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Correspondence, conference threads and debate

Fact and Fiction in Electrodynamics

In 1960 the consensus of opinion was that there existed four fundamental forces of nature. They were (1) the force of gravitation, (2) the electromagnetic force, (3) the weak nuclear force, and (4) the strong nuclear force. Each of these forces was unrelated to the others. By 1990 the list had been shortened to three forces. As jargon has it, the weak nuclear force was unified with the electromagnetic force to constitute the "electroweak" force. In other words, the weak nuclear force was really an electromagnetic force. Which of the force laws governed it? Was it Coulomb's, or Ampère's, or Grassmann's, or Lorentz's law?

At times it has been argued that Maxwell unified electric and magnetic forces. There is no Maxwell's force law. In fact Maxwell (Maxwell 1873) felt uncertain which of the electrodynamics laws was valid: Ampère's or Grassmann's? The claim that field theory unified electric with magnetic forces is simply fiction.

Lorentz combined the electric Coulomb force with the magnetic Grassmann force in the Lorentz force formula, long after Maxwell's death. Lorentz's was a force combination and not a unification of forces. The original electric and magnetic force laws were modeled on Newton's simultaneous far-action law of gravitation. What Lorentz did achieve was to change this and base both forces squarely on field-contact action in the Maxwell ether. The ether was attached to matter and capable of sustaining mechanical stress. In this way attraction between distant bodies was replaced by ether tension, and repulsion became ether compression.

The Maxwell ether was swept away by Einstein's revelation (Einstein 1923) that it could not deal adequately with the phenomenon of electromagnetic induction. How could field-contact action be explained without the ether? Einstein insisted on retaining local actions rather than return to what he called "spooky" action at a distance. At this point, most physics writers fell back on the field-of-force concept which was developed as part of the action at a distance theories. The force field was merely a calculating aid for simultaneous far-action phenomena. It could not replace the Maxwell ether.

In order to retain Einstein's local actions, another "subtle" medium had to be invented. This became the medium of "free energy". How could this give rise to mechanical pressure? Relativity theory provided the following answer. Traveling free energy has mass. When the energy is stationary it does not posses this mass—otherwise it would fall to the ground! Special relativity claims that free energy always travels with the velocity of light. When flying energy is stopped by metal, it transfers its momentum to the metal. The transfer of energy-momentum generates a force, and this is the field-contact force. Current elements are said to emit traveling energy by the Poynting vector mechanism. Their interaction can be ascribed to field-energy momentum transfer. But stationary charges do not emit energy. They should then still be subject to Coulomb's far-action law. Particle physicists were not satisfied with this return to Newtonian distant action. As a remedy they invented quantum field theory and quantum electrodynamics. In quantum electrodynamics (Feynman 1985), two electrons are supposed to emit continuously, and spontaneously, a stream of photons. The photon momenta are later absorbed by the same electrons and so cause field-contact forces. It is said the Coulomb force between the repelling electrons is mediated by the momentum exchange of photons.

Does field-energy momentum transfer really take place? A test case is the star-wars weapon known as the railgun (Graneau 1987). In one of the most powerful railgun shots, a mass of 0.317 kg was accelerated to a velocity of 4200 m s^{-1}. For momentum conservation by local field action, an electromagnetic mass of 4.44 mg should have struck the projectile at the velocity of light. Einstein's law ($E = mc^2$) then requires the involvement of a total energy of 3.99×10^{11} J. But the energy supplied to the gun was only 3.99×10^{6} J. The huge discrepancy between the two energy figures easily disproves the field contact action hypothesis.

Furthermore, the recoil force should have been the force acting on the field and decelerating incoming energy-mass. The gun itself should have felt no recoil force! Experiment proved the opposite (Graneau 1987). It demonstrated the recoil action in the rails, as predicted by Ampère's far-action law.

If that is not enough trouble for field theory, another experimental railgun fact (Graneau *et al.* 1990) revealed a failure of Faraday's law of induction, as embedded in Maxwell's equations.

Ampère's force law predicts that co-linear metallic current elements repel each other. Field theory and the Lorentz force law deny this repulsion. At least fifteen experiments have been published in the past 170 years which confirm the existence of longitudinal Ampère repulsion forces (Graneau 1985). One of the most decisive of them concerns wire explosions. According to Ampère, the current in a wire sets up ension. When the current rises into the kilo-Ampère range, his tension becomes strong enough to break the wire into nany pieces. The fragmentation process can only be observed vith very short current pulses, because long pulses melt and evaporate the metal. Solid-state wire fragmentation was dis-overed in 1960 by Nasilowski (1964). With metallurgical neans he proved conclusively that each break was caused by ension, for which there is no explanation in field theory.

