# Refutation of Special Relativity

introducing

# Gravitation Space as Medium of Propagation

Jakob Møller Christensen

http://relativity.ordr.org

July 2, 2013

# Contents

# Relativity Theory

*To punish me for my contempt of authority,*
*Fate has made me an authority myself.*

**—Albert Einstein, 1930**

This text is a logical/philosophical treatment of Albert Einstein's Relativity Theory, refuting the temporal relativity proposed in the Special Relativity Theory, which refutation is, in part, supported by the General Relativity Theory.[1] The treatment will base itself upon Einstein's so-called popular exposition of Relativity Theory,[2] and from this treatment will emerge a holistic sense of temporal and spatial relativity that is incompatible with Special Relativity. With the proposition of the substanceless, frictionless gravitation space *of density varying as gravitation strength* as medium of radiation propagation, many confirmed predictions of Relativity Theory will be reconfirmed, while some objections to Special Relativity, such as the Twin Paradox, will be validated.

Hopefully, the new perspectives on space and time will make the the phenomena treated by Special Relativity accessible and understandable by many of those whose efforts at approaching Relativity Theory have foundered on various obstacles, as well as to many of those too in awe of the theory to ever have attempted an approach. There will be no mathematical gymnastics in this text, as it is a logical examination in a language requiring no mathematical skills on the part of the reader, but a good imagination able to visualize both three-dimensional configurations and their dynamics is invaluable.

This treatment must necessarily point out logical flaws in Einstein's reasoning, as well as problems due to his super-motivated approach, the 'leap' that will consider a gap bridged because of the paramount desire to get to the other side, from where no one has any interest in turning around to scrutinize the gap and question whether the bridge really was there or it was all leap.[3] This will in no significant way detract from the brilliance of the genius that was Albert Einstein, but merely establish that our imagination sometimes takes us to conclusions with implications beyond our own field of expertise. There can never be any blame for posing alternate interpretations of reality which one believes to be true—on the contrary, they are necessary for scientific evolution, even the ones that do not go entirely in the right direction, because then we find out why and are the wiser for it. There can only be

[1] Einstein's Relativity Theory consists of two parts, Special Relativity published in 1905 and General Relativity published 10 years later.

[2] Translated to English by Robert W. Lawson, first published August 19th 1920

[3] Or rather, the ones who *would* make such scrutiny could not understand the motivation to get to the other side, much less execute the leap.

blame for hanging on to interpretations after inherent, logical contradictions are demonstrated, or after they are shown to be in discord with reality. The latter way of refutation has always been honored in physics and other natural sciences, but the former way became increasingly neglected as even the theoretical physicists specialized themselves away from the logical/philosophical roots of the science.

## Propagation of Radiation

*We may assume the existence of an aether; only we must give up ascribing a definite state of motion to it, i.e. we must by abstraction take from it the last mechanical characteristic which Lorentz had still left it...*
*But this aether may not be thought of as endowed with the quality characteristic of ponderable media, as consisting of parts which may be tracked through time. The idea of motion may not be applied to it.*[4]

**—Albert Einstein, 1920**

Imagine a carousel with a water cannon on either side, each turning so as to keep hitting you with its water beam. As the carousel turns, the water beams will hit you at varying speeds, even though they are both shot out at the same, unvarying speed, because the cannons are in motion relative to you, towards you while going around one side, away from you while going around the other. The faster the carousel turns, the greater the difference will be. If the carousel turns fast enough, it will even cause the cannons, when going through the fastest part of the away-side, to recede from you faster than they shoot out their water beam. But if arranged so the fastest beam hits you at twice the speed of the slowest beam, then, when they first start shooting, several of the fastest beams may hit you before the first of the slowest beams, depending on how far away you stand. It is quite an ardous task for the imagination to visualize the sequence, but it will suffice to realize that it will be messed up, in the sense that numbered balls in the flow of each water beam, e.g. twelve at equal intervals for every revolution of the carousel, would not hit you in numerical order. If sound moved through air in a similar fashion, and someone, in place of one of the water cannons, was talking to you, then the words would not reach you in the order they were spoken. But sound *propagates* through air as a *medium* at a speed that is constant relative to the medium, so the words *will* reach you in the sequence they were spoken. But the sounds made on the away-side will be 'stretched' a bit as they enter the air medium in your direction, so the voice will sound a bit deeper than

[4] A popular quote based upon Einstein's address at Leiden University in 1920. It should be added that Einstein, in the same address, points out that General Relativity replaces 'empty space' with certain physical qualities, and *in this sense* aether *does* exist, and, Einstein continues, space without such an 'aether' is unthinkable, because no propagation of radiation would then be possible.

normal, while on the approach-side the sounds will be compressed as they enter the air medium in your direction, so the voice will sound a bit more high-pitched than normal.[5]

Now to light—or rather, *electromagnetic radiation*, of which spectrum visible light is but a small range. X-rays and gamma radiation are higher-energy ranges of the spectrum, while microwaves and radio waves are lower-energy ranges of radiation. One will use 'radiation' generally (including 'radiation speed' rather than 'speed of light'), reserving 'light' for scenarios where the visible aspect plays a role, but it is all just radiation,[6] which consists of photons of various sizes, corresponding to the energy: The *larger* the photon, the *less* its energy. In terms of radiation, *wavelength* corresponds to photon size, so *greater* wavelength means *less* energy. Large photons are less dense than small ones, and for photons it is the density alone that determines the energy. In an effort to keep things simple, one will use only *wavelength* to describe radiation in this treatment, but as radiation is often described in terms of its *frequency*, one will describe the relationship between the two here: Frequency is *oscillations per time interval*, where one oscillation is one complete wave, from crest to crest or from trough to trough, so frequency denotes the number of waves one may register per time interval, which measure is a bit more complex than the simple length of a wave. The smaller the waves, the more waves one will register per time interval (there are no gaps between the waves). This makes the frequency and the wavelength *inversely proportional*, so wavelength times frequency always gives the radiation speed, which is considered to be constant *in vacuum* (space empty of particles), just under 300,000 km/s. When referring to radiation speed, or the speed of light, it is always the speed in vacuum that is meant, but since the speed in air is only slightly less, the distinction is not always made (the distinction is necessary in water or glass, though). Hence, with radiation speed being a known constant under general circumstances, one description of radiation (wavelength or frequency) can readily be derived from the other, by making the known description the denominator of a fraction where radiation speed is the numerator. Sound, too, can be described both by wavelength and frequency, the two descriptions likewise derivable from each other when *the propagation speed of sound for the given medium* is known.[7] For both, wavelength (or

[5]It is assumed that the carousel's rotation is quite slow as compared to the speed of sound. At higher rotational speeds the deep-pitch↔high-pitch shifts become so large that utterances cannot be interpreted. If the rotation is so fast that the sound source moves toward you faster than the speed of sound on the approach-side, you would hear the latter part of the sound before the former, because the sound source overtakes the sound it emits, just like a jet-plane 'breaking the sound barrier,' as it was called back when it was thought unsurmountable.

[6]Among physicists, however, it is common practice to use 'light' in both the general and the specific case.

[7]With propagation such as sound, it is not the medium of propagation (air or water) that moves ahead, but alternating high-low-high-low medium densities propagating spherically outward from the source, while the (particles of the) medium just move forth and

frequency) uniquely indicates pitch for sound and color for light.[8]

A binary star system consists of two stars orbiting each other, and if you see their orbital plane edgewise, their motion relative to you will be just like that of the water cannons on the carousel, in case the stars are of equal mass and their mutual orbit is circular. If the stars emitted light like the water cannons shot water, the sequence would become visibly messed up, entailing that their mutual orbits would appear entirely crazy, which is not the case. In fact, radiation propagates through space quite similar to sound through air (but upwards of a million times faster), and for a long time scientists found it natural to assume that radiation was propagating through a medium pervading all space, which hypothetical medium was named *aether*. There is even a nice analog to the pitch-change (deep vs. high) of sound with medium-relative motion (recede vs. approach), namely a color-change (red-shift vs. blue-shift).[9]

It was assumed that Earth would be moving through this aether, causing an aether 'wind' relative to Earth's surface due to Earth's motion through space in its orbit around the Sun. This should make radiation propagate a bit faster in the direction *opposite* Earth's motion around the Sun than in the direction *along* that motion,[10] but clever apparatuses were constructed that would detect such a difference in propagation speed, and no difference was detected. Rather, differences *were* measured, but they were much smaller than they should have been, even if only to account for Earth's velocity around the Sun, not to mention the Solar System's velocity around the Milky Way galaxy etc., which would be relevant if the aether was a stationary medium of the entire Universe, and different versions of the experiment (at different locations, with various improvements of the apparatus) were much in disagreement, so it was accepted that Earth does *not* move through an aether.

It was then considered that perhaps the aether is dragged along by matter, as indeed radiation is dragged along by a moving medium.[11] However, radiation is only *partially* dragged along by a moving medium, and if, cor-

back, in something like a push-and-pull motion. This is also true for waves in deep water.

[8]In the case of color, the eye registers the average wave pattern from each small observed area; some patterns, like pink, do not have a single wavelength, but is a combination of multiple wavelengths. It would not be correct to say that the eye registers the average *wavelength* from each small observed area; it must be the average *pattern*, or pink would not be known to us.

[9]Of course, the *width and height* of the waves are unchanged with relative motion toward or away from them, but that does not matter to our senses; only the time it takes for each wave to enter our senses matters, qualitatively (intensity matters quantitatively). Whether it is the source or the observer that is moving relative to the medium does not matter. If both source and observer move relative to the medium, one after the other with unchanging distance, the sensation is just the same as when both remain still.

[10]Due to Earth's rotation about its own axis there would be a secondary effect of radiation propagating a bit faster West to East by day and East to West by night.

[11]Radiation propagated in the direction of e.g. water flowing through a tube will go faster than radiation propagated through a parallel tube with non-flowing water.

respondingly, aether is only partially dragged, there should still have been definite results in the aether testing experiments mentioned above. The aether would have to be dragged completely along (or nearly so) by Earth, but this was, and still is, held to conflict with the observable phenomenon of *stellar aberration*; a telescope pointed at a star will see that star trace slightly differing paths across the telescope's field of view, the pattern of displacement repeating itself over the period of a year. Stellar aberration is explained by Earth, in its orbit, moving 'under' the star in different, relative directions over the year, and to catch the light of the star in the exact center of the telescope's field of view it is necessary to aim a little ahead of the star's true position—where 'ahead' is considered relative to Earth's motion around the Sun—because the telescope will have moved a small distance 'under' the star during the time it takes the light to pass through the telescope. This effect is likened to rain falling straight down on a windless day appearing to fall slanted towards you if you start running. If the radiation moves in a medium that is stationary *with respect to Earth*, it is argued, then the radiation propagation will follow the medium, and there can be no 'slanting' effect.[12]

Einstein's idea was that *everybody* will observe the same radiation speed, whether they move toward the radiation or away from it, and so he abandoned the notion of a medium. That radiation go at the same speed in any direction is called radiation isotropy. Without a propagation medium, in Einstein's idea, radiation isotropy does not depend on where you are or how you are moving, as long as your motion is not accelerated or rotating; one says that radiation isotropy is regardless of *inertial frame*.[13] It is impossible to imagine this, because how can someone travelling at great speed towards you register the same radiation speed as you, when observing the same ray of light? It is on this obstacle to understanding that the attempts of philosophers and many others to understand Relativity Theory have foundered. However, mathematically it is possible for a mutually consistent set of equations to express just this. In fact, just such a set of equations had already been developed, but they are based on the bizarre notion of *local time*, that time is specific to local frames of reference, as opposed to absolute time, where time is independent of motion. It was this notion of local time that Einstein endeavored to give a physical interpretation, to justify the use of this set of equations (transformations) as ways to translate between the local

[12] There is a way to salvage the notion of complete aether drag, if only because the medium of gravitation space could be considered to be aether that is completely dragged by matter, adding only gradation of density—but more on this later, along with the reason stellar aberration is an observable phenomenon.

[13] Whereever referring to radiation isotropy, it is understood in this sense; as regardless of inertial frame. Gravitation space as medium, being non-homogenous, does not support radiation isotropy in any sense, just as Einstein in General Relativity disproves radiation isotropy in any sense. If there was a homogenous medium, such as aether was supposed to be, then there would be radiation isotropy in the medium, but not with respect to a frame of reference in motion relative to the medium.

time of contexts in relative motion, because if this sense of temporal relativity could not be demonstrated in an intuitive manner, then the use of the transformations would remain a bizarre, mathematical possibility.

Abstractly, the transformations can be thought of as an adjustment of classical mechanics, imperceptible at speeds that are low relative to radiation speed, quite imperceptible even at a million km/h, the transformation increasing in significance more and more steeply, until terminating abruptly in the impossibility of attaining radiation speed.

## Special Relativity

*Concepts that have proven useful in ordering things easily achieve such authority over us that we forget their earthly origins and accept them as unalterable givens. Thus they might come to be stamped as "necessities of thought," "a priori givens," etc.*[14] *The path of scientific progress is often made impassable for a long time by such errors. Therefore it is by no means an idle game if we become practiced in analysing long-held commonplace concepts and showing the circumstances on which their justification and usefulness depend, and how they have grown up, individually, out of the givens of experience. Thus their excessive authority will be broken. They will be removed if they cannot be properly legitimated, corrected if their correlation with given things be far too superfluous, or replaced if a new system can be established that we prefer for whatever reason.*

—**Albert Einstein, 1916**

In the preface to the popular exposition, Einstein assures us that he makes "no pretense of having withheld from the reader difficulties which are inherent to the subject," yet it nonetheless manages to be quite gentle with regard to mathematics, in an effort to make it accessible.

[14]Ideas and phenomena are interdependent. Existence without concepts is chaos, and concepts without existence are undefined, leaving only the principles of pure logic. The latter is that which cannot be otherwise (*said* to be otherwise, yes, but not (consistently) *thought* otherwise), and is thus not relative to perspective. A few examples: Something cannot be one way and not that way at the same time (this principle is very helpful in exploring seeming paradoxes, conflicting sentiments and differences in what we denote by the same words). Something cannot contain that which contains it (but something may well contain *a portion* of the element in which it is contained).

Pure logic is not responsible for what categorizations are made of existence, but we *make* categories, because we cannot think otherwise. These categories made, they may be explored by logical principles. Thus, there are principles that are not of Earthly origin, but universal, just like mathematics is universal; mathematics is a subbranch of logic, developing from the mathematical *axioms* through application of *generic* logic to these, yielding increasingly *special* logic.

But Einstein's objection remains valid, as universal validity is implicitly assigned to that which is not (or no longer) questioned, reflecting that local experience is implicitly considered the totality of existence.

The treatment will follow the popular exposition chronologically, giving a short description of most sections in colored text to distinguish it from comments. Naturally, this should be considered a guideline only, as any description implicitly contains interpretations, just as comments may include some section contents. Explicit interpretations are not necessarily colored. All footnotes are comments. Exact quotes are not necessarily colored, as they are sufficiently identified by quotation marks.

The first section deals quite philosophically with geometric propositions, and the notion that something is true.[15] We may use 'true' to describe a proposition that is logically deducible from axioms, which is the way it is with geometry, and with mathematics. Einstein proceeds to state that the correctness of the *axioms* cannot be evaluated, that they are abstract definitions or ideas.[16] A more habitual use of 'true' is to describe a statement that is in accord with reality,[17] which accord does not concern geometry, being an entirely abstract discipline. Then Einstein goes on to propose merging this abstract paradigm of geometry with physical reality, enabling evaluations of factuality "by the single proposition that two points on a practically rigid body always correspond to the same distance (line-interval), independently of any changes in position to which we may subject the body." This proposition is problematic, as it would not allow contraction or expansion to occur with changes in pressure,[18] so one may question this merge, even if one does not become the slightest bit apprehensive at the suggestion of taking reality into the domain of ideas.

The second section provides an introduction to coordinate systems, and the notion of relative location, such as 'Trafalgar Square' *in* 'London' *on* 'Earth', but also 'a cloud' *above* 'Trafalgar Square', even though the cloud is not part of the rigid context. Pursuing relative location further, one might go on to consider Earth's location relative to the Sun, the Sun's location relative to the Milky Way galaxy and so on, until arriving at the center of the Universe, the Big Bang origin.[19] Since such regression of relative location is always possible, any location may be indicated in absolute space coordinates in the system whose origin is the origin of our Universe. And since the same goes for relative time, an event on Earth is relative to a time line (a calendar) of Earth, which again can be related to a time line of the Sun and so on, until, again, arriving at the center of the Universe. However, the axes of the coordinate system must be indifferent to gravitational variance, making it a

[15] These abstractions were intended to distract the dogmatic defences of the readers (at that time) clinging to euclidean geometry and newtonian physics.

[16] This statement is quite in accord with Gödel's incompleteness theorems.

[17] Cf. deflationary theories of truth.

[18] Einstein does warn that the validity will be shown to be limited in the General Theory

[19] Big Bang theory came later than Relativity Theory. Einstein's rather more sophisticated theory of the Universe *without a center* will be treated later. 'Big Bang' is a poor name for the event, though, as a bang necessitates a material medium for sound propagation, and since no such medium was present, the event was without sound. Henceforth one shall call the event the 'Big Birth.'

coordinate system of ideal space, as would exist without any gravitational variation whatsoever, as in an empty universe. In this manner absolute time is established, and although ideal space is found nowhere within gravitational reach of an actual universe, there will, nonetheless, be a space coordinate and a time indication for every moment at any location. As Special Relativity is incompatible with absolute time, this could be considered a preemptive refutation.

The third section introduces motion as a non-absolute phenomenon, that is, motion is a relation between oberserver and observed object. As example, Einstein drops a stone from a railway carriage going at constant velocity. To Einstein, the stone will drop straight down, but to someone observing from the ground, the stone will follow a parabolic trajectory. This also marks the introduction of the train-and-embankment thought example that is used throughout the next sections.

The fourth section describes the traditional coordinate system, in which the law of inertia states that an object under no influence of force will continue in a straight line or remain still. Basing such a coordinate system on Earth and regarding the stars, one will observe the stars to describe an immense circle in the course of an atronomical day, just like the Sun and the Moon apparently move around Earth. Hence the law of inertia does not hold for objects far removed from Earth in a coordinate system thus based. This, of course, is due to Earth's rotation. The proper coordinate system to use for objects away from Earth must not follow Earth's rotation.

The fifth section introduces the *principle of relativity*, which is not to be confused with Einstein's own Relativity Theory; the principle of relativity is far older. A general statement of it is that one will derive the same physical laws regardless of inertial system, that is, regardless of one's relative motion, as long as that motion is in no way accelerated (or rotational, which involves acceleration), so there is no *preferred* coordinate system in which physical laws are simpler. Einstein approves this principle, supporting its claim by mentioning that Earth orbits the Sun, and so, due to always *changing* direction, would not be able to be at rest relative to an all-encompassing, preferred coordinate system at all times, but would experience annual variations of physical laws—and a location on Earth would experience daily variations due to Earth's rotation about its own axis, which would change *orientation* relative to a preferred coordinate system. While not explicitly stated, it is clear that Einstein is here referring to the experiments that failed to detect aether wind, the aether being the candidate for an all-encompassing, preferred coordinate system, but he keeps quiet about the notion of a completely dragged aether, which would make Earth (and any other considerable mass) its own preferred coordinate system, and thus consistent with the mentioned lack of variations in physical laws.

The sixth section deals with addition of velocities in 'classical' mechanics: If a passenger on a train walks in the direction of the train's motion, then the speed of the passenger as seen by an observer on the embankment will be the sum of the speed of the train relative to the embankment and the speed of the passenger relative to the train. As mentioned earlier, this addition of velocities is what Special Relativity wants to alter.

The seventh section explicitly states the apparent incompatibility between constant radiation speed and the principle of relativity, and states the aim of reconciling the two.

## Abandoning absolute time

*It has often been said, and certainly not without justification, that the man of science is a poor philosopher. Why then should it not be the right thing for the physicist to let the philosopher do the philosophizing? Such might indeed be the right thing to do a time when the physicist believes he has at his disposal a rigid system of fundamental laws which are so well established that waves of doubt can't reach them; but it cannot be right at a time when the very foundations of physics itself have become problematic as they are now. At a time like the present, when experience forces us to seek a newer and more solid foundation, the physicist cannot simply surrender to the philosopher the critical contemplation of theoretical foundations; for he himself knows best and feels more surely where the shoe pinches. In looking for a new foundation, he must try to make clear in his own mind just how far the concepts which he uses are justified, and are necessities.*[20]

**—Albert Einstein, 1936**

The eighth section prepares the attack upon absolute time, by way of examinating the notion of simultaneity. What does it mean for two lightning

[20]One often recognizes deep philosophical insights in many great scientists, although their navigation between them is, perhaps, less fluent than it would have been, had that been their primary inclination. Surely the assistance and guidance of those who *are* primarily thus inclined is *only* of value when charting new territory or proposing alternative charting principles. Is that not entirely analogous to the relationship between theoretical and experimental physicists? If experimenters acknowledged theoreticians only while experiments confirm theory, considering theoreticians less capable than themselves of forming theories to explain unexpected observations, then theoretical physics would eventually grow stale and wither from lack of input, and experiments would decrease because the experimenters were increasingly occupied with theory, perhaps becoming the new generation of theoretical physicists, while others would then have to take up experimenting...

If the stem of the tree is not a support for the branches, it will miss out on the nourishment gathered under the Sun by the leaves on them, and the branches claiming the roots for themselves may find the shortcut less fruitful than connecting through the stem.

On the other hand, if theoreticians deny every objection from experimenters on the grounds that theory is well-established, adamantly insisting that experiments are misinterpreted, without immersing themselves in the problem to aid in resolving the issue, what choice have experimenters then, failing to interpret their experiments in other ways, but to turn to theory themselves and attempt to fix the shoe's pinch? It is not impossible, after all, that the key to a deeper mystery should come from an unexpected angle. Physicists are acutely aware of this—the problem goes for the relationship between philosophy and theoretical physics.

strokes to hit the rails at two different points *simultaneously*? It is suggested that the hits will be called simultaneous by an observer positioned exactly midway between the points of impact, who, with the aid of mirrors, is able to observe both impact points without turning his head, if the the flash from each stroke meet where the observer is positioned. It is then put into question whether one can be sure that the two flashes will propagate at the same speed from each impact point to the observer, yet this rhetorical objection is not really pursued, but dismissed in a logically peculiar turn: "I maintain my previous definition nevertheless, because in reality it assumes absolutely nothing about light. There is only *one* demand to be made of the definition of simultaneity, namely, that in every real case it must supply us with an empirical decision as to whether or not the conception that has to be defined is fulfilled. That my definition satisfies this demand is indisputable. That light requires the same time to traverse the distance $A \rightarrow M$ as for the path $B \rightarrow M$ is in reality neither a *supposition nor a hypothesis* about the physical nature of light, but a *stipulation* which I can make of my own freewill in order to arrive at a definition of simultaneity." $A$ and $B$ are the impact points, and $M$ the exact midway point. This, then, is the assumption of radiation isotropy in the reference frame of the observer, that $M$ is *chosen* such that light takes the same time to reach it from $A$ and $B$, respectively (one hopes for non-fluctuating climatic conditions). Note that the proposed definition is just *a* definition, with no claim to be *the* definition. An equally valid definition would be to measure the the travel time of currents induced by the lightning strokes. Another equally valid definition would be to measure by the sound of two pebble impacts in place of the two lightning strokes (more on these alternative definitions below).

Einstein's definition of simultaneity, then, is *arbitrary*, not *necessary*. As such, it will not do for altering an idea. Rather, the definition gives meaning to the idea by way of experience, but altering the idea on the basis of a particular mode of observation, although commonplace, is not valid. Altering the mode of observation readily leads to another aspect of the idea, but ideas *have* aspects, they cannot *be* one (or a subset) of their aspects, because then the idea would be less than itself, but one may well define aspects of an idea to be a new idea. Hence, Einstein's definition thus far could be called 'radiation-based apparent simultaneity,' but the idea of simultaneity is left unaltered.

The ninth section introduces a train passing by at the time of the lightning strokes. The train is long enough to extend beyond both impact points. Einstein then poses the question whether the lightning strokes that were perceived as simultaneous by the observer on the railway embankment will also be perceived as simultaneous by the observer on the train, if the same definition of simultaneity is now applied to the reference frame of the train. The midway point on the embankment corresponds to a midway point, $M'$ on the train at the instant of impact (as judged from the embankment). The observer on the train, then, would consider the lightning strokes simultaneous by the proposed definition if the flashes meet at his position. "Now in reality (considered with reference to the railway embankment) he is hastening towards the beam of light coming from $B$, whilst he is riding on ahead of the beam of light coming from $A$. Hence the observer will see the beam of light emitted from $B$ earlier than he will see that emitted from $A$. Observers who take the railway train as their reference-body must therefore come to the conclusion that the lightning flash $B$ took place earlier than the lightning flash $A$." One wonders why a reference to the railway embankment is employed at this point *in describing the experience of the observer on the train*. Certainly, the simultaneity established for the observer on the embankment made no reciprocal reference to the passing train. This misstep, then, is the origin of ascribing *appearances* in one inertial frame to the *reality* of another—the origin of all the confusion. It is hardly noticeable, hidden in a parenthetic remark, preceded by 'in reality,' which would be correctly placed *without* the parenthetical remark, *with gravitation space as propagation medium*. Let the lightning flashes be reflected into the train immediately after impact, and then reflected again toward the observer on the train (assuming the whole train to be a single big car) to make it obvious that the light now propagates in the inertial frame of the train; if isotropy regardless of inertial frame is assumed, it follows that the travelling observer *will* experience the flashes to meet at his position.

Indeed, at the end of the eleventh section, after application of the mathematical transformations mentioned earlier, Einstein arrives at the result that the light *does* propagate at the same, constant radiation speed in the inertial frame of the train as in the reference frame of the embankment. Hence, the two observers' disagreement on simultaneity was used to justify introduction of transformations, the consequence of which is that the two observers would not disagree in the first place *according to Einstein's test of simultaneity*. This is the most crucial, logical flaw in Einstein's thought experiment, the missing bridge across the gap.[21] It illustrates how natural it is to consider Earth (the embankment) the primary frame of reference, as well as how natural it is to consider motion relative to the light, even within a specific inertial frame, although this specifically contradicts the conclusion that is aimed for. Rather, radiation propagates in the medium of gravitation space created by that which constitutes the primary frame of reference: Earth. The two observers would indeed *disagree* on simultaneity according to the test proposed by Einstein, because the medium of radiation propagation *is not carried* by the car.

Regarding arbitrariness of the choice of test of simultaneity; using the

[21] Later one will outline Richard Feynman's version of the thought experiment, in which radiation isotropy and the principle of relativity *is* consistently honored, at the cost of dealing only with appearances to observers in other inertial frames, which, in the context of Einstein's thought experiment, pretty much amounts to saying that to the observer on the embankment it will seem that the observer on the train is moving relative to the points of impact, and vice versa.

alternate test of measuring sound from pebble impacts, the result will be that the two observers will agree on simultaneity, because air, the medium of sound propagation here, is carried completely in a closed train car, hence the observer on the train would experience the sounds to meet at his position, just like the observer on the embankment would experience the sounds to meet at *his* position, but the observers would, of course, no longer be opposite each other when this occurred. Tweaking this alternate test by removing walls and roof of the car, leaving only a metal frame for the pebbles to hit, the two observers will no longer agree on simultaneity by the sound test, because the air is no longer carried by the open car. The result of using current in the metal frame for the test of simultaneity would approach the closed-car sound test, to the extent that current is carried completely by the metal frame.

## Time dilation and length contraction

The transformation formulas that Einstein sought to utilize require not only local time, but also length contraction of objects in motion. In the tenth section Einstein suggests that the length of the train as measured on the train itself, may not be equal to the length of the train as measured from the embankment while it passes by. However, the section does not attempt to *demonstrate* length contraction, but the *suggestion* that the two measurements may differ is rather a preface to introducing the transformations, which is done in the eleventh section. The *consequence* of the formulas is that moving inertial frames experience *time dilation* and *length contraction*, that is, time goes more slowly and matter is compressed in the direction of motion, not as measured within the inertial frame, but as measured from the reference frame it passes through, e.g. the embankment. But when the effects are only proposed to exist from the perspective of an external frame of reference, when no inertial frame is considered more primary than others, they can be no more than *apparent* effects. Originally the transformations were devised in defense of the aether notion, and aimed to translate appearances to and from the primary frame of reference (the aether), and in this context the transformations would have predicted *real* time dilation and length contraction effects. Einstein 'lifted' the transformations out of this intended context, abandoned the notion of a naturally primary frame of reference (the medium) and arrived at the mathematical abstraction of radiation isotropy regardless of inertial frame.

Except, he could not really abandon the naturally primary frame of reference that is Earth, or, more specifically, the embankment. It is one thing to assert a principle, another to follow it consistently.

After the eleventh section saw the transformations introduced, the twelfth section goes on to describe how the transformations entail time dilation and length contraction. It is also pointed out that, as a mathematical consequence of the formulas, radiation speed cannot be attained, because that would involve division by zero, and even higher speeds would cause some of the transformations to give the result of going back in time—except the invalidity of division by zero precludes the possibility of passing radiation speed in the first place. But what is speed measured relative to? Any such frame of reference is necessarily arbitrary, since the theory claims any frame of reference to be equally valid. This problem was pointed out in the famous Twin Paradox:

One twin remains on Earth, while the other sets out to explore the Universe in a spaceship. If time goes more slowly in the inertial reference frame that is in motion, the travelling twin will age more slowly, and, returning, will thus be younger than the twin who remained on Earth. Except, to the travelling twin it is the Earth that is in relative motion, so which twin is it, exactly, who will experience the time dilation of motion? The arguments out of the twin paradox, though generally accepted, were rather ad hoc; the twin travelling in the spaceship is the one experiencing the acceleration necessary to attain a speed close enough to radiation speed that the time dilation of the transformation can become appreciable, then the deceleration followed by acceleration in the opposite direction to return to Earth, and finally deceleration to slow down before landing. Note that, around the journey's turn from outbound to homebound, the travelling twin first decelerates to come to a stop relative to Earth, then accelerates to go in the opposite direction. If the travel speed both ways is nine tenths of radiation speed, then the return speed is *eighteen tenths* of radiation speed relative to the inertial frame of the travelling twin just before commencing deceleration. Aside from this, the arguments of acceleration to indicate which frame is the one in motion might suggest that the time dilation would somehow be proportional to the experienced acceleration, but the time dilation effect was introduced for moving inertial frames (specifically not accelerated), and besides, the acceleration processes undergone by the travelling twin are finite, saying nothing about how long time the traveller spends at non-accelerated cruise speed in between. Further, as Einstein points out in General Relativity, accelerated motion is equivalent to gravitational acceleration, so the space traveller may actually experience a smaller sum of acceleration over time than the twin remaining under the influence of Earth's constant gravitational acceleration.

According to the later Big Birth theory and expansion of the Universe, it is recognized that the Earth-relative motion of very distant stars exceed radiation speed. It does not mean that radiation from such stars will never reach Earth, because as the radiation travels towards Earth it will gradually enter space expanding away from Earth at *less* than radiation speed, meaning also that it will gradually move away from the star emitting it at *more* than radiation speed.[22] But if a *bullet* was shot away from the star at radiation speed (or an insignificant fraction less) it would never reach Earth, but would

[22]The wavelength of the radiation will gradually lengthen due to the expansion, though, thus 'exhausting' the energy of the starlight, so light emitted by the star will be far below the visible range once it arrives.

experience the stars to fly past at gradually slowing speeds, until reaching a region of space in which it is more or less stationary relative to the local gravitation space. Due to continued expansion, the now stationary bullet will then, gradually, recede both from Earth and the star from which it originated. By the same reasoning, a spaceship might leave Earth, accelerate to half the speed of radiation, Earth-relative speed, then proceed at constant velocity and eventually reach a region of gravitation space relative to which it is stationary, where it may wait for universal expansion to increase its Earth-relative speed to more than radiation speed. It is argued that this relative speed exceeding radiation speed is *not* in disagreement with Special Relativity, but the arguments are far too mathematically sophisticated for this one to follow—and unnecessary, if one does not wish to defend Special Relativity.

## Relativistic addition of velocities

The thirteenth section proceeds with addition of velocities. In classical mechanics the result would be the simple sum,[23] as was described in the sixth section. Physical justification for applying the transformations—that make the result *less* than the simple sum, though only noticeably so for speeds significant as compared to radiation speed—is sought in the observable phenomenon that radiation is partially dragged by a moving medium,[24] such as liquid in a tube. "In accordance with the principle of relativity we shall certainly have to take for granted that the propagation of light always takes place with the same velocity *w with respect to the liquid*, whether the latter is in motion with reference to other bodies or not. The velocity of light relative to the liquid and the velocity of the latter relative to the tube are thus known, and we require the velocity of light relative to the tube." Simple addition of velocities (the velocity of radiation in the liquid plus the velocity of liquid relative to the tube) will not give the correct, measurable result of the radiation's velocity relative to the tube. There happens to be, Einstein states, a quite close quantitative correspondence between the *calculated* results obtained by applying the transformations and *measured* results. However, it is also observable that radiation of different wavelengths (light of different colors) is dragged differently by the same medium, making colors at one end of the spectrum go faster than those at the other end of the spectrum, so the close correspondence stated by Einstein must be as compared to measurements with radiation of just the right wavelength, or with the liquid flowing at just the right speed. There is no wavelength differentiation in Special Relativity, so rather than the radiation propagating according to the reference

[23] Assuming motion to be in the same direction.

[24] It must be noted here that photons propagate somewhat slower through most matter than through 'empty' space; its speed is very slightly reduced through air, and rather more significantly reduced through water, even more through glass and more yet through diamond.

frame of the liquid, it is necessary that the moving liquid *partially drags* the radiation.

It was not the intent of the section to *derive* a modified way of adding velocities, though, only an attempt to justify the use of the already adopted transformations and the way of adding velocities prescribed by them, which is what serves to validate the possibility of a single ray of light being experienced to have the same speed by multiple observers travelling with different velocity along the direction of the light ray's propagation. Imagine a dozen spaceships of identical built flown into different locations in space along the same, straight line. To make it obvious that no medium of propagation is carried, the spaceships are merely platforms, and at each end of each platform is a device for registering light passing through it. The 'platforms' are now accelerated towards each other in such a way that they will all pass each other at the same location, moving at various significant fractions of radiation speed. It is arranged that a wide ray of light reaches them all at the exact time when they are all aligned beside each other. Special Relativity now states that they will all measure the same speed of the light ray, with the measuring devices at either end of each platform. On each platform the observer then projects how long it will take for the light to reach a certain planet, the distance to which is known to all observers. Each observer, measuring the same radiation speed across the platform, counting also on the light to propagate away from the platform at that speed, would project that the light ray will reach the planet at radiation speed faster than the platform is approaching the planet, thus arriving at different results.[25] There is, of course, only one correct projection, as can be testified by an observer on the planet in question. Special Relativity might like to employ its adjusted addition of velocities, but there is no room for it from the point of view of the observers on each platform, because the platforms are not contracted in length *in their own frame*. The transformations would, however, work out nicely from the point of view of the observer on the planet.

Imagine another scenario where two meteors moving in the same direction pass Earth at the same time, one at a third of radiation speed, the other at two thirds of radiation speed, both shooting a harpoon into the planet, the slower meteor also shooting a harpoon into the faster meteor. Unbreakable wire is attached to the harpoons, and is unreeled without friction from plentiful supplies. Intuitively (and in accord with classical mechanics) one would assume that wire from the direct connection between Earth and the faster meteor would unreel at two thirds of radiation speed, while wire would unreel from the slower meteor at one third of radiation speed in both directions. Special Relativity says otherwise. If the faster meteor moves at a certain speed away from the slower meteor, and the slower meteor moves at a certain speed away from Earth, then the faster meteor will move away from Earth at less

[25]The platforms moving to recede from the planet count their planet-relative speed as a negative approach in this calculation.

than the sum of the two speeds. If the slower meteor passes Earth at one third of radiation speed, and the faster meteor passes the slower one at one third of radiation speed, still passing Earth at the same time, then, according to Special Relativity, this is a completely different scenario, in which the faster meteor will move away from Earth at three fifths of radiation speed rather than two thirds, that is, less wire is unreeled from the faster meteor's connection to Earth than the sum of wire unreeled from the slower meteor.

## Review

The fourteenth section states that natural laws should henceforth be considered covariant under the relativistic transformations, rather than under the classical transformations, as hitherto accepted. The new way of adding velocities, as treated above, is an example of this.

The fifteenth section explicitly acknowledges that Special Relativity is based upon findings in the area of electromagnetism, the laws of which are unchanged by Special Relativity. However, the laws of electromagnetism are most definitely compatible with a medium of propagation as well, since such a medium was assumed by the scientists deriving and formulating the laws. As gravitation space is at rest relative to Earth that is the local cause of it, apparatus (such as that designed to detect aether wind) stationary on Earth will naturally give evidence to the notion of isotropy. But if the apparatus is in horizontal motion through Earth's gravitation space, or put on a spaceship going away from Earth's local gravitational dominance and into that of the Sun, then gravitation space will be revealed as medium, as the rest frame of the apparatus (the vehicle) will then be of insufficient mass to constitute a local 'override' of the surrounding gravitational field.

The section also introduces the famous mass-energy equivalence, $E = mc^2$, which is most widely known for non-moving mass; if the mass is in motion, it has more energy. But if motion is only a matter of which arbitrary frame of reference one chooses to observe from, then neither mass nor energy would be of any definite amount. With gravitation space as medium of propagation, there *is* a definite frame of reference relative to which a mass may be in motion, and radiation from it would then, upon entering the medium, have its *wavelength decreased*, thus *increasing the energy* of the radiation relative to the energy the same radiation would have had had the mass been stationary in the medium. This is an *average* effect; if radiation is emitted opposite the direction of the movement of the mass, its *wavelength increases* as it enters the medium, thus making its *energy less* than the energy the same radiation would have had had the mass been stationary in the medium, but as radiation occurs equally in all directions, it will, on average, gain energy upon entering the medium proportional to the medium-relative speed of the mass. It is certainly true that a meteor will hit a spaceship harder if it flies head-on into it at great speed than if it just bounces it gently in a docking maneuver, but there is no reason to ascribe the energy of relative motion to the meteor rather than the spaceship if there is no medium.

Finally, the section states that all electromagnetic propagation, as well as propagation of gravitational fields, occur at radiation speed. If one merely adds *relative to the medium* the principle is intact.

## Predicted and explained effects

The sixteenth section notes Special Relativity's compatibility with stellar aberration, which is a natural consequence of there being no medium of propagation.[26] But the medium of gravitation space is also fully compatible with stellar aberration, the explanation of which was promised earlier. The medium of gravitation space is non-homogenous, having greater density closer to the masses causing the gravitation. If ideal space has a fixed medium density, then there will be increasingly more than one ideal space unit worth of medium packed into one ideal space volume (as superimposed on real space) as gravitation space density increases. Radiation traverses one ideal space unit length of ideal space medium density per fixed time interval, so when the medium density increases, radiation traverses less than one ideal space unit length (as superimposed on real space) per fixed time interval. Additionally, radiation travels by the quickest path, as demonstrated in quantum electrodynamics.[27] Mirages are observable examples of light following the quickest path (through warmer air, lower atmospheric pressure and less humidity) rather than the shortest path. And finally, Earth's gravitational field is propagated at radiation speed throughout the Solar System's gravitation space. It follows that the quickest path must enter Earth's local gravitation density a little ahead of Earth's motion around the Sun, in order to lessen the distance that must be traversed through increased medium density. The stellar aberration effect would be more pronounced if Earth had more mass. It is somewhat analogous to the more visible effect of fish seemingly being farther away than they really are,[28] except variations in density of the substanceless gravitation space has the same effect on all wavelengths, whereas substances (air, water, glass etc.) has a *prismatic* effect on incoming light, slowing different wavelengths to different degrees,[29] causing a separation of colors. Also, the light moves slower through air than space, contributing to increase the stellar aberration, including a slight prismatic effect.[30]

[26] As described earlier, it would then be exactly equivalent to straight-falling rain appearing to fall slanted to someone running through it.

[27] Rather, radiation travels by all paths, but most of it travels by the quickest path, and the alternative paths are symmetrical around the quickest path and cancel out, leaving only the quickest path as apparent position of the source.

[28] When the fish are some distance below the water's surface, and they are observed from some distance above the water's surface.

[29] Just like substances drag different wavelengths to different degrees, as mentioned in the context of radiation being dragged by liquid flowing through a tube.

[30] The prismatic effect of the atmosphere is visible as variation in the color of the sky on a clear day, the sky being more blue farther from the Sun, since blue light is the visible

Special Relativity *does* account for the effect of radiation changing apparent wavelength when one moves relative to it, although this is not mentioned in Einstein's popular exposition. It is not necessary to develop here; it is, of course, consistent with experience, but it is much more simply explained in a medium, as has already been done. Earth's motion relative to stars changes their color by this effect.

The remainder of the section deals with the earlier aether notions, although skipping the version with completely dragged aether, but this has all been included in the introduction to this treatment.

## Four-dimensional space-time

*The meaning of relativity has been widely misunderstood.*
*Philosophers play with the word, like a child with a doll.*
*Relativity, as I see it, merely denotes that certain physical and mechanical facts, which have been regarded as positive and permanent, are relative with regard to certain other facts in the sphere of physics and mechanics.*
*It does not mean that everything in life is relative*[31] *and that we have the right to turn the whole world mischievously topsy-turvy.*

**—Albert Einstein, 1929**

As Special Relativity considers time intervals meaningless without also mentioning the frame of reference, it is a natural fourth component of space indications, and never an independent or absolute indication. Like Special Relativity's version of temporal relativity is unique, so, too, its version of four-dimensional space.

radiation that is most affected by the prismatic effect (its wavelength is smaller than that of other light, and it is 'bent' more sharply upon entering the atmosphere). The prismatic effect is much more pronounced through water, as can be seen in a rainbow, which offers an exquisite wavelength spectrum of light. Of course, the effect upon light from a single, distant star is quite small, as it is but a pinprick on the huge atmospheric prism.

[31]But most things in life *are* relative to our perspective (point of view), the change of which may alter our very lives and estimation thereof. Relativity is the principle of cognition that we are confined to perspectives out of an infinite potential, the acknowledgement of which inspires agility therein. It may well be argued that cognition is a dimension in addition to time and the three spatial dimensions, when considering that a potentially infinite variation of interpretations is possible for each event, just like each location has a temporal continuity, each space an infinity of planes, each plane an infinity of lines and each line an inifinity of points.

Somehow it came about that all relativity notions were considered dubiously inspired from Einstein's Relativity Theory, although even physics' own principle of relativity is far older. The cognitive relativity principle, that perception depends upon perspective (including psychological and social background, mood, etc.) has been explored for thousands of years, not least by poets who must necessarily shift *their own* perspective to bring their characters to life. This cognitive relativity is just not commonly appreciated in any significant depth. Commonly, one equates one's own notions of reality with *the* reality. Argumentation is futile unless minds are humble and open to other ways of thinking, and to achieve this openness one must first defeat one's ego.

The more intuitive version of temporal relativity was outlined earlier in this treatment; it has to do simply with translation between time lines, and, in the current context, especially to and from containing gravitation space systems, Earth, the Solar System, the Milky Way etc.

The more intuitive version of four-dimensional space deals simply with the time line of every location; the history of the location. In this version, indications of an event must also include both space coordinates (relative to a local reference frame or universal ideal space coordinates) and a time indication (relative to a known time line, possibly the time line of the Universe), but a time *interval* is the same everywhere, as it can be translated into universal time. Of course, the universal time line is foremost a *possibility*; the very large numbers would be very cumbersome to handle in daily use, as would any calendar remaining in use for billions of years. And universal, ideal space coordinates are also foremost a *possibility*, due to the very rapid motion, swirls within swirls within swirls, of gravitation space through the universal ideal coordinate system. But relative *ideal space distances* are *required* for trigonometry to work; trigonometrical calculations are only as good as ideal space distances can be approximated.

Space and time are not absolutely inseparable in physical existence, but motion makes them so. In the outer darkness, farther away from the center of the Universe than radiation speed times the age of the Universe (what may be called the expanding radiationsphere), time has no meaning, as there is no change, nothing visible, unless it can be brought out there—not until the radiationsphere arrives. To an entity brought out there, it would likely rather seem that *space* had no meaning, because cognitive activity would give a measure of time. Even if space and time were absolutely inseparable in physical existence, it does not entail equivalence of all four space-time coordinates to enable four-dimensional transformations of space-time differences, in which transformations temporal difference may be converted, in part, to spatial difference and vice versa, as is the case with the transformations employed by Special Relativity. Shape and matter—shape and *energy*, to be more precise—might also be considered physically inseparable, but that does not mean that shape can be converted to energy and vice versa; the *shape* of a football has no momentum. Everything in existence has multiple ideas applying to it, but even though they may be inextricably joined in that existence, it does not join the *ideas* in an inseparable compound of internal equivalence, but the compound idea may well be considered a new idea.

This almost concludes the treatment of Special Relativity. Hopefully the refutations were clear, without detracting from Einstein's acute, philosophical differentiation of various notions of truth.[32] Of course, nothing could detract from the immensely important physical clarification revealed by the mass-energy equivalence, all conceived by his mid-twenties, along with other ground-breaking discoveries. The mental acrobatics of Special Relativity em-

[32] More on Einstein's perceptions of truth in the chapter 'On Evolution of Science.'

bedded its logical flaws as well as any paradox might, making it extremely challenging and interesting to solve, and all the other physics that had to be digested for this purpose turned out treasure troves of insights into the dynamics all around us, contributing to making the task worthwhile.

## General Relativity

*I was sitting in a chair in the patent office at Bern when all of sudden a thought occurred to me: If a person falls freely he will not feel his own weight. I was startled. This simple thought made a deep impression on me. It impelled me toward a theory of gravitation.*

—**Albert Einstein, 1922, recalling event in 1907**

The theory of General Relativity was published ten years after Special Relativity. The popular exposition is an exposition of both theories (with continued section numbering).

The eighteenth section is mostly a short reiteration of Special Relativity, followed by an introduction to the aim of General Relativity, which is to include all sorts of motion (including accelerated motion and rotation), in a common relativity principle, rather than just inertial motion to which Special Relativity confined itself. A primary focus in General Relativity is the phenomenon of gravitation, which is given brilliant treatment from various perspectives.

The nineteenth section asserts the physical reality of *fields*, as in electromagnetic and gravitational fields, as opposed to action at a distance; there actually *is* something between the Earth and the Moon, and between a magnet and a piece of iron, causing the attraction. These *real* fields exist as much in 'empty' space as in Earth's atmosphere. If there were no medium, then there would have to be *something* travelling through space to constitute the field. With a medium there is also the possibility of *effects* constituting fields, as is the case with the density variations of gravitation space (mediumless interpretation of gravitation has hypothesized 'gravitons' to communicate the attraction, like photons are supposed to communicate the attraction and repulsion of charges, in spite of the lack of energy loss which such continual, unidirectional emission would seem to entail).

The first extraordinary insight into gravitation, that inertial mass equals gravitational mass, is explained in the twentieth section: Someone subjected to a constant acceleration through space might be forgiven for assuming the presence of a gravitational field instead of motion at increasing velocity. Might all gravitation then only be an apparent effect, what is often called a pseudo force? Einstein states that it is impossible to choose a frame of reference that makes Earth's gravitational field disappear in its entirety. Yet one might object that in orbit around Earth no acceleration is experienced, at least not if one is unable to determine that one is describing an orbit rather than standing still or moving in a straight line.

The twentyfirst section restates the requirement of a general relativity theory, that it can describe motion even from the point of view of an observer that is undergoing accelerated motion.

The twentysecond section describes how a ray of light will not seem to go straight to someone accelerated past it, but that it will describe a curve. Since gravitation works just like accelerated motion, it follows that light will curve around massive objects such as the Sun, if moving sufficiently close past it. This prediction was confirmed during a subsequent Solar eclipse; stars close to the Solar disk appeared to be farther out from the disk than their true position, as established when the Sun is elsewhere. This disproves radiation isotropy. "A curvature of rays of light can only take place when the velocity of propagation of light varies with position." And "the special theory of relativity cannot claim an unlimited domain of validity; its results hold only so long as we are able to disregard the influences of gravitational fields [. . . ]." Thus Einstein proposes that Special Relativity, rather than being discarded completely, "lives on as a limiting case." As gravitation is recognized to be an important factor influencing the path of radiation, and the thought experiment of Special Relativity took place on the surface of a planet, it would have been prudent to create a new version of the thought experiment outside gravitational influences. The lack thereof is easily remedied, though:

Consider two spaceships passing each other. They are of identical built and symmetrical lengthwise, and there is an observer in a space suit on each ship, and a one kilometer wide gap in the hull of each ship, through which gaps the observers can see each other's ship, as well as each other. Once more assuming radiation isotropy regardless of inertial frame, the observers cannot tell whether they are going in different directions, or one is at rest and the other going past or vice versa, or if they are going in the same direction, one faster than the other. There is no lightning in space, and testing by sound will not work as sound propagation requires a medium of substance, but one ship might have a lamp embedded near each end of the gap, with the observer positioned exactly midway between them. To avoid complexities of wiring and length contraction of same, the lamps are made to blink using a lever system from observer to each lamp, such that if the observer gives the levers a slight push, both lamps will blink, and, Special Relativity would claim, the observer on the ship would register the blinks simultaneously. What about the observer in the other ship? Following the train-and-embankment example, the lamps should blink when the two observers are exactly opposite each other. The passing observer should not be farther away from the lights than the other observer, because this would make the distance the light must travel to one observer different from the distance it must travel to the other observer, which would introduce an unwarranted complexity. Therefore the spaceships pass extremely close to each other, and the observer on the ship with the lamps stand a little farther back from the gap than the passing observer in his identical ship, so they are equally distant from the straight line between the lamps. Where, now, is the reason to think that the passing observer will not experience simultaneity just as well as the other observer? At the moment the ships pass, one may even question which ship the lamps belong to.

The notion of radiation isotropy regardless of inertial frame (due to lack of medium) can now be stated more clearly; radiation always reaches an observer at radiation speed. This was what experiments (using stationary apparatus) had demonstrated on Earth, and it was what the transformations were devised to reflect *in the reference frame of the medium*. But upon abandoning the medium while maintaining the validity of this isotropy principle in *any* inertial frame, the consequence became that radiation should propagate at radiation speed relative to the observer or the equipment it will eventually encounter, which it would have to know at the outset to adjust its velocity accordingly. Further—if that is not sufficiently absurd—it would entail that there would be no constant radiation speed, or rather, constant radiation speed is absolutely defined relative to the observer, which would make all radiation in the Universe propagate observer-dependently. In other words, it would give individual perspective absolute validity, which is a contradiction (but a nice challenge to let imagination play with the consequent intersubjective perspective).

The twentythird section goes on to consider rotating motion, by example of a rotating disk. Here is another analogy to gravitation, namely the seeming acceleration toward the edge of the disk, increasing as one approaches the edge from the center. It is the reverse scenario of mass-gravitation, but it would do nicely as gravity environment on a wheel-shaped space station. Einstein goes on to analyze identical clocks, unfortunately using Special Relativity to conclude that clocks near the edge of the disk go more slowly than a clock at the center. This is unfortunate since he had just acknowledged that Special Relativity does not apply in the presence of gravitation, and that the rotating disk creates acceleration that is analogous to gravity. Besides, it would be better to use something simpler than clocks for identifying temporal properties. Time measurement is derived from periodic motion, and the disk's rotation is just such a periodic motion, so time might be derived from counting passes of a star. Then there is no difference in temporal properties from one location on the disk to another.

Einstein uses Special Relativity again to point out a problem in deriving the correct value of $\pi$ (the ratio of a circle's circumference to its diameter), on the rotating disk, since a moving measuring rod is contracted lengthwise when measuring around the edge, but not contracted measuring the radius, so the observer would arrive at a too large value of $\pi$. As shown in the treatment of Special Relativity, length contraction and time dilation is unfounded even as appearances, and even if there were such apparent effects, they could not be ascribed to the observed phenomenon, because then the observed phenomenon itself would change according to the observer,[33] and this is not even legitimate within Special Relativity, as it explicitly states that an object is unchanged within its own frame of reference. Even if there is an effect causing contraction of the measuring rod, the same effect would apply equally to the circumference of the disk, so the right value of $\pi$ would be derived anyway—but if the circumference is contracted without the radius being contracted, the circumference would become too short to reach all the way around the disk.

What the old principle of relativity stated was that inertial motion is always defined *relative* to some point of reference, e.g. Earth (as habitual, ever present reference), or a train, or the Moon etc., that the inertial motion does not exist independently. Accelerated motion like rotation (apart from the center of the disk) is different in that it has a very definite effect on the observer *moving with the frame of reference*, namely that of inducing an effect similar to gravity. It does not make rotation *absolute motion*, exactly, since the acceleration effect only exists when rotation occurs relative to gravitation space. There is no friction to the motion (in free space), so a big plate set to rotate about some center axis or other in free space will retain that motion indefinitely, unless or until some force interferes. It takes energy to set it in motion, and it takes energy to stop the motion, but maintaining the motion requires no energy. There is a stress on the material, causing it to break up and fly apart if it is not strong enough to hold itself together. The same effect causes someone to slide off the rotating disk if moving away from its center. But if another disk is coupled to the rotating disk, their planes parallel, and set to rotate in the opposite direction, it may be arranged that only one of the disks is rotating relative to gravitation space, and the other, although rotating relative to the former, will *not* experience any acceleration effect or stress.

A similar example can be construed on Earth, digging a hole in which a smoothly rotating platform is mounted, with another counter-rotating platform on top of it. The latter platform can be level with the ground, and, indeed, connected to the ground, so it is obvious that no one will slide off. Even though rotational motion was not covered by the old principle of relativity, the principle is refuted by this experiment, because it demonstrates gravitation space to be an absolute frame of reference, and not merely a habitually natural one.

The twentyfourth section introduces unhomogenous space, by way of a marble slab that is heated in the middle. Using tiny, identical sticks, a grid of perfect squares could be made before the marble was heated, this grid serving well as a normal coordinate system. With the heat difference, the sticks expand according to how much they are heated, and the grid breaks down. Then follows an interesting consideration; different materials react differently to heat, and there might even be sticks of a material that would not cause

[33] Which would be a severe challenge in case of multiple observers.

the grid to break down as consequence of the partial heating of the marble slab. But what if all materials were to react alike to temperature variations, and these reactions were our only way of measuring temperature? An analogous consideration is; what if all matter react in the same way to varying gravitation density, and our only means of measuring distance is using material devices? As radiation 'slows down' through a region of high gravitational density,[34] measurements by radiation would not differ from measurements by material devices, if material reaction to gravity is to contract in the same proportion as the radiation is slowed down. Such uniform contraction would necessarily apply down to the dimensions of an atom, which makes sense if the electrons of the atom is considered to move in an electromagnetic pattern emanated from the nucleus—propagation time (rather than distance) from nucleus to orbiting electrons ought to be constant, in order for the emanated pattern to have the same phase at the electrons' orbit levels. This is backwards, of course; the electrons orbit where the emanated pattern is in certain phases conducive to orbit at the specific energies of the electrons.

The twentyfifth through twentyeighth sections introduces a way of making grids to reflect non-homogenous space, by letting grid lines spread out in less density (such as the heated part of the marble slab), while letting them come closer together in high-density areas, which is too mathematically abstract for this one to treat. A consequence, however, is explicitly stated, namely that only space-time *coincidences* retain validity as basis for physical descriptions. What is not stated, is that this requirement invalidates trigonometrical derivations. That trigonometrical derivations[35] are only approximate cannot be helped, since we cannot tell precisely where starlight is coming from, because of the possible gravitation density variations the light has curved its way through.[36] However, gravitation decreases as the square of the distance away from the mass causing it, so the assumption that radiation travels fairly straight is probably not altogether useless, as long as it is understood that trigonometry 'pretends' that space is ideal, undistorted by gravitation. Consider also that measuring a distance of some kilometers with a meter wheel (or something equivalent) may yield somewhat different results from time to time, even if it is assumed that the wheel traces the exact same path each time, because climatic variations may cause the wheel to change size. Achieving complete exactness of measurement seems time and again to be beyond human achievement.

[34] If the progress of a light beam could be tracked from another location in space, the slowing down through a high-gravity region would be apparent.

[35] Such as the distance between two stars calculated from the distance to each and the angle between the lines of sight to them, which is *ideally* possible in trigonometry using what is known as the law of cosines: $c^2 = a^2 + b^2 - 2ab\cos C$, where $a$, $b$ and $c$ are side lengths of a triangle and $C$ is the angle opposite the side $c$.

[36] Compensating for this would require complete mapping of gravitational variations along all the distances in question, but the gravitational variations are ever fluctuating with the movements of the masses responsible for the gravitation, so any instantaneous mapping would lose validity with time.

It seems rather awkward, this construction of non-ideal coordinate systems with non-linear coordinate lines to reflect non-homogenous space. A three-dimensional topography, on the other hand, with curving semitransparent contours to indicate equal densities of gravitation space, spherical close to planets and stars, their outer layers straightening as they merge together, would be intelligible to everyone. It should, of course, fluctuate with time to reflect actual motion of significant masses and consequent topographical transformations. The main difference between a non-ideal coordinate system and a topography is that the latter does not have unique, formal location indications, but an ideal coordinate system superimposed on the topography remedies that. Cognition uses the ideal (ideas) to understand reality (which is chaotic without cognition); it does not seem reasonable to mix the two together just because reality does so. In reality everything is mixed together, but then, reality does not understand itself; it simply *becomes*, in an eternal flux, at every instant moving or transforming with never a hint of reflected choice or driving will. Cognition discerns ideas in reality, thus *taking reality apart* into an abstract context which it can understand and *correlate* with experience, and *register* as experience. Thus it is that cognition is comfortable with superposition of two abstractions, interpreting them more readily than the real mix.[37]

[37] Traditional coordinate systems are fair approximations when applied locally, even with the requirement that variation of gravitational density be aligned with one of the axes, with any density value occurring at only one distance along that axis. This is what has always been considered (to local experience) the most natural coordinate system, stretching from Earth's surface and up. In fact, there is a very natural way to define the axes of a coordinate system, if a bias to the right-handed majority can be forgiven; as one observes with one's two eyes, one natural axis goes straight past both eyes, defining negative values leftward and positive values rightward; the second natural axis follows the nose right between the eyes, defining positive values upward (and negative values downward, but this 'most natural' coordinate system does not go below ground), and since one's head is generally upright when making conscious observations, this second axis is the one with which variation of gravitational density is aligned (up is the direction one must jump, down the direction one falls); the third and last natural axis defines positive values forward, in the direction of sight, and negative values backward. This coordinate system may be used for describing events above ground, as long as these do not stretch very far around the globe, and not so far up and away that other gravitation-generating masses interfere significantly. If Earth were flat, this coordinate system would work even better! If one extends the vertical axis below ground, gravitational density decreases toward zero as one approaches the center of Earth, because the ground above pulls the other way, so each density value will occur both at a positive and a negative distance along the axis (and again as one goes *through* the center, and yet again beyond Earth's surface on the other side).

The more natural coordinate system *to approximate reality* is spherical as gravitation-generating masses are generally approximately spherical, with the origin of the coordinate system at the the center of the mass, and with one natural axis the one about which the mass is spinning (considered vertical), and another entirely arbitrary axis perpendicular to the vertical considered the horizontal one (in case the mass is not spinning, the 'vertical' axis is also entirely arbitrary). Locations are now uniquely indicated by one angle relative to the vertical axis, one angle relative to the horizontal axis (which two values uniquely

The twentyninth section mentions three predictions of General Relativity and its interpretation of gravitation:

Curvature of starlight passing close to the Sun's gravitational influence has already been mentioned in this treatment, and works as well with gravitation space as medium of radiation propagation, which is described rather closely by General Relativity's gravitation theory, except that the latter does not consider the gravitational topography of the Universe to be a medium.

A steady change of Mercury's orbit—the orbit itself gradually shifts around the Sun by a small fraction each century—was a known phenomenon that General Relativity explains. Most of this phenomenon is explained by the gravitational influence of other planets, but a portion was unaccounted for. Also, the Sun is not stationary, but tugged about a bit by the orbiting planets.[38] These factors were also known and taken into consideration. What was unaccounted for was that gravitational fields propagate at radiation speed, so the Sun's motion will 'chase the tail' of the relatively fast-moving planet closest to the Sun.[39] Add that gravitational fields propagate at radiation speed *through the medium of gravitation space*; it entails that gravitational field propagation, like radiation, is slowed through regions of high gravitational density. Would this be a paradox for black holes, that the gravitational field cannot escape the gravitational field? No, even radiation will escape a black hole if it goes sufficiently straight away from the center. Gravitational contraction effects propagate in all directions (as would electrical effects), all of which will work themselves outward, the gravitational density being due to the initial slowness of propagation. More accumulated, one might say, in a sense like a barge can be loaded more fully if passing slowly by the docks than if it passes swiftly by, if loading is performed at a steady rate over time.

A phenomenon known as gravitational redshift was also explained by

indicate direction away from the center of the mass), and a distance in this direction, which distance should always be a positive value, because a negative distance can always be expressed as a positive distance in the opposite direction (which direction is defined by different angles). This spherical coordinate system is more natural to reality (than the one natural to local experience) because gravitation density increases in all directions away from the center of the mass until one gets to the surface, beyond which gravitation density decreases in all directions. Other gravitation-generating masses interfere with this simplicity. Whatever the coordinate system, then, it cannot have gravitational density variations aligned with a single axis (or a single direction) if it is to encompass more than one gravitation-generating mass, let alone the entire stellar Universe. This is another reason for preferring three-dimensional topography with a superimposed ideal coordinate system as the general way of describing astronomical contexts.

[38] Jupiter tugs so much at the Sun that their barycenter (common orbital center, the center of mass) is actually a little bit *outside* the Sun's radius. For comparison, the barycenter of Earth and the Moon is about three quarters of Earth's radius out from the center of Earth.

[39] The orbits of all the planets are shifted thus, but this is not easy to measure, either because the orbit is very nearly circular, making it hard to tell if it is shifted, or because the orbital period (of the planets farther out) is so long that the orbital shifts have not accumulated to any appreciable amount, or because they are too small to tug very much at the Sun, in which case the Sun does not do much 'tail chasing.'

General Relativity's interpretation of gravity. Stars consist of known materials, and these materials emit radiation of certain wavelengths, giving rise to patterns known as spectral lines. These spectral lines are shifted towards red (greater wavelength, lower energy) the heavier the star emitting them. Radiation is emission of photons, occurring (among other ways) as electrons 'fall' to orbital alternatives closer to the nucleus.[40] Gravitational redshift is readily explained by gravitation space as propagation medium as well, since decreasing medium density (as the radiation leaves the star) naturally causes wavelength expansion. The more interesting question in the medium model is why the same wavelength pattern is emitted regardless of gravitation density as observed at the location of emission. Consider, as proposed earlier, that matter contracts in the same proportion as radiation is 'slowed,' causing electrons to be closer to the nucleus, as they orbit in the electromagnetic pattern emanating from the nucleus, so their distance from the nucleus is determined by medium density. That everything aligns with the pattern ensures that the differences in energy levels are the same always.

## Recapitulation of Logical Inconsistencies

Although multiple logical problems have been pointed out, and are apparent as a variety of flaws in the clarity of retrospect, they should be counted as one, namely the more crucial one of deriving through the train-and-embankment thought experiment consequences that defeated the derivation. Nonetheless, an overview is compiled here.

For the purpose of deriving temporal relativity, an arbitrary way of testing simultaneity was devised, yielding an equally arbitrary result,[41] thus invalidating its use for revising the idea of time.

The aim of Special Relativity was reconciliation of radiation isotropy and the principle of relativity, but the principle of relativity was not kept intact, as inertial motion was implicitly considered absolute whenever ascribing time dilation and length contraction to the observed inertial frame, although these effects, at other times, were merely *apparent* to an observer in another, arbitrary, inertial frame of reference.[42] Nor was radiation isotropy consistently honored in all inertial frames *by Einstein*—Richard Feynman's thought experiment, which is outlined below, remedies this particular detail (but, as mentioned earlier, deals only with appearances).

[40] An orbiting electron may also absorb a photon, provided the photon energy raises the electron's energy to compatibility with a higher orbital alternative that is more or less stable. The definite energies required for stable orbital alternatives is what causes the spectral lines, that only certain wavelengths can be emitted and absorbed.

[41] Equally valid alternative tests yield different results.

[42] It lends a measure of freedom to the defence of Special Relativity that the frame of observation may be chosen to be any inertial system, meaning that a scenario merely has to check out from a single point of view.

As it has also been shown, the principle of relativity was not tenable in the first place, which was not known at the time. The reason for this has been given by demonstrating the absolute frame of reference of gravitation space by example of counter-rotating disks.

Later, Einstein's logical derivation of non-isotropy in gravitational fields did not cause Special Relativity to be abandoned, even in presence of gravitational fields, in which Special Relativity had been acknowledged *not* to be valid.

If the Universe is to have the same age everywhere, it must preclude local variations in time's passage.

## Richard P. Feynman's Lectures on Physics

Richard Feynman's Lectures on Physics and QED have provided the major part of one's research material into validity of Relativity Theory and related fields. In fact, Feynman's treatment of most subjects is so engaging, accessible, eminently formulated and rewarding that one went through the whole set of Lectures[43] for the sheer abundance of insights it yielded. Readers of Feynman's works who consider themselves philosophers do well to develop intellectual masochism, though, as we take some beatings time and again. Many scientists are deeply sceptical of logical reasoning, due to its tendency to turn up erroneous conclusions when some factors have been missed or misinterpreted, and those scientists tend to consider validation by experiment prerequisite for granting any amount of credibility to notions. As Feynman states it, Lectures on Physics Vol. 1 section 1-1 "*The test of all knowledge is experiment.* Experiment is the *sole judge* of scientific "truth."" With Feynman it goes well beyond that, at times turning to outright ridicule. As it turns out, one happens to be a bit of an intellectual masochist, finding the ridicule quite amusing, and not altogether in error. One is worried, though, that the philosophically inclined in general may be repulsed by Feynman's attitude toward philosophy and logic. At the very least it must be pointed out that Feynman is quite a philosopher in his own right, particularly when he is not aware of dealing with philosophy or logic; he is scrupulous in pointing out limitations of physical theories, where they break down, what is not yet understood, and he gives quite deep interpretations along the way. Of course, it is not possible to make any absolute distinction between philosophy and theoretical physics (or theoretical whatever); philosophy must think of *something* after

[43] Though not as most students of physics would, as one has little interest in the formalized equations and ways of calculating with them (*some* mathematical notations had to be learned, at great pains, in order to decipher the treatments), primarily noting principles and phenomena involved, the analyses of the *nature* of processes (the appreciation of the feel for which one shares with physicists), generally finding 'easy' stuff very difficult (authors of physics always have to call transformations and combinations of equations easy, or something one immediately gets. . . ), while feeling quite comfortable during passages of (non-mathematical) abstractions.

all, naturally leading to specialization as one digs deeper, but one returns toward philosophy by abstracting from one's specialization, and Feynman is quite good at that. He also has endearing humor and self-irony on behalf of physics; it is only when conscious about dealing with philosophers' interpretations of physics that he turns to ridicule.

One issue that aggravates Feynman about philosophy, which is also relevant for this treatment, is that of *understanding*. To the mathematically or practically inclined physicists, physics is a very *descriptive* science, formulas describing projections of behavior, with less emphasis on the internal dynamics giving rise to that behavior—until the internal dynamics are clarified, after which physicists eagerly attack the problems of describing the various stages of those dynamics, with less emphasis on the internal dynamics of those, and so on. Perhaps it should not be so surprising that formulas describing behavior so often come before grasping internal dynamics, but one considers it a tribute to the creative genius of mathematicians. As mentioned above, Feynman often gives deep interpretations, looking into internal structure and dynamics, and cannot be called a 'descriptive physicist,' but he does revel in cases where physical understanding, as yet, is almost purely descriptive mathematical abstractions, such as quantum mechanics and quantum electrodynamics. These fields have no structural renderings of the quantum particles of which they treat, dealing only with their *probability* of being in some state in a given context—or rather, their state at any time is considered an abstract combination of multiple discernible states. One does not doubt the exactness of description, as far as it goes—it is, after all, fitted to agree with experiments—but the underlying physical reality is *not* a mathematical abstraction. Discernible states are definitely guidelines for quantum structural interpretations (although interpretation is likely to cause some redefinition of discernible states), yet lack of consistent interpretation makes physicists in general ignore the challenge, insisting, rather, that the ability to predict *is* understanding, making them quite content with working formulas and leave the challenge behind. It is not right to tell physicists that ability to predict *is not* understanding, because it certainly is *some* understanding compared to the *inability* to predict. The disagreement is due to the physicists' specialization of theory versus the philosophers' abstraction *from* specialized theory (if it is to have any interest at all), that only those few of a philosophical bent appreciate the ability to imagine phenomena for its own sake, while the others esteem the ability to predict first and last. Phenomena are much easier to understand, to teach and to learn, if one is able to imagine them. For this, imagination may win passing appreciation, but is immediately left behind once it has lead to the ability to predict. Thus, what for philosophers is one and all, is to physicists merely an aid to effect the vanishing moment of transition between inability and ability to predict; those who already master prediction have no use for the imaginative renderings. Whether calling it understanding or something else, what is important to each individual is that which improves (eradicates flaws, makes more comprehensive and discerning) the integrity of the metastructures one is building, and that differs dramatically from individual to individual.

As Feynman puts it in Lectures on Physics Vol. II section 20-3 on scientific imagination regarding electromagnetic fields: “Suppose that we were to begin by imagining that the world was filled with thin jello and that the fields represented some distortion—say a stretching or twisting—of the jello. Then we could visualize the field. After we “see” what it is like we could abstract the jello away. For many years that’s what people tried to do. Maxwell, Ampère, Faraday, and others tried to understand electromagnetism this way. (Sometimes they called the abstract jello “ether.”) But it turned out that the attempt to imagine the electromagnetic field in that way was really standing in the way of progress. We are unfortunately limited to abstractions, to using instruments to detect the field, to using mathematical symbols to describe the field, etc. But nevertheless, in some sense the fields are real, because after we are all finished fiddling around with mathematical equations—with or without making pictures and drawings or trying to visualize the thing—we can still make the instruments detect the signals from Mariner II and find out about galaxies a billion miles away, and so on.”

Philosophers, of course, would never object to imaginations standing in the way of progress. That is what philosophy is all about. Gravitation space is just such abstract jello (‘abstract’ in the sense that it is frictionless and substanceless), except matter is not something else moving through it as much as tension- or contraction patterns of it moving through it, with sufficiently large accumulations of contractions generating their own sphere of stationary medium, locally overriding the otherwise dominant mass (gravitational contraction) in the region, the effect of this override gradually lessening with distance away from the generating mass.

Further, in Lectures on Physics Vol. II section 18-1: “It was not yet customary in Maxwell’s time to think in terms of abstract fields. Maxwell discussed his ideas in terms of a model in which the vacuum was like an elastic solid. [...] There was much reluctance to accept his theory, first because of the model, and second because there was at first no experimental justification. Today, we understand better that what counts are the equations themselves and not the model used to get them. We may only question whether the equations are true or false. This is answered by doing experiments, and untold numbers of experiments have confirmed Maxwell’s equations. If we take away the scaffolding he used to build it, we find that Maxwell’s beautiful edifice stands on its own. He brought together all the laws of electricity and magnetism and made one complete and beautiful theory.”

Again, any truth explorer would much prefer the way to the discovery over just being handed the synthesis of the discovery; to care only about whether behavior projected by the equations check out or not is to miss the revelation of the journey. If one is just given edifices without insights into the construction process, how can one pick up inspiration for building other edifices? Or spy out weaknesses hidden within the structure? The equations may be very useful, but that is no motiviation for philosophers, nor is usefulness a virtue in its own right. Indeed, ever so often scientific discoveries have found their first application in destruction—and most contributions to industry and material welfare have severe negative side effects to humanity or environment, casting a deep shadow over technological evolution in general. Enough of this, and lovers of truth and creativity are repelled from the field in question—repelled in the very deep sense that opening up the mind to higher levels of sensitivity has no defence against awareness of unilateral death and suffering to which the field has contributed, other than withdrawal from that field, to at least avoid complicity in generation of new disasters, notwithstanding that there are positive aspects as well, and that it is not the discovering scientists who are directly responsible for misdeeds. A mind cannot open up without its conscience. There is always another less tainted field to explore, after all, or a new one is invented. The way to a discovery is a revelation, and an invention is a testament to truth, but use and further production have no intrinsic virtue; utilization can only be judged by the sum of its effects (not the selection employed to sell it).

It is characteristic of Feynman that he advocates sufficience of description over deeper understanding, even while probing into deeper understanding of a subject. Had he not been thus at odds with his recommendations (although he often makes it out as a final farewell before putting obsolete ways of thinking to rest), one would not have loved his works. Besides, reducing interest to equations does not get rid of the difficulties of imagination. Rather, it suppresses them, sweeps them under the carpet. The formalized 'edifice' is not *explicitly* a construct of imagination (when the 'scaffolding' is taken away), but that just makes the imagination *implicit*, the only relief in which is that one does not have to be bothered by its too manifest presence if one is impatient to move on and get practical or do calculations. Mathematical fiction is no less fiction than otherwise imaginative interpretation. Believing imagination not to be necessary, and so avoiding explicit imagination of internal dynamics, precludes both access and interest from philosphers, though.

It is curious and most disturbing irony of fate that Special Relativity, conceived by a genius who praised imagination as being of paramount importance for creative thinking, turned out to contribute in closing the doors to imagination, due to the theory's inherent emphasis on mathematical abstraction. It is also curious that physicists who are distrustful of logical reasoning embrace mathematics which is a subbranch of logic. One shall now return focus to the inconsistent application of these abstractions, by way of examining some of Feynman's introductions to Relativity Theory that supplement the earlier treatment.

## Derivation of relativity of simultaneity

In Lectures on Physics Vol. I section 15-6, Feynman *does* put his attempt at deriving temporal relativity into space, rather than reproduce Einstein's train-and-embankment thought experiment, thus removing it from the gravitational context which General Relativity excluded from Special Relativity's domain of validity:

A man in a spaceship, called $S'$, synchronizes two clocks, one at either end of his spaceship, by first finding the exact midpoint between them, then synchronizing by isotropically propagated light beams. So far so good, assuming radiation isotropy. Another man in another inertial reference frame, called $S$, moves at different speed in the same direction as $S'$: "[...] the man in $S$ reasons that since [$S'$] is moving forward, the clock in the front end was running away from the light signal, hence the light had to go more than halfway in order to catch up; the rear clock, however, was advancing to meet the light signal, so this distance was shorter. Therefore the signal reached the rear clock first, although the man in $S'$ thought that the signals arrived simultaneously. We thus see that when a man in a spaceship thinks the times at two locations are simultaneous, equal values of $t'$ in his coordinate system must correspond to *different* values of $t$ in the other coordinate system!" The values $t'$ and $t$ are times in $S'$ and $S$, respectively.

Feynman's scenario is quite similar to Einstein's train-and-embankment thought experiment. Radiation isotropy is not acknowledged by the man in $S$ to apply equally in $S'$, because then he would know that the reasoning of one clock running away from the signal and another advancing to meet it would be wrong; it is the error of ascribing *appearances* in one inertial reference frame to the *reality* of another. Yet the scenario consistently honors the principle of relativity and radiation isotropy; the observer in $S$ would not see the signals reach the clocks at the same time, while the synchronization trick would nonetheless work nicely in $S'$, despite the *apparent* discrepancy. The difference is not due to the signal propagating from the middle towards the ends of the spaceship (as opposed to the flashes propagating from ends of the train car to a midpoint in Einstein's thought experiment); Feynman's version is easily altered to look more like Einstein's by letting signals originate from the ends of the spaceship and meet in the middle *if they are emitted simultaneously*; it would still seem to the observer in the other spaceship, $S$, that $S'$ was moving relative to the signal, that is, rushing toward the signal from the front end and away from the signal from the rear end. The absurdity of ascribing the appearances in $S$ to the reality of $S'$ (remaining within the constraints of radiation isotropy and the principle of relativity) may be illustrated by adding a self-destruct mechanism that is triggered if the signal from one end of the spaceship does not meet a sensor at the observation post in the middle of the spaceship at the exact same time as the signal from the other end; then the spaceship would explode from the point of view of the passing observer, but not (fortunately) in the experience of the observer within the spaceship!

## Gravitation-acceleration equivalence

As mentioned in the treatment of the twentieth section of Einstein's popular exposition, Einstein pointed out that gravitation and accelerated motion are indistinguishable. There is one problem with this equivalence, which was not mentioned; if compatibility with Special Relativity is desired, then constantly accelerated motion must reach an upper boundary as radiation speed is being approached. Radiation speed relative to what? —That is always the question in Special Relativity. Relative to its starting point of motion, for example.

In Lectures on Physics Vol. II chapter 42, Feynman applies this equivalence principle to clocks on a rocket, one near the top/front, one near the bottom/rear. When the rocket is accelerating through space, flashes emitted from the front clock each second will be registered at the rear clock at decreasing intervals, because the rocket increases its velocity between flash emission and flash registration, and increases its velocity by an even greater amount between the subsequent flash emission and registration and so on, giving the result that the front clock appears to go faster than the rear clock. The change is not really in the rate of clocks, though, but in ever decreasing travel time of the flashes, which it is then a bad idea to include in a device that is supposed to keep time.

There is another possibility of interpretation, if one adheres to mediumless radiation isotropy, namely that it follows the reference frame of the rocket, except the rocket is not an inertial reference frame, as it undergoes constant acceleration, but the difference from an inertial reference frame is the same in each time interval, so the rear clock would gain on each flash by the same amount, with the result of registering flashes at the rate they are emitted, only shifted a bit relative to the case of no acceleration. Honoring isotropy, the problem would return to the former case if, instead of constant acceleration, the rocket undergoes constant acceleration of acceleration.

The equivalence principle says that constant acceleration through space is equivalent to letting the rocket stand on Earth, which is true (in both cases the flashes will be blue-shifted when registered, relative to their emission wavelength, which illustrates the equivalence of gravitational blue-shift and blue-shift due to relative motion), but as is shown, there is no discrepancy in the rate of time's passage.[44]

Feynman goes on to derive the discrepancy by a different argumentation. An atom in an excited energy level (an orbiting electron has absorbed a photon, so it moves in a higher orbital alternative) is lifted some distance up in Earth's gravitational field, then emits the photon, after which the atom is lowered to its former position and absorbs the photon it had just emitted. If the photon had not been emitted, the atom would wind up in the original position with the exact same energy it started with, but as it *did*

[44]Feynman applies 'identical clocks' to the experiment, without specifying that they go at the same rate, so depending on the construction of the clocks there *may* be a discrepancy between the rate of their processes. See 'Atomic Clocks vs. Time' below.

emit the photon, more energy was lifted than lowered, so the emitted photon cannot be of the same energy (wavelength) as it would have been had it been emitted at the atom's lower location; it must have a little more energy. This is just gravitational blueshift, though; radiation moving into higher gravitational density has its wavelength shortened (increasing its energy). The work in lifting the atom can be considered the work needed to stretch the dimensions of the atom, which contract back again when it is lowered. When photons move in the medium rather than being bound in a particle, it will gain or lose energy when moving into higher or lower gravitational density, respectively. Bound in a particle, on the other hand, it can be transported as that particle is transported, without gaining or losing energy. It follows that if the atom in the experiment is lifted high enough before emitting the photon and being lowered back, the previously emitted photon would have too much energy to be absorbed, should it find its way back to its former host—it would no longer be compatible with the excitation to the higher orbital alternative (but it may, of course, become compatible with an even higher orbital alternative). There is no support for temporal discrepancy in different gravitational potentials in this scenario either, when gravitation space is recognized as propagation medium of varying density.

## Atomic Clocks vs. Time

Certain atoms, under favorable conditions that can be engineered to stimulate emission and absorption of photons, have a very steady periodic property, and are thus employed in high-precision atomic clocks. Such clocks would not go wrong by a second in a million years. As it turns out, however, the rate of this periodic property changes with different gravitational density,[45] so their use as clocks are limited to fixed gravitational density, but not necessarily to Earth's surface, because the difference in periodic rate can, of course, be

[45] The rate speeds up in less gravitational density. This *is* very interesting—but perhaps it should not be too surprising, as the dimensions of the atom expand with diminishing gravitational density, so even though the rate of electron orbits remains the same, the electrons will have to move faster to accomplish this—not faster relative to the electromagnetic pattern emanating from the nucleus, because that too has increased in scale, but faster relative to ideal space scale, and faster relative to the (less dense) medium. Hence they can absorb and emit photons of a wider range, absorbing photons of less energy when the electron and the photon have some relative velocity toward each other, and absorbing photons of more energy when the electron and the photon have some relative velocity away from each other. Likewise, the electrons will be emitting photons of higher energy in the forward direction, and of less energy in the backward direction. As a direct consequence of this reasoning, spectral lines of radiation emitted in lower gravitational density will be somewhat broader than those of radiation emitted in higher gravitational density. Of course, higher gravitational density will usually entail more heat, which is atoms jostling each other into a range of velocities, which will equally widen the range of absorbable and emitted photons from a given transition, thus widening the spectral lines as well as less gravitational density.

compensated for from one fixed gravitational density to another, which is what is done with satellite systems using atomic clocks, such as GPS.

Unfortunately, clocks are generally equated with time by physicists. But clocks are just some kind of machinery or other, and should be evaluated by how well they keep time. It is not valid to let a clock define *the* rate of time, when not maintained under ideal (unchanging) conditions—there will always be another kind of time device that changes differently with the change of some condition or other, or ways of measuring time that are indifferent to that change. The age of the Universe is the same whether one asks the question while weightless in a spaceship or standing on a planet surface, regardless of how time is measured; translating from one measure to another, however, is no trivial task, possibly necessitating compensation for a host of differences in conditions, particularly if measuring with as complex a mechanism as a clock.

It is not possible to go through time at a different rate, not to mention going back in time, because the whole Universe has a single exact configuration at every instant. If one were to go back in time, one would have to be oneself at an earlier time, to fit with that earlier universal configuration. One ever moves forward in time, regardless of the speed of one's motion. Time travel, understood as the notion of going backward in time while going forward in time,[46] while entertaining fiction, is not possible—the many paradoxes involved (such as reduplication of mass and identity and reconfiguration of events) are amply explored in said fiction, and without the transformations employed by Special Relativity, there is nothing to suggest its possibility, except by association from memory excursions.

## Particle Acceleration

A charge accelerated in a synchrotron to speeds upwards of radiation speed gains momentum in a way compatible with Special Relativity; as the speed becomes very high, continued acceleration yields only little increase in speed, while momentum (mass times speed) continues to increase.

The synchrotron accelerates a charge in a circular motion, though. The accelerated charge is continually being pulled centerward to keep it in orbit, even if the speed of the charge is not sought increased further, so it effectively contracts, just as it would in increasing gravitational density, and like a

[46] One is surprised to encounter just such assertions in Feynman's QED pp. 97-98 as distinguishable states of quantum interactions, which states are assumed, among others, to get the mathematical descriptions aligned with experimental results. One hazards the guess that these assertions are purely mathematical fiction pending further understanding, as conservation of energy (which is a very fundamental rule of physics) cannot hold if one quantum particle can be in two locations at the same time, but then, if quantum particles are somewhat loose energy patterns rather than tight little balls, their effective range of interaction may well give the appearance that they can be at two close locations at the same time.

stone is heavier on Jupiter than on Earth, so the charge becomes heavier in the artificially induced gravity. There will naturally be an upper limit to this acceleration, as conditions for the charge approach that of a black hole. Perhaps it will actually become a transient black hole intermittently, enabling it to absorb photons, thus increasing its mass, and alternately emit those photons and losing mass—at least it is known that particles at high speeds emit showers of photons.

Anyway, rotational motion is not inertial motion, and is thus not covered by Special Relativity, precisely because acceleration (which is equivalent to gravitation) is significantly involved, so using Special Relativity as model of explanation was not valid in the first place.

