Conclusion Paper

Robert J. Buenker[1]

[1]*Fachbereich C-Mathematik und Naturwissenschaften, Bergische Universität Wuppertal, Gaussstr. 20, D-42097 Wuppertal, Germany*

email: bobwtal@yahoo.de

I. INTRODUCTION

The Lorentz transformation (LT) is the cornerstone of Einstein's relativity theory. What the great majority of physicists have not understood is that it is fatally flawed. One can easily see this from a critical examination of the light speed postulate on which it is based (see Chapter IV). Consider the following case in which a light source leaves the laboratory with speed v at the same time that it emits a light pulse in the same direction. Einstein's postulate LSP) in the theory of Special Relativity (SR) states that the speed of the light pulse is c for *both* the stationary observer in the laboratory as well as relative to the source. One can see that this is an untenable assumption by calculating the respective distances separating the light pulse from each rest frame after a certain time T has passed. The value of this distance is seen *to be cT in each case.* But this is impossible, since the source and stationary observer *are no longer at the same position in space.* In arriving at this conclusion, it clearly does not matter how great T is, whether it is just a few milliseconds or many thousands of years. In summary, *Einstein's light speed postulate is completely unrealistic.*

There is also another effective way to use the above ("distance reframing") procedure. Consider again what happens when some time T has elapsed since the light source began to move with speed v. After this time has passed the source is found at a distance vT from the stationary observer, while the light pulse is again located at a distance cT from the source. The corresponding distance separating the light pulse from the stationary observer is obtained by simply adding these two partial distances together, in which case the answer is clearly vT+cT. We don't need Newton or Galileo to deduce this value, nor the ancient Greek and Roman philosophers. It involves the same "theory" as we use to measure the length of a room with a meter stick. We measure out the various portions of the room in meters and just add the results.

Since the motion of the light pulse and source occur at the same time T, it is possible by definition to calculate the speed of the light pulse relative to the stationary observer, namely as the ratio of the distance travelled to the amount of elapsed time, i.e. as (vT+cT)/T=v+c. This result is exactly what one obtains when one applies the classical (Galilean) velocity transformation (GVT). It therefore stands in clear contradiction to another of Einstein's conclusions from SR, namely that the GVT does not apply to light or other fast moving objects. The GVT is known in standard mathematical language as the *vector addition* of velocities.

Moreover, it can be stated without fear of contradiction that, just as for vector addition, it applies to motion in all three (not four!) spatial directions. It was used by Bradley in the 17^{th} century to deduce a key aspect of astronomical measurements, namely the aberration of starlight from infinity. Einstein concluded on the basis of his light speed postulate that the angle of aberration is $\tan^{-1}(\gamma v/c)$, whereas the correct value that Bradley obtained by vector addition is $\tan^{-1}(v/c)$. The maximum speed observable speed in free space is not c as SR would have one believe, but rather 2c when two light pulses approach each other head-on. Each pulse travels a distance of cT in time T, so their total closing distance is 2cT. There is no reason to doubt this,

As discussed in Chapter III, another problem with the LT is that its space-time mixing characteristic violates the Law of Causality. Consistent with Newton's First Law, one expects that an inertial clock cannot change its rate spontaneously, that is, without the application of some unbalanced external force. The ratio of the rates of any two inertial clocks must therefore be constant. This means that the elapsed times Δt and Δt' measured for a given event must always occur in the same ratio (Q) as their rates, i.e. Δt'=Δt/Q. This equation is referred to as Newtonian Simultaneity because it is evident therefrom that if the events occur simultaneously for one of the clocks (Δt'=0), they must also be simultaneous based on the other (Δt=0). The attribution to Newton is appropriate because of his longstanding belief that events occurring anywhere in the universe must always occur at the same time. The equation is also referred to as the Clock-rate Corollary to Newton's First Law. The failure of the LT to satisfy this physical requirement is therefore proof that it violates the Law of Causality.

Einstein was aware of the fact, first pointed out by Poincaré, that the LT predicts that events do not always occur simultaneously for two observers in relative motion to one another (remote non-simultaneity or RNS). His famous example of two lightning strikes on opposite sides of a train as it passes by the station platform was intended to bolster belief in RNS. Examination of his argument, however, shows that is based on his LSP which has been shown above to be unreliable. When the GVT is used to analyze the problem instead, however, the strikes are found to occur simultaneously.

The impetus for treating the speed of light differently than for other objects can be traced to the Fresnel-Fizeau light-damping experiment in the early 19^{th} century. It leads to the conclusion that the speed of light in a medium with a refractive index close to n=1 is independent of the medium's speed v in the laboratory; c(v)=c. It was recognized that this behavior is inconsistent with the GVT. After the Michelson-Morley experiment carried out in 1887 appeared to be in agreement with the above relation, Voigt suggested that a suitable transformation could be obtained by simply introducing a free parameter into the GVT equations. His result was inconsistent with Galileo's Relativity Principle (RP), however. Larmor and Lorentz were able to modify Voigt's transformation so as to remove this objection and Einstein used the resulting transformation, the LT, in developing his version of relativity theory, i.e. SR.

The point which has not been appreciated is that this success in no way removes the necessity of using the GVT for other purposes. In Chapter V, the distinction has been made between experiments of Type A, in which two observers in relative motion obtain different values for the speed of light emitted from a given source, from those of Type B in which a single observer measures the light speed *under two different conditions*, such as occurs in the Fresnel-Fizeau light-damping experiment. For the latter purpose, one must use the relativistic velocity transformation (RVT), which is easily derived from both the Voigt transformation and the LT. The ranges of applicability for the GVT and RVT are seen to be mutually exclusive.

The Newton-Voigt transformation (NVT) shown in Chapter VI is consistent with the $\Delta t' = \Delta t/Q$ relation (Newtonian Simultaneity) and, unlike both the LT and the Voigt transformation, is therefore consistent with the Law of Causality. The corresponding (different from the LSP) light speed postulate assumes that the speed of light in free space is always equal to c *relative to its source,* independent of the states of motion of both the observer and the light source; the NVT also satisfies this requirement. It also satisfies the condition required by the Galilean RP. This is proven on the basis of an identity derived in Chapter VI, namely $\eta\eta' = \gamma^2$. Previously, it has been assumed incorrectly by most physicists that the LT is the only space-time transformation that is consistent with the RP. The same identity is also used in Chapter VI to prove that the RVT, which can be derived from the NVT as well, is also consistent with the RP.

In order to apply the NVT in a given case, it is necessary to know not only the relative speed v of the two observers involved in the transformation but also the value of the ratio Q of the rates of their respective clocks. The latter value must be obtained experimentally. The results of the Ives-Stilwell experiment and the various studies of the lifetimes of muons and pions were in agreement with Einstein's time dilation prediction. It was found that the value of Q depends on the speed v of the light source relative to the laboratory, namely as $\gamma(v)=(1-v^2/c^2)^{-0.5}$.

The Hay-et al. centrifuge experiment with x-ray radiation showed, however, that time dilation is **not** symmetric. The LT prediction of a red shift being observed in all cases was contradicted in this study, although this was not recognized by the authors. The atomic clock experiments on board circumnavigating airplanes that were carried out by Hafele and Keating a decade later ruled out the possibility that Einstein's 1907 Equivalence Principle satisfactorily explains what occurs in general. In the centrifuge experiment it was found that the clocks on the eastward flying airplane ran slower than those flying westward. The explanation is that the speed v of each clock that determines the clock rate is taken to be relative to the earth's center of mass (ECM). This fact shows that Einstein's Symmetry Principle is not viable and instead that time dilation is an asymmetric phenomenon,

The parameter Q in the Newton Simultaneity formula is thus seen to the ratio of the corresponding $\gamma(v)$ factors. An inverse proportionality therefore exists between a given elapsed time measured with each clock and the associated $\gamma(v)$ factors. This relationship is referred to in Chapter IX as the Uniform Time Dilation Law (UTDL). To apply it in a given case, it is necessary to specify a rest frame, referred to as the *objective rest frame* or ORS, relative to which the speeds of the clocks (v and v') are to be referenced in each case. It is the laboratory in the Hay et al. x-ray study, the ECM in the Hafele-Keating experiment with circumnavigating atomic clocks, or more generally, as the rest frame from which an object has been accelerated. With these definitions, it is possible to define Q as the ratio of γ(v') to γ(v). The latter is most effectively seen as a *conversion factor* between the rates of the clocks.

It is also possible to prove that the same conversion factor applies to distances. If an object of length L is accelerated, as discussed in Chapter X, *length expansion must accompany time dilation* in order that the speed of light in free space has the same value c in both rest frames, This is the opposite relationship expected based on the FitzGerald length contraction prediction of SR. Moreover, again unlike the case for the FLC prediction, the amount of the expansion must be *independent of the orientation* of the object.

The experiments of Bucherer in 1909 with electrons accelerated to speed v in an electromagnetic field found that the inertial mass of the electrons increased in proportion to γ(v). On this basis it can be concluded that inertial mass also scales with factor Q. The conversion factors of all other physical properties can therefore be deduced to have conversion factors which are integral multiples of Q. For example, speed is the ratio of distance to speed, so the conversion factor for speed is $Q/Q=Q^0=1$, that is, it is independent of the state of motion of the observer. This is of course consistent with the light speed postulate stated above, namely that the speed of light in free space relative to its source is always equal to c. The conversion factor for frequency is Q^{-1} based on the fact that it is defined to be the reciprocal of the period of clocks. Accordingly, energy scales as Q since it is defined as the product of inertial mass and the square of speed.

The scaling procedure outlined above is consistent with the Principle of Rational Measurement (PRM) introduced in Chapter I. It is the basis of the Uniform Scaling method as a whole (see Chapter XI). A key aspect of Uniform Scaling is that the reverse conversion factor Q' is always the reciprocal of the original (Q'=1/Q), It is clearly distinguished from Einstein's Symmetry Principle which states that two clocks can both be running slower than each other at the same time.

A consequence of the perfect objectivity of the Uniform Scaling method is that it allows one to deduce the value of Q for any two rest frames (2 and 3) from the respective Q values of another rest frame (1): Q(2,3)=Q(1, 3)/Q(1,2)=Q(2,1)Q(1,3). It should also be noted that the rest frames do not have to be inertial in order to apply the Uniform Scaling method. The Hafele-Keating airplane experiment shows that the UTDL is valid for atomic clocks that are constantly accelerating. The values of the speeds are those measured instantaneously at the current time.

There is an analogous scaling procedure for differences in gravitational potential, as discussed in Chapter XII. In this case the quantity $A_i=GM/c^2r_i$ plays the same role as γ (v) for kinetic scaling. The corresponding conversion factor S is equal to A_o/A_p. The two factors Q and S are independent of one another. This is again seen from the Hafele-Keating study in which the effect of gravity on the clock rates is simply added to the corresponding kinetic effect. This is a key observation since physicists have traditionally believed that the two effects are intertwined. A typical unfounded assertion is that the effects of gravity cannot be "painted" onto SR.

The conversion factors for each property are integral multiples of S, just as in the case of the factors of Q for kinetic scaling. The integers for the fundamental properties of time, inertial mass and distance are -1, -1 and 0, respectively, whereas they are 1, 1 and 1 for the exponents of Q. It is only necessary to know its composition in terms of the three fundamental properties in order to determine the power of S for a given property, similarly as is the case for the power of the corresponding kinetic conversion factor. For example, since speed is the ratio of distance to time, the exponent of S is found to be 0/-1=1 in this case. The composition of energy is inertial mass times the square of speed, hence the gravitational factor exponent in this case is computed to be -

1+1+1=1. Because the two types of factors are independent of one another, it is possible to list the value for each property as a product Z of an S factor with the corresponding Q factor. Values for the most important physical properties are listed in Table 1 in Chapter XII. For example the value for energy is Z=QS, while that for time is Q/S.

The role of these conversion factors is to allow the measured results in one rest frame (S') to be converted over to the corresponding units in another (S). For example, if the value of the energy E of an object is measured to be E in rest frame S', the corresponding value in rest frame S is Z=QS E. The relationship in the same two rest frames for Planck's constant h, and for angular momentum in general, is $Zh=Q^2h$. The Uniform Scaling method is consistent with the PRM. *The only reason two observers can legitimately differ on the value of a physical property is if their unit is different.* There is a unique set of kinetic and gravitational scaling factors for any pair of rest frames which enables the conversion of the values of any physical property between them.

The values of Q and S are positive definite and finite in all cases. It is theoretically possible for the unit of length to be much larger in one rest frame than in another. For example, if the factor of Q has a value of 1000, this means that a length of 1.0 m in rest frame S' must have a corresponding value in S of 1.0 km, whereas a length of 1.0 m in S has a corresponding value in S' of only 1.0 mm. There is no experimental evidence that stands in contradiction to these comparisons, nor to the results for any other property. Consistent with what is stated in Chapter I, an assertion that the Uniform Scaling method is not a law of nature has no validity until such contradictory evidence becomes known. The situation is exactly equivalent to the claim that the energy conservation principle is a law of nature.

A law of nature is of no interest to physicists, or to the general public for that matter, unless it has some practical application. This requirement for the Uniform Scaling method, as discussed in

Chapter XIII, is satisfied by the Global Positioning System (GPS) navigation method. Uniform scaling for time is applied to the rates of atomic clocks carried on satellites. Both kinetic and gravitational scale factors are used to adjust the rates of satellite clocks to be the same as for their counterparts on the earth's surface or elsewhere. This procedure is essential in order to assure the level of accuracy required for the practicality of GPS. It has been suggested that the "pre-correction" technique used by the GPS engineers could be improved by adjusting the rates by on-board computers based on the predictions supplied by the Uniform Scaling method. It should be clear that Einstein's Symmetry Principle of SR is not capable of providing the necessary information for the adjustment of the clock rates for the simple reason that it rules out the possibility that there is an asymmetric relationship between the rates of atomic clocks located in different rest frames. More generally, the Uniform Scaling methods opens up the possibility of obtaining useful information regarding the rates of atomic clocks located near the moon or other planets.

It is possible to extend the Uniform Scaling method to electromagnetic quantities such as electric charge and electric and magnetic fields. As shown in Chapter XIV, this can be done by taking advantage of ambiguities connected with basic relationships such as Coulomb's Law and the Biot-Savert Law. For example, the units of electric charge and the electric permittivity constant ε_0 can be chosen to have mks values; electric charge can be assigned the unit of Joule (J) whereas ε_0 then has the corresponding unit of Newton (N). Once this assignment is agreed upon, it becomes possible to apply both kinetic and uniform scaling to these two quantities. It should be noted in this context that it is claimed incorrectly in many standard texts that the charge of an electron is simply invariant. The corresponding units for all the other commonly used electromagnetic quantities are shown in Table 2 of Chapter XIV.

In order to successfully determine the effect of gravity on light waves, it is necessary to make an adjustment relative to the scaling factors shown in Table 1. The component of velocity radial to the gravitational field must be scaled with an extra factor of S, also the corresponding value of the distance vector (Chapter XV). This follows the suggestion made by Schiff in his 1960 paper, but it is not the consequence of either the FLC or Einstein's Equivalence Principle as he claimed, rather it is simply an empirical adjustment required to obtain agreement with experimental data.

There is another critical aspect to Schiff's method, however, namely that in his trajectory calculation light always follows the same straight line throughout, and with the same local value of the light speed of c. The finding that the angle of displacement of star images during solar eclipses is non-zero is *not due to the ben*ding *of light waves* because of the use of curvilinear coordinates in the calculation, as GR would have one believe, but rather because of the fact that *the speed of light decreases as it passes by a gravitational mass* (consistent with Table 1). Shapiro's experiments demonstrated what he referred to as the "fourth test of general relativity" by carrying out experiments with radio waves passing by Venus and other planets. As Fig. 1 in Chapter XV shows, the consequence of this gravitational effect is to rotate the wave fronts of the light away from the sun. The quantitative calculation of the angle of displacement then follows based on Huygens' Principle enunciated in the 17^{th} century. as demonstrated by use of finite differences in the calculations.

Schiff, who was an acknowledged expert on GR calculations, acknowledged that his scaling method was not able to explain the other key gravitational effect, the variation of the angle of precession of Mercury's orbit. In Chapter XVI, it is shown that this conclusion was due to his failure to include the effect of g, the acceleration due to gravity, in his calculations. His star displacement image calculation does not include g in any way, so he apparently thought that the

Mercury effect should not depend on this either. The correct value of the precession angle is obtained by including g with a particular scale factor: $Q^{-2}S^{-3}$. It needs to be emphasized that this scaling procedure also explains why g does not have to be included in his calculation of the displacement of the images of stars; since the speed of light is c, $Q=\gamma(v)$ is infinite and the value of Q^{-2} in that application is therefore exactly zero.

There is another quantity that needs to be closely considered in this context. Schiff points out that the GR calculation of the Thomas precession of the earth's orbit around the sun leads to a quite unusual result for the component of spin in the plane of the earth's orbit; it is in the *opposite sense and different in magnitude* from what is expected based on the Newtonian Law of Gravity. The calculations of the Uniform Scaling method, on the other hand, are in perfect agreement with the classical Newtonian prediction. Combining this characteristic with its claim that light is bent by the sun provides ample evidence to subject GR to much more careful scrutiny than has been the case in the past century.

The corpuscular/particle theory of light was used by Newton to predict that the speed of light increases when it enters water, contrary to what was assumed on the basis of Huygens' wave theory. When it was found in the 19th century that the light speed does decrease in water, it was widely assumed that this proved beyond any doubt that Newton's particle theory was incorrect and that it needed to be replaced by Huygens' wave theory.

Upon closer examination, however, it is seen that the reason for Newton's error was his assumption that the mass of the particles does not change when they enter water from air. His argument based on the Second Law of Kinetics (see Fig. 2 of Chapter XVII) only supports the conclusion that the *momentum* of the water molecules is directly proportional to the index of refraction n, not their speed. As discussed in Chapter XVII, the fact is that the mass of the light particles is proportional to n^2. This in turn suggests that the speed of light decreases by a factor n when it enters water, in agreement with the wave theory. In other words the two theories actually support each other on this point.

Moreover, the fact that experiment finds that the wavelength λ of light is inversely proportional to n indicates based on the particle theory that $p\lambda$ is a constant. This relationship is seen to be identical with de Broglie's principle, whereupon the above constant is equal to Planck's constant h. One can go a step further, by invoking Hamilton's principle $dE/dp=v$ (which perhaps ironically can be derived from the Second Law). Integration leads to the conclusion that $E=pc$ for light in free space since $v=c$ in this case, which therefore leads to the conclusion that $E=p\lambda\nu=h\nu$, which is Planck's energy/frequency relationship.

Since p is proportional to n, one can generalize the above formula to $E=pc/n$ for light in refractive media. One can further apply Hamilton's principle to obtain the following dependence of light speed on refractive index: $c(n)=c/n-pcn^{-2}dn/dp$. Substitution of $p=h/\lambda$ then leads (see Chapter XVIII) to the experimentally determined relationship between c and $k=2\pi/\lambda$: $c(n)=c/n-kcn^{-2}dn/dk$.

The strongest indication that light is indeed composed of particles comes from Einstein's interpretation of the photoelectric effect, which he also published in his "miracle year" of 1905. It is clear from these results that energy does not *accumulate.* Unless a certain threshold frequency is reached, no metal particle is able to exit the surface. This behavior simply cannot be explained on the basis of the wave theory. A similar situation exists for claims that light waves are dispersed when they enter water from air. An attempt is made to make an analogy with sound waves, but for that argument to be plausible, one would like the light waves to exhibit beats, something which has never been observed. On the other hand, the TCSPC measurements discussed in Chapter

XVIII show that the statistical pattern of the photons is merely transported more slowly in water than in air and is otherwise indistinguishable between the two media. This is exactly what one would expect if the photons are simply slowed when they enter water.

There is another experiment with light refraction that could be most illuminating. The diagram in Fig, 3 of Chapter XVIII illustrates how one might be able to measure the speed of light directly in water without relying on wavelength comparisons. By measuring the angle of approach of the light from air *with an apparatus located in the water*, it would be possible to confirm the assumptions made on the basis of the particle theory. This would also lend support to the interpretation of the displacement of star images during solar eclipses, as is indicated in Fig. 1 of Chapter XV.

The energy-mass equivalence relation ($E=mc^2$) does not depend on space and time coordinates and therefore is not affected by either the distance-reframing procedure or the Law of Causality. As pointed out in Chapter XVIII, it is interesting that Einstein arrived at his result through considerations of the Doppler effect and on the basis of the non-relativistic kinetic energy formula: $E=0.5mv^2$.