When exploding wires with electric current pulses, a large amount of energy is concentrated in a small volume of matter. This persuaded some physicists in Germany to look for nuclear fusion in wire explosions. Eventually they achieved success with deuterium containing liquid filaments in capil-lary channels (Lochte-Holtgreven 1976). In capillary fusion, as it is now called, deuterium nuclei are accelerated toward each other by longitudinal Ampère forces (Graneau & Graneau 1992). The same acceleration process appears to be responsi-ble for fusion reactions in plasma-focus and dense z-pinch experiments performed during the last thirty years.

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The Dichotomy of c

In physics, the designation "c" is universally understood to represent the speed of light, at 3×10^{10} cm s^{-1} in vacuum. There are several corollaries to this which are not universally accepted.

1. The speed c is the maximum physically attainable speed.
2. In empty space, c is the only speed of photons of light, regardless of their wavelength.
3. In empty space, c is the speed of the gravitational effect.
4. The speed c is measured with respect to any receiving object (*i.e.* mass) regardless of its state of motion.
5. Furthermore, c is also measured with respect to the emitting object (mass), regardless of its state of motion.

Corollaries (4) and (5), taken together, represent a dichotomy which merits geometric scrutiny.

Consider a rest-mass, such as a Planck mass, having the Planck length of 10^{-33} cm (Misner *et al.* 1973, Penrose 1989), and considered by many to be the minimum possible unit of space. Such a mass (at rest) is both a receiver and emitter of gravitons, traveling through space at speed $v=c$ in all possible directions, even through the Planck length(Arp 1989, Broberg 1987, 1991, Kropotkin 1991). The effective total mass of gravitons in transit along any one line through the Planck length constitutes the Planck mass (see Figure 1).

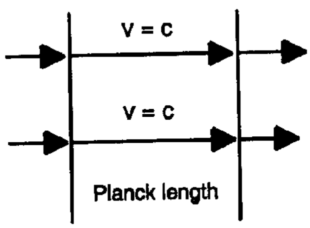

Figure 1—*Planck length at rest*

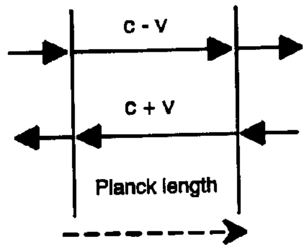

Figure 2—*Planck mass in motion*

If the Planck length translates to the right at speed v, as depicted in Figure 2, the effective total mass of gravitons in transit from the past direction is increased by the time factor $c/(c-v)$, while the effective total mass of gravitons in transit from the future direction is decreased by the time factor $c/(c-v)$.

The effective total mass of gravitons from the past and gravitons from the future is thus increased by the composite time factor

$$\sqrt{\frac{c}{c-v}\cdot\frac{c}{c+v}}$$

similar to Phipps's "frame-time speed" (Phipps 1986). Thus the velocity dependent mass becomes

$$m_v = m_o\sqrt{\frac{c}{c-v}\cdot\frac{c}{c+v}}$$

But this equation is algebraically equivalent to Einstein's well-known equation for the increase in mass with velocity.

$$m_v = \frac{m_o}{\sqrt{1-v^2/c^2}}$$

However, there is a significant geometrical difference. The new form of the equation represents a direct geometric view of how gravitons can constitute mass—either rest-mass or velocity-dependent mass.

The above equations are strictly valid only for translation along an absolutely straight line. Yet the absolutely straight line does not exist in nature. Nature knows only curves, great and small, from the orbits of planets to the orbits of electrons in atoms, to the great orbits of the gravitons.

From the above, we may hypothesize that gravitation between massive objects is due to the time-lag of gravitons passing through the mass. The time lag is just the ratio of the Planck time to the Planck mass, or G/c^3, where G is Newton's constant of gravitation. The time lag is then just 2.477×10^{-39} s g^{-1}.

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Light velocity and redshift

A recent suggestion by Huber (1992) that the velocity of light changes with time is interesting. As noted by him, this is a speculative idea; unfortunately, standard journals do not publish such ideas. For this reