldness as to stun three generations of the world's greatest minds. Over seven decades have now elapsed since the time of his original pronouncement in 1905; and if the present claim to discovery of a fault in his reasoning is ever to be substantiated, it must first reverse a consensus in physics which, with minor exceptions of periodic objectors studying effects of the theory rather than underlying causes, is worldwide.

But second and far more germane to historical evaluation of Einstein is this: *As of the date of the formulation and publication of his General Theory of Relativity over the period 1913-1916, humanity has become elevated to the ranks of the gods—able to gaze down upon the totality of the manifested universe, debate its probable and possible forms as a non-Euclidean curved manifold embedded within the hyperdimensional spaces of the liberated intellect, and consider both beginnings and endings through reduction of time to a dimensional feature of geometry.*

Humanity will never be the same again. All over the world, and into illimitable future times, a mere human being can now seat himself comfortably at his desk, toy with the cosmological models and applications stemming from the General Theory, and gaze thoughtfully *down upon* models of Riemannian or hyperbolic or other hyperdimensional forms of whatever possible application to the total physical system—a facility theretofore absolutely and categorically restricted to the status assigned by philosophers to gods. Prior to Einstein, the human intellect was trapped within 3-space, only able to look out—and wonder. Since Einstein, the mind not only easily transcends 3-space to permit looking down, but has the mathematical tools to do it. Little wonder that this man is regarded as a "saint" within intellectual circles. The evaluation is quite correct. For Einstein initiated an upgrading of the human intellect of categorical sort, such as is otherwise only ascribed to leaders of the world's great religions, in fields other than the intellect. In fact, the "Einstein event" invites unabashed comparison with the archaeologists' Ceramic Age, Bronze Age, and Iron Age; also with the paleontologists' series from *Homo erectus* to hominid to *Homo sapiens sapiens;* and perhaps even with the Eras and Epochs of geology—insofar as the human intellect can be regarded as related to global modification. For the Space Age promises to do just that; and its beginnings are to be pinpointed to the Einstein Era, and specifically to Einstein himself. While it was Wilbur and Orville Wright who freed humanity from imprisonment in 2-space

between 17 December 1903 and 5 October 1905, this was in the nature of the culmination of a long dream of mankind in general, at last made possible by advancements in engineering. But the reception of Einstein's first manuscript on relativity, by the editor of *Annalen der Physik* on 30 June 1905, hence at exactly this same point in time, began the freeing of the human mind even from 3-space.

Historians of future generations, therefore, will likely view the Special Theory more as a mark of the stunning intellectual brilliance which presaged the General Theory, rather than a thing of value or permanence in itself. Hindsight now discloses it to be but one of four imposing and important steps into the new era: First was the problem with which such as Lorentz, Larmor, and Poincaré wrestled regarding covariant transformation between systems in relative motion when the instrumentation of experimental physics failed to record the expected factor of Earth velocity relative to interplanetary space. Second was Einstein's facile and impressive solution offered by his Special Theory. Third was the brilliant Minkowski's fascination with Einstein's equations, and his proposal to render them in terms of geometry, with the resulting space-time continuum. Fourth was Einstein's fascination in turn for Minkowski's geometric approach, followed by his determination to tackle gravitational problems in similar manner, involving acceleration and non-Euclidean geometry in place of the flat space and constant velocity of the Special Theory, with the resulting General Theory.

Among these four, only the climactic fourth is essential to Einstein's historical position in relativistic physics, the Special Theory being but one of the preliminary steps. Other "saints" have been found in error, too, without serious reduction of historic status—Peter denying the Christ three times, King David lusting after Bath-Sheba, wife of Uriah the Hittite. *Exitus acta probat*—the result measures the deed. No more value need therefore attach to the permanence of the Special Theory than to the discarded models of Lorentz and others which preceded it. The same is true for the particular form of Minkowski's space-time continuum, insofar as it involves the allegedly erroneous $(1 - v^2/c^2)^{-½}$.

But then, this is a matter of history which has not yet been written.

Portrait by P. Halsman of New York City