It has been pointed out, however, that many of the most famous relativistic equations only hold when the observer is located at the ORS position which determines the value of v The UTDL shows that it is only in this case that $Q=\gamma(v)$. Otherwise, the appropriate relationship for inertial mass is $m=Q\mu$, not $\gamma\mu$, and $p=Q\mu v$, not Planck's definition of $p=\gamma\mu v$. Planck applied Newton's Second Law $F=dp/dt$ to obtain $E=mc^2$, whereas this route to $E=mc^2$ is not feasible when the relevant equation is $p=Q\mu v$. At the same time, the $E=mc^2$ relation itself is nonetheless valid because it only requires knowledge of the E/m ratio, in which case the scale factor Q is cancelled out in the appropriate calculation. At the same time, it is also clear that the E/m ratio is not equal to c^2 in the case of refractive media. This is because p is proportional to n while v is inversely proportional to it. The E/m ratio is therefore proportional to the square of the refractive index in this case, and therefore is not equal to c^2.

One of the most widely held tenets of physicists in the field of relativity is that forces must change from one rest frame to another as a result of application of a Lorentz transformation. Consider the following application discussed in Chapter XX which makes use of the Lorentz Force Law: **F**=e(**E**+**vxB**). Assume that the electric field **E** is pointed along the x direction in which the electron moves while the magnetic field **B** is perpendicular to it. It is found in the laboratory that the electron initially moves in the x direction. However, shortly thereafter, consistent with the Lorentz Force Law, as its speed increases to a value of v *relative to the laboratory observer*, it begins to veer off in a perpendicular direction since the **vxB** term is no longer zero. Thereupon, the electron follows an increasingly curved path at ever higher speed.

Next consider how this process is viewed from the vantage point of an observer who is co-moving with the electron. *According to Einstein's theory*, the electron is continually accelerated with him along the x axis of his coordinate system. Its direction can never change according to the Lorentz Force Law since there is supposedly no effect caused by the magnetic field **B** (since v is assumed to be relative speed of the electron to the observer). As a result, the effect of the magnetic field never kicks in and therefore the electron continues indefinitely on a path in the x direction. *As a consequence, the two observers must disagree as to whether the electron follows a curved path or not.* One has to give up the principle of objectivity of measurement to believe this. There is certainly no way to demonstrate that the two observers *do not agree on the path of the electron.* There is thus a clear choice; either one believes that measurement is objective, or instead that the Lorentz Force Law has a different form in each rest frame.

The present argument stands in direct contradiction to the ubiquitous claims that forces must be invariant to a Lorentz transformation. It needs to be acknowledged instead that, in accord with the RP, *forces must always have the same form in every rest frame*.

A similar situation arises in application of the FLC of SR. The angles of a triangle are different for any two observers in relative motion in this view. But angles are dimensionless quantities, just like numbers, so it is logically impossible that the two observers could disagree on this point either. The only physically plausible position is that in both cases all observers must be in complete agreement on the values of dimensionless quantities, independent of how fast they travel relative to one another. Therefore, this example constitutes indisputable proof not only that the FLC is unphysical but also the tenet that insists that forces must change from one rest frame to another in accord with application of the Lorentz transformation..

A way around this dilemma is to change the definition of v in the above example. Instead of being the speed relative to a given observer, *it should be changed to be the speed relative to the rest frame in which the electromagnetic field originates.* When this is done, the only way the two observers can disagree on the values of their respective measurements is if they use a different set of units in which to express their results. That view is consistent with the Uniform Scaling method as a whole, and thus no adjustment is required in order to be consistent with the expected outcome of the experiment with electromagnetic fields.

One only has to remember that Minkowski's four-vector formalism is based squarely on the LT to realize that it has no basis in reality. As discussed in Chapter XXI, every Minkowski four-vector can be decomposed into a scalar and a conventional vector of three dimensions without the necessity of introducing the imaginary number i into the formalism. According to his biographer, Einstein agreed with this assessment, at least initially, even though he claimed that the ideas had somehow helped him to develop GR at a later time. It is a pity that physics students through the past century have been forced to commit Minkowski's ideas to memory in order to obtain a good grade in their examination. One can only hope that this situation gradually changes in the relatively near future, and that the comparatively straightforward formalism of the Uniform Scaling method takes hold in the world's graduate schools.

A similarly negative assessment applies to the FLC of SR. Once one accepts both light speed constancy and asymmetric time dilation as experimental facts, it follows that length expansion must accompany the slowing down of clocks upon acceleration. In the Uniform Scaling methodology, this relationship is established by assuming that the scale factor for distance is the same as for time (see Table 1). In the past, it has been argued that the narrowing of particle beams that is observed when they are accelerated relative to the laboratory is a manifestation of the FLC. In fact, this is simply another confirmation of de Broglie's principle, namely that the wavelength of the beams is inversely proportional to the momentum of the corresponding particles. The FLC, by contrast, refers to a single distance between two points in space, and hence the experience with particle beams is completely irrelevant in this respect.

The Ives-Stilwell experiment provides a clear example of the FLC's totally misleading predictions. In that case, it is found that the wavelength of the radiation observed in the laboratory *increases* in direct proportion to the standard value observed in the rest frame of the accelerated light source (obtained after eliminating the influence of the first-order Doppler effect). The argument often made by SR proponents is that the FLC simply does not apply to light, even though the same experiment is used to confirm the theory's predictions regarding light frequencies.

In general, it is a mistake to take predictions of the LT at face value. Its RNS claim falls in the same category as the FLC experience. The Newtonian Simultaneity relation ($\Delta t' = \Delta t/Q$)

incorporated in the NVT indicates instead that there is absolute simultaneity throughout the universe, in agreement with Newton's position. It also stands in contradiction to the LT prediction of the possibility of time reversal, which was used long ago to supposedly rule out the occurrence of light speeds exceeding c. Experiments with light traveling through absorptive regions in which the index of refraction is less than unity have unquestionably demonstrated that faster-than-c photon speeds do in fact occur in nature. Belief in the LT has prevented physicists from accepting such results at face value, however. On the contrary, Newtonian Simultaneity and the NVT completely rule out the possibility that the sign of one elapsed time can be the opposite of the other's for the simple reason that the scaling factor Q is positive definite.

The negative influence of the LT is shown perhaps most strongly in that it led physicists to reject the use of the GVT in all but low-speed applications. Einstein unquestionably took the lead in this misconception by insisting on his light-speed postulate. As discussed in Chapter IV, the latter is shown to be untenable when attention is centered on the distance travelled by a light pulse relative to two observers who are located at a different position in space (distance reframing procedure). The correct postulate is that the speed of light relative to its source is always equal to c.

The same line of argument shows unequivocally that the speed of the light pulse is indeed determined correctly on the basis of the GVT. The Uniform Scaling method incorporates the latter conclusion by asserting its claim that the *relative* speed of two objects is the same for all observers independent of their respective states of motion. Representing the velocities of a given object as vectors allows one to conclude on the basis of *vector addition* that the *relative* velocity of any pair of objects must be the same for both observers. As discussed in Chapter XXIII, the corresponding three vectors simply form a triangle one of whose legs is connected to the corresponding vectors representing the velocity of the object to their respective positions. From the point of view of logic, it is clear that the decision to exclude the GVT in all cases involving light is based on the belief that since it does not hold for the Fresnel-Fizeau light-damping experiment, it supposedly cannot be accurate for any application involving light. On the contrary, it is shown in Chapter V that there are simply two distinct types of experiments, designated as Type A and B respectively, the former always described accurately by application of the GVT, the latter always by use of the RVT. In other words, the areas of application for the two transformations are *mutually exclusive*.

The Lewis-Tolman conjecture is characterized by a different type of experience with the LT. These authors concluded correctly on the basis of SR that an increase in inertial mass caused by acceleration is directly proportional to the corresponding increase in the periods of clocks. What one finds, however, is that Lewis and Tolman reached this conclusion by ignoring one of the basic premises of SR, namely the constancy of the speed of light in free space. Thus, this is an example where the correct result is obtained *by making two false assumptions* that tend to offset each other.

This is also reminiscent of the experience of the GPS engineers. They simply ignored another of Einstein's tenets, namely the Symmetry Principle, whereby the clocks located on a satellite would supposedlybe running at a slower rate than those on the ground from the vantage point of an observer there, while at the same time from the vantage point of the stationary observer on the satellite, the clocks on the ground would be running slower than those located on the satellite. The Uniform Scaling method by contrast is the byproduct of pure empiricism. It asserts that inertial mass and elapsed times are subject to the same conversion factor because that is what has been found in all experiments to date. As discussed in Chapter I on a general basis, this relationship does *not* rely on deductions that follow from some First Principles, The same holds true for the Conservation of Energy Principle.

The origins of sound and light can both be described in terms of the motion of particles. In the former case, the particles are combinations of different molecules such as the components of air, whereas in the latter they are photons. The speed of the particles relative to the source of the waves is variable in the case of sound waves (v_O), whereas it is always equal to c for light waves. The speed v of both relative to a given observer depends on the speed of the source v_S and is accurately described by the GVT. In the case of sound, $v=v_O+v_S$, whereas for light, $v= c+v_S$. As discussed in Chapter IV, it is possible for v to exceed c whenever the light source moves in the same direction as the emitted light from the vantage point of the observer.

The Doppler effect for wavelengths depends on the speed v_S of the source relative to that of the sound waves, i.e. $\lambda=(1-v_S/v_O)\lambda_0$. When the source moves into the waves, i.e. $\mathbf{v_S}$ and $\mathbf{v_O}$ have the same direction relative to the observer, the space in which they move is decreased and so the wavelength measured by the observer decreases. The wavelength increases when the opposite is the case.

It does not matter whether it is the source or the observer which is moving in a given reference frame. The situation is different for periods (τ), however. If the source moves into the waves, their period decreases, i.e. $\tau =(1-v_S/v_O)\tau_0$, in accord with the predictions of the Doppler effect. However, if the observer moves into the waves while the source stays in place in a given rest frame, the period of the waves relative to the observer does not change ($\tau=\tau_O$). Were it otherwise, it would constitute a violation of the Law of Causality. Einstein made this point in his study of the gravitational red shift. As a consequence, the phase velocity λ/τ does not equal λ_0/ τ_0 in this case, whereas it is unchanged when it is the source that moves. In either case, the speed of the sound waves is not equal to the phase velocity, but rather is equal to $v_O + v_S$ in accord with the GVT.

The manner in which the wavelength of sound changes with the speed of the observer is critical in understanding the origin of sonic booms. As discussed in Chapter XXVI, an airplane is continuously causing sound waves to be created. Their wavelength decreases as the speed of the plane v_S increases. It reaches a null value when $v_S=v_O$. According to the de Broglie $p=h/\lambda$ relation of quantum mechanics, the momentum **p** of the air molecules becomes infinite at this speed (Mach 1). This increase in **p** leads to a strong force **F** in accord with Newton's Second Law of Motion: **F**=**dp**/dt. This force can only be applied to the surroundungs of the plane, which explains why a sudden increase in energy occurs there, and this is perceived as a sonic boom.

A model for the motion of galaxies has been developed which is based on Hubble's Constant. There is a standard relation from elementary calculus which predicts the values of the speed v and distance L travelled by an object under the assumption of a constant value A of its acceleration, namely $A=v^2/2L$. Inserting Hubble's Constant H=L/v in this equation leads to the conclusion that $A=\Delta v/\Delta t=v/2H$, i.e. that the acceleration of a given galaxy is proportional to its current speed. The value for Hydra with v=38000 mi/s is only $1{,}17\text{x } 10^{-10}$ ft/s^2 which is miniscule in comparison to the acceleration due to gravity on the earth's surface of 32 ft/s^2. It is clear that this is only a residual acceleration, but it definitely supports the conclusion that the force of gravity is never able to overcome the effects of the Big Bang explosion.

Further development of the model indicates that Hubble's Constant is gradually increasing with time, rendering it to be something like a "clock of the universe." The galaxy speeds are all increasing linearly with elapsed time t, whereas the corresponding distances from the earth increase as t^2.

The results of the present model are quite consistent with the cosmological theory of an "expanding universe." They do not agree with the "oscillating universe" of GR, nor do they agree with the steady-state model. The Big Bang itself is consistent with the Laws of Thermodynamics. The Second Law states the amount of entropy in the universe is always increasing, and therefore always decreasing when one looks backward in time. The Third Law states that entropy is a positive definite quantity, so it never can go below a null value. Taken together, these two laws indicate that there was a *complete lack of disorder* prior to the Big Bang. This is consistent with null values of v and L for each galaxy predicted by the present model.