# Considerations of the Universe

*Our experience hitherto justifies us in trusting that nature is the realization of the simplest that is mathematically conceivable. I am convinced that purely mathematical construction enables us to find those concepts and those lawlike connections between them that provide the key to the understanding of natural phenomena. Useful mathematical concepts may well be suggested by experience, but in no way can they be derived from it. Experience naturally remains the sole criterion of the usefulness of a mathematical construction for physics. But the actual creative principle lies in mathematics. Thus, in a certain sense, I take it to be true that pure thought can grasp the real, as the ancients had dreamed.*

**—Albert Einstein, 1933**

Having ended the popular exposition of General Relativity, Einstein follows up with some considerations from the vantage point of his gravitational interpretations. First, in the thirtieth section, he attacks the (then) prevailing notion of the overall shape of the Universe, that it is a somewhat spherical concentration of stars, more dense closer to the center, the density dropping off outwards until, at a finite distance from the center, there are no more stars, beyond which is infinite, empty space. This notion, as proposed by Isaac Newton, is accompanied by the notion that any mass has a number of 'lines of force' stretching from infinity and terminating in the mass, the number being proportional to the mass. To Einstein's reasoning, these 'lines of force' would become impossibly crowded at the surface of the imaginary sphere containing the stellar Universe. But Einstein's 'proof' of this assumes approximately homogenous distribution of matter in the stellar Universe, notwithstanding the previous mention of diminishing density outward from the center, and states that expanding volume of the stellar Universe (assuming also increasing mass, as the average mass density is maintained) entails that the 'lines of force' through any area of the surface of the stellar Universe sphere increase in proportion to the increase of radius, thus going to infinity as the stellar Universe is expanded toward infinity. But the diminishing matter density outward from the center makes the 'lines of force' through the surface area of the stellar Universe the same at any stage of expansion, if the rate of infusion of mass through the center of the stellar Universe determines the rate of expansion.

The "distasteful conception that the material universe ought to possess something of the nature of a centre" has the saddening prospect that light is "perpetually passing out into infinite space, never to return, and without ever again coming into interaction with other objects of nature. Such a finite material universe would be destined to become gradually but systematically impoverished." Einstein found it more intuitively right that the Universe should be infinite, with more or less the same concentration of stars everywhere, but he accepted the Big Birth theory and universal expansion when proposed some years later.

As it turned out, spectral line displacement (aside from gravitational redshift and relative motion due to Earth's orbit) was observed to be greater the more distant the stars, regardless of direction, making universal expansion evident, as well as suggesting that everything had been closer together in the past, so it seems we are back to the notion of a finite (but expanding) stellar Universe surrounded by infinite, empty space. But how is it that the finite stellar Universe expands rather than collapses in on itself due to mutual gravitational attraction? One explanation is that there is a giant swirl of gravitation space around the center of the Universe, causing the embedded swirls within swirls of solar systems and galaxies to spiral outwards with more effect than gravitation pulls inwards. Such an overall swirl would engender a so-called accretion disk, whereby matter in the Universe would tend to concentrate in a plane, just the way planets orbiting a star tend to align their orbital planes. Another explanation (they are not mutually exclusive) is that the Big Birth was not a singular energy explosion, but the beginning of an ongoing infusion, possibly an accelerating one. One wonders if a black hole collapse continues as a Big Birth explosion of a new universe, in a new set of dimensions (cannot be the same, or the energy would exist doubly), converting all matter to pure photon energy in the transition, such that each universe contains as many subuniverses as there are black holes, giving rise to the notion of a Universe Tree, possibly infinite in the root direction (of course, comparability of time lines would go for all universes through a common source universe).

## Curvature of Space

Before all that, Einstein performed some imaginative acrobatics in the thirtyfirst section, introducing the notion of a finite, yet unbounded universe, initially as a two-dimensional space, like the surface of a sphere, in which two-dimensional beings live out their days, oblivious to any third dimension. They may travel infinitely, but would eventually come round to their starting point. They would be able to draw circles, using the rule that the circumference everywhere has the same distance to the center, and from this derive $\pi$ as the ratio of the circumference to the diameter, as long as they were keeping the circles small; large circles would yield increasingly smaller values of $\pi$, by which the two-dimensional beings may deduce the curvature of their two-dimensional space, but only if such larger circles were within their range of experience. From this is inferred the possibility of curvature of our three-dimensional Universe, in which we might come back to our starting point if we keep going straight away from Earth, but the curvature might also be deduced on a smaller scale, if it turned out that $\pi$ as derived from the ratio of a sphere's surface area to its radius would gradually yield a smaller value as the radius is made very large. Such finite space has the pleasing prospect that light never truly escapes, that it may one day return to us.

It is definitely a very sophisticated mathematical abstraction, and curvature of space is still widely considered by advanced mathematicians, although the Big Birth theory seems to have suggested a spherical overall shape of the Universe, possibly with the stellar Universe in an accretion disk, but the first radiation from the Big Birth event ought to have proceeded outwards to describe a simple sphere with a radius of radiation speed times the age of the Universe, whether or not radiation concentration is higher around the plane of an accretion disk than above and below the disk. But the very foundation of the abstraction is not valid: Two-dimensional existence is an impossibility. No points, lines or planes exist (possibly excepting black holes; according to current theory, a black hole will collapse completely in on itself, thus ending in the zero-dimension of a point). A piece of paper, the thinnest sheet of film, subatomic particles, photons of the smallest wavelength, all require three dimensions (four, including time, which is necessary for motion). Inferring from an impossibility is groundless. It is interesting, though, that Einstein would do this after proposing that time is inextricably embedded in the three spatial dimensions, because movements of the two-dimensional beings in their two-dimensional existence presumably also require time, so it is two dimensions plus time, like it is three dimensions plus time, making a quite definite, ideal distinction between space and time.

# On Evolution of Science

*The words or the language, as they are written or spoken, do not seem to play any role in my mechanism of thought. The psychical entities which seem to serve as elements in thoughts are certain signs and more or less clear images which can be 'voluntarily' reproduced and combined. There is, of course, a certain connection between those elements and relevant logical concepts. It is also clear that the desire to arrive finally at logically connected concepts is the emotional basis of this rather vague play with the above-mentioned elements... The above-mentioned elements are, in my case, of visual and some muscular type. Conventional words or other signs have to be sought for laboriously only in a secondary stage, when the mentioned associative play is sufficiently established and can be reproduced at will.*

**—Albert Einstein**

As temporal relativity has been considered valid for a bit of time, one wishes to put the phenomenon of enduring scientific mistakes into a more abstract perspective, which is not specific to physics; it is by no means the only old field to have known long stagnation in some aspect of it (philosophy has had its long ages with an ultimate authority—not that the one so honored is necessarily mistaken, but it is still stagnation to confine exploration to a single framework of perspectives when alternate pespectives can reveal other depths and bring growth to the field); nor is it the only field to have pursued a course based upon some invalid interpretation for a long time—on the contrary, we pursue 'wrong' courses until they reveal their errors, whereupon we are happy to correct them (if we do not have some stake in them, that is). As offset for this abstraction, there are some excellent insights into the scientific process in the beginning of the third appendix of Einstein's popular exposition of Relativity Theory, from the authentic perspective of the genius himself. These insights may be considered elaborations of the content of the first section.

"From a systematic theoretical point of view, we may imagine the process of evolution of an empirical science to be a continuous process of induction." Based upon experiences, we generalize principles from what seems to describe the experiences. Such a principle may be found to clash with observations that was not known or overlooked when deriving the principle, and it is then discarded, or at least adjusted so it is no longer in discord with observations. Thus far we are guided by factual correlation, that is, a principle is true if, and only if, it is in accord with reality. Yet the principles may not fit so well together, perhaps because they belong to alternative models of explanation, perhaps because the distinction between the principles is vague. This is somewhat like ordering phenomena into categories, keeping the categories as clear and distinct as possible.

But, Einstein continues, once a set of principles (axioms) begins to emerge, different approaches to evolving the science becomes possible, since the axioms, variously combined, have consequences that can be deduced by logic alone, thus effectively expanding knowledge (or means of testing the validity of employed perspectives, if you will). Intuition plays a significant role when such deduced consequences cannot be tested directly. "As soon as a science has emerged from its initial stages, theoretical advances are no longer achieved merely by a process of arrangement. Guided by empirical data, the investigator rather develops a system of thought which, in general, is built up logically from a small number of fundamental assumptions, the so-called axioms. We shall call such a system of thought a *theory*. The theory finds the justification for its existence in the fact that it correlates a large number of single observations, and it is just here that the "truth" of the theory lies.

"Corresponding to the same complex of empirical data, there may be several theories, which differ from one another to a considerable extent. But as regards the deductions from the theories which are capable of being tested, the agreement between the theories may be so complete, that it becomes difficult to find such deductions in which the two theories differ from each other."

From a very abstract perspective, the 'correlation of a large number of single observations' can be considered an optimizing principle for the mind, as general relationships replace distinct relationships (when different relationships, perceived more clearly, turn out to be but aspects of a smaller number of general relationships), effectively reducing the amount of particulars to be registered for information in general, thus freeing up mental capacity for new complexities.

Such correlation being a theory's justification, concerning the recognition of principles, not just the ones originally induced, but also the ones deduced from those inductions, the ability to thus distinguish more aspects in observations, to comprehend them more fully, is a most excellent notion of truth, making evident the increased observational potential as well as the inherent dynamic nature of truth, rather than the trivialization of truth into factuality that is so widespread in both science and philosophy. This is also expressed in the famous quote of Einstein "Imagination is more important than knowledge." Factuality is attributable to knowledge, whereas imagination is the exploration of truth, which may *yield* knowledge once the 'territory' is explored, but that is when imagination's work is done. Fortunately, the territory, once explored, reveals its boundaries to the unknown all around, making it increasingly evident how little one knows.[1]

[1]Hence, if one wishes to be confident in one's knowledge, one should refrain from expanding one's horizons. This is easily achieved at an arbitrary stage by adopting the conviction that one's horizons are now fully expanded.

# Truth Exploration: A Subjective Endeavor

*The important thing is not to stop questioning; curiosity has its own reason for existing. One cannot help but be in awe when contemplating the mysteries of eternity, of life, of the marvelous structure of reality. It is enough if one tries merely to comprehend a little of the mystery every day. The important thing is not to stop questioning; never lose a holy curiosity.*

**—Albert Einstein, 1955**

There is some analogy between imagination's inward exploration of ideas and the outward exploration of the World, in that both venture into and chart the unknown (which production may aid other explorers), both are perilous undertakings (one psychologically, the other physically), and what fruits they may bear cannot be promised in advance, making it very difficult to give *reasons* for going on the journey—it is, indeed, a poor explorer who is motivated by desire for whatever fruits the journey is imagined to yield, especially in case of the inward journeys where such focus on return and vindication is anathema, directing attention the wrong way (homebound instead of outbound) and giving it the wrong attitude; desire makes a narrow and selective filter of perception, rather than opening the mind to any (that is, unexpected) discovery. The parallel between inward and outward exploration only goes so far, though; inward exploration, as in theoretical evolution, goes through fundamental redefinitions of the 'metascape,' the perspectives from alternate theories yielding different notions of *reality*, as opposed to difference in *aspects* of reality, as revealed from various locations on the outward explorer's journey.[2] Theories can only represent various aspects of reality to the extent that they are not mutually exclusive.

In contrast to the preceding abstractions, one will examine various inclinations and temptations that makes the exploring subject liable to err. These factors are important to realize, because one is, necessarily, subjective when exploring new scientific areas; there is no such thing as objective exploration (although many scientists would beg to differ), because one is limited to the perspectives one happens to probe by. Later, when discoveries are probed from many perspectives, that is, approached from different subjective directions (an exploring subject must change its subjectivity in order to change direction of approach), then it gradually becomes *knowledge*; becomes increasingly objective. The subjectivity changes can be difficult to detect when one is learning from a good teacher, or when undergoing well-known changes, but they are there nonetheless, just as one's subjectivity is changing when

[2] Of course, one may also change one's conception of reality during outward explorations, but only incidentally, however well an outward experience may serve as iconographic indicator of the particular individual evolution, because it is an *inward* unfolding, and as such depends entirely on the individual's previous inward explorations. In other words, the outward experience only serves as trigger due to subjective dispositions for perceiving it as such.

engaged in listening to a good story. The changes are more deeply felt if one does not understand something for a time; one attacks the problem from the wrong angles, and then, suddenly, often serendipitously, one grasps the sense of it, and now it is easy to understand in more ways, but the exhilaration decreases or vanishes after the initial breakthrough of one's individual horizons; it is not just a new piece of knowledge that is won, but the ability to change *oneself* in a new way.

## On Expedience

Any programmer who has worked on development of a program growing in scope is intimately familiar with headaches accumulating due to shortcuts taken. Sometimes shortcuts present themselves as irresistibly tempting solutions to particular problems. One may well be aware that the solution does not take a host of subtleties into account, but as those are beyond the scope of the program *at the time*, one leaps. Or the subtleties are not even perceived yet, in which case one is not aware of leaping. Then the program grows in scope, or it just turns out that some feature depending on the unsupported subtleties is greatly missed, but by then the shortcut supports a lot of superstructure, and is not easily changed. That is when necessity must fight a sometimes protracted battle with reluctance due to other considerations for concession to radical reprogramming. The alternative is always the shortcut 'patching up' the existing programming to support new requirements, which, while often possible, becomes increasingly difficult, aside from being error-prone due to the lack of what may be called 'natural flow' or 'harmonic correspondence' between program parts.

There are myriad reasons for taking the shortcut, none of which have anything to do with exploring truth; the shortcut *works*; it does not yield new understanding, but it works, and so attention may proceed to the next challenge. In this form the temptation of the shortcut may be called the scientific expedience.[3] Eagerness to connect phenomena and consider the connection well established after a few validations, then rush on to make new connections based on the ones just made, has long been recognized as a quite universal human trait, and has lead to guidelines of doubt toward notions one considers adopting (or notions already considered firmly in place), where doubt should be understood in the sense of *turning to attack*; this one can only do if already inclined to adopt a notion, or examining notions already held; the doubt is misapplied if used as cognitive resistance to newly encountered notions. Only when a notion *seems right* is it exactly the right time to turn and ask why it is wrong, rather than looking for additional confirmations.

One famous proponent of this *turning to attack* was Karl Popper, who called the guidelines *falsificationism*, as opposed to the confirmation drive of

[3] Absence of non-scientific considerations that make shortcuts even more compelling and truth exploration subsidiary is regrettably rare.

*positivism*. Popper applauded scientific theories for making disprovable predictions,[4] at times referring to Einstein's General Relativity as a fine example. However, theories can seem descriptive of known facts and still be wrong (Einstein understood this, as is evident from his thoughts on evolution of science, about different theories making almost indistinguishable predictions). A theory originates from perspectives, the consistency of which is difficult to ascertain thoroughly, especially if coming from a source generally considered a great authority, in which case cognition is liable to grant credence rather than attack analytically (what Einstein despised as blind faith in authority). Additionally, perspectives are primarily local to the individual's own experiences and interests, where they may be quite consistent, in which case identification with the perspectives reveals that consistency, but the theory may concern matters outside this primary field of experience, and consistency among inexhaustive perspectives is a relatively weak indication of validity.

One may ask, then, why a theory is wrong, even though it survives experimental test after experimental test to disprove its predictions. One good reason a theory may yet be wrong is if it reveals no further truths—if it does not provide imagination with new vantage points from which new regions of the unknown may be glimpsed. An overlooked connection may appear this way, being given by what has already been discovered; but if the connection is not simply so given, if it entails radical redefinition of root phenomena to resolve theoretical inconsistencies in an abstract fashion, then the theory, even though yielding a much desired result—or rather, *especially* if it yields a much desired result—should be met with far more doubt than alternative physics interpretations that do not yield different equations; those are food for the imagination, if nothing else. One must not, however, ridicule projection of consequences of however small effects to their possible conclusions, even if, relative to the notion of completely dragged aether, the slight annual displacement pattern known as stellar aberration was what caused abandonment of propagation medium as well as distortion of the definition of time. Had these conclusions been otherwise manifest, which, indeed, was what Einstein attempted to show that they were, then expedience would not be involved at all.

## On Pride

Any programmer is disabused of a certain sense of pride early on—after a few hundred 'discoveries of flaws in the programming language' has turned

[4] Although this has always been considered good science, it is by no means universal among scientists to remember actually trying to disprove their theory; after all, the exhilaration of experimental confirmations is so much more uplifting and promising than attempting to undermine one's glorious theory—in fact, one may not *really* find it in one's heart to do so with the full force of one's intellectual artillery, because the theory is so obviously true and beautiful...

out to be flaws in the program at hand. One learns to quell the pride that congratulates one with being the genius able to stroll right in and discover in practically no time what had eluded everyone else. One learns to give such pride its proper name: Stupid. Then, as one develops one's skills, going on to honing them in some field or other to levels matched by few others, pride starts congratulating once more, and must be put down repeatedly, although one already knows it for being stupid. Rather than give up, though, pride then pretends it has been defeated, congratulating one with the victory, particularly considering all one's talent and skill, making it no mean feat to remain humble...

Is there any boy who does not fantasize about being applauded for some grand achievement, picturing himself dealing more or less graciously with a host of devout worshippers and pronouncing judgment on the ones he dislikes, and banning unsavorable food forced upon him by tyrannical parents while he is at it? —Fantasies about becoming 'leader of the pack' who all the others follow. Whenever ambition is accomplished, there is a strong impulse to celebrate in just the manner suggested by pride, and thus fantasies are fed new fuel for perceiving their validation in reality, eager for the assurance that it is not base instinct but high virtue.[5]

In exploration of truth, pride has no place. The exploration is accomplished by opening one's mind, enabling it to *receive* truth. One finds truth; one does not create it.[6] The extent to which one considers it one's own accomplishment, is the extent to which one's mind is closed. Although truths are found within, one does not *posess* truth; the connection is *latently* there, and through it all truth's infinity, but it can only be received as a gift; any

[5]With not a few fulfilling *their* ambition by milking this craving.

[6]Might one be forgiven for suggesting a rather thorough revision of names in physics? Formally speaking it is perfectly true that the name does not matter; what is important is what the name indicates, so why not choose names for laws, fundamental principles and natural constants after those who discovered them? Initially, there is some sort of prudence in this, while the validity of the discovery is still on trial, because then one may more readily dissociate oneself from it if it turns out false. When the name of the discoverer continues to be attached to what was discovered, it is in honor of that discoverer, which convention is appealing to pride (compounded by the habit of expression that physical phenomena *obey* this or that law, almost elevating the discoverer to arbiter). Indeed, were one to compile a list of physical laws, principles and constants, one would get, essentially, a memorial to outstanding physicists, with only here and there a word to give a hint of physical significance, and that is the problem; the human mind has difficulties learning and remembering arbitrary names, and keeping straight which denotes what. The hint, the short descriptive, is far preferable when learning the field, partly because one gets some idea of whether something is relevant to one's current angle of approach, but mostly because it makes it easier to remember and apply the law or constant or principle correctly. One may still get things messed up in memory to *some* extent, but not in the arbitrary way of mixing up two names. Once all the names are learned, the problem no longer exists; rather, it becomes a burden to learn new (descriptive) names, but for the accessibility of physics to new generations of students, perhaps the inconvenience of switching to names carefully chosen through much close scrutiny and contemplation may be endured. After all, the naming process itself can be quite an inspiring one.

illusion of taking is but a picking among what one already has. Oneness with the journey requires absence of ego. Awed gratitude for the blessing of experienced truths is the most humble expression of self-reflection, insofar one resists turning it into pride in one's *ability* to experience truth.

Never in the youthful fantasies does one consider pride to be absent from accomplishment, but if these fantasies include gaining a measure of wisdom, then none of them can be realized as they are fantasized, because growth of wisdom and truths experienced become defining for one's perspectives, ever evolving from previous states as long as one keeps up the exploration. The desire for celebration, grand parades and general admiration fades as one becomes increasingly devoted to truth exploration, for which all the previously desired honors would only be in the way as disturbances and distractions, with the danger of ensnaring one's attention so completely that 'reality' appears as the awakening from a mysterious dream that one can no longer revive because of attention's new ties to reality through perceived obligations which one must keep busy to fulfill. Confronted with expectant regard, one may, out of kindness, wish to respond amiably, rather than reject and ignore expectations, and so one accepts the mantle of authority, implicitly perpetuating the belief that regarding authority is a virtue superior to individual responsibility.

Beware pride's temptation; pride is a most unfailing herald of untruth. To explain: One may consider imagination ever truthful, if one remembers to put revelations into the context in which they were perceived. In the same manner, one may always be truthful by adding explicit subjectivity to one's statements, which then become renderings of one's impressions and current beliefs. To avoid such repeated explicitation, one may consider subjectivity implicitly *understood*. However, as people generally omit subjectivity in formulation as well as intent, so imagination's discoveries are often taken out of context, or (mis)applied in a different context. In this manner the professed truth is of one's personal creation, rather than revelation humbly perceived, and so it is that the person, perceiving one's own authority, becomes prideful. Pride, then, heralds one's own misinterpretation.[7]

One may indeed have fallen victim to pride, proposing that temporal relativity is erroneous, despite having been held to be true by physicists in

[7]There is a very close alternate perspective on this, which considers recognizable ideas to be only approximate carriers of the connection that was revealed, just like words are but approximate carriers of intent, entailing that a revelation must express itself in one's own 'vocabulary' of ideas, thus *requiring* interpretation to find out the true meaning. The distinction is fine and fragile, considering that cognition is quick to substitute impressions with approximate ideas already known, so the revelation loses granularity and becomes distorted already while memorizing, and much more so in the formulation process; that is, the distinction claims that the revelation was more truthful before cognition was done. One then requires another revelation, or a renewal of the revelation, in order to clear it up by fine-tuning the ideas with which it is memorized. Whether or not the distinction is true, although an interesting question, is not relevant here, because as long as one is expressing oneself in terms of *attempts* at meaningful interpretation, then pride is not present.

general for a long time. Thus, one must show, as far as one is able, that it is not pride speaking, but first, to illustrate how pride can be very persuasive in its reasoning, one will confess a little story, which is quite analogous to Einstein's reasoning (in the quote heading the subsection 'Abandoning absolute time') about philosophers doing philosophy being all well and good, as long as theoretical physics have no reason to question ideas considered fundamental in philosophy. Here goes: One had a tooth operation in which the broken root of a tooth was removed; some time after the operation, though, there was a sensation of something sharp pricking from the inside, as if a splinter had been missed, and was now making a nuisance of itself. The dentist, however, scoffed at the suggestion that he should have overlooked a splinter, insisting that everything was quite as it should be, and after worrying at the 'splinter location' for some time, one could, indeed, no longer distinguish the pricking sensation. Yet the sensation returned on and off, in a small but annoying way, and one even felt the splinter pricking on the other side as well when worrying it, so one became increasingly convinced that the dentist had been defensive due to wounded pride over the suggestion of his operation's imperfection, and one was even on the verge of removing it oneself (one 'knows best and feels more surely where the shoe pinches'), using a sterilized needle to poke a hole, but then risk of infection and inferiority of tools made one confront the dentist instead. As it turned out, there was some scarring tissue making small knots, one of which pinched, without there being anything behind to cause the pricking. The sensation that there was some pricking by the splinter on the other side when worrying it *may* have been due to the edge of the rootless tooth 'scraping' on the other side as the tooth was rocked, yet it may also have been an entirely psychologically induced confirmation of one's conviction, as one has not been able to reproduce the sensation after being finally convinced of one's error. One is *by no means* immune to erroneous convictions. On the contrary, in one's primary field, one adjusts erroneous convictions (theoretical flaws) quite frequently, and calls this evolution of science. In the case of dental matters, one is able to maintain a quite simple erroneous conviction for a long time, because one has little insight into dental matters with which to challenge the conviction.

Whereas Einstein entered philosophy with the intent of *changing* something in that field, namely the concept of time, one entered physics with the intent of *understanding* temporal relativity. One's primary field is cognitive dynamics, and one's angle of approach that event indications are temporally comparable. One was sufficiently acquainted with Relativity Theory to know that temporal relativity would have some definite role in this regard, the extent of which it was consequently necessary to understand. One was not at all reluctant, having long ago abandoned cutting of corners in studies of fundamental cognitive principles, and as temporal relativity, in the manner explained, would be relevant for spatio-temporal comparability of information, one had to learn about it. One *failed* to grasp temporal relativity. Although there was some obscurity in the derivation (the train-and-embankment thought experiment), it was not initially a reason to attack temporal relativity, because a more clear derivation might be found elsewhere, and the wide regard of Relativity Theory forbade amateur criticism (although Einstein and other great physicists have stipulated that the ideas of physics are not particularly inaccessible, only the ways of calculation based upon those ideas may require advanced studies). Thus, one was defeated in the first round by failure to understand it. One then dug deeper into physics to refresh and expand one's understanding of physical phenomena, and it was then, in a gradual way, that lack of explanation of critical points, lack of alternative derivations (of temporal relativity) for comparison, and one's deepening definition of the problematic points, lead to the emerging alternative theory of gravitation space as non-homogenous medium of radiation propagation that seemed everywhere a viable alternative, when adjusted for flawed interpretations and mistaken assumptions along the way.

Might one be straying from truth in feeling satisfied that temporal relativity is at best a trick of calculation, making some sense only when the local gravitational field is the basic frame of reference, with time dilation and length contraction to compensate for the notion of homogenous, mediumless space—twice an abstract 'bending out of whack,' so to speak, to accomodate 'straight space' for radiation isotropy regardless of inertial frame, when it appears non-homogeneity of space (medium density) is sufficient variance? In case one is enlightened to the contrary, one should admit to the foolishness in composing the present treatment without discovering the deeper truth, but far more importantly, one would rejoice in the enlightenment, as that would most definitely expand one's horizons. Yet one is satisfied that said relativity does not modify the idea of time, so comparison of time lines—spatial and/or temporal cooccurrence and/or difference—is quite possible to the extent one is *able to translate* between indications, which is enough as regards fundamental cognitive principles.

## Cooperation vs. Competition

*Everything that is really great and inspiring*
*is created by the individual who can labor in freedom.*

**—Albert Einstein, 1938**

Pride, and in turn expedience, is the cause of the communication gap between the ambitious and the truth explorers; to the former, pride is time's carrot keeping them busy with progress, never minding truth or untruth, only accomplishment; in such eyes 'aimless' truth exploration is a waste of time, and by their authority they recommend going more directly for results, and by their power of influence they add to the expedience of cutting corners. To truth explorers, on the other hand, pride is a mental blindfold. Thus, ambition's whip and call for results obstructs human evolution. Only with patience can truth be explored, and only with exploration of truth is human potential increased, and human evolution depends upon human potential. Praying for riddance of extraneous tests and influences is not a desire for easiness and relaxation; all evolution of consciousness in truth is fraught with peril, not only pride's temptation to blindness and expedience's temptation to cut short one journey to get on with the next; for the opening mind cannot hide from itself, nor from its heritage, and so it must struggle with guilt and forgiveness, personal and inherited, and find harmonious resolution without blocking, as integral part of being a truth explorer.[8]

Competition is imposed by extraneous influences, making shortcuts expedient as means to leap ahead of the others, often leading to the least stable foundation for further development being selected as winner, besides making it strategic to withhold insights from one another, effectively turning truth explorers against each other. Cooperation is the fruitful way; it suspends the temporal whip, and restores sharing to the virtue that it is. Sharing truth, everyone ends up with more than they had.[9] Those blessed to be (or have been) part of a group, community or network, in which there is cooperation withholding nothing, know the miracle of sharing as something natural and self-evident, whereas competitors and schemers scoff at the notion, and so they are unable to get past the conviction that giving away means less for themselves, when it is really a property of the attitude that it generates its own fulfillment, as it is then *reluctance to give* that is shared and growing. Where *positive* sharing is not common practice, a leap of faith is required to make it so. It will not do to test the waters cautiously with one toe, withholding any real giving, at least until the principle has proven itself, in order to avoid or minimize risk of loss in the experiment; one must leap all the way, or never get to swimming.

[8]These struggles are, of course, not undertaken only by truth explorers, but by the conscientious in general. However, while blocking always generates distortions to perception accumulating in the long run, it is more debilitating the more one's work depends on clarity of perception rather than routine, to find and navigate new patterns rather than honing fluency in known ones.

[9]Einstein discovered the principle behind lasers, which principle is an excellent illustration of the benefit of cooperation. Radiation of certain wavelengths in certain contexts of matter will correspond to the energy difference between two (or more) relatively stable energy levels, which, as has been described, enables absorption. The rate of emission and absorption is greatly increased when radiation of the right wavelength(s) is already present. With a bit of anthropomorphization, one might say that emission occurs much less reluctantly, as there is plenty of other photons to absorb. The result is that photons of the wavelength(s) already present will tend to be released in the material context, synchronizing and sharing the free radiation flow—naturally, this state only works as long as the free flow is present; it will cease if the flow is drained externally. The anthropomorphization of vanishing reluctance is quite general; people are far more likely to do something when others are already doing it. It requires daring to go first. When everyone else is going, it requires daring *not* to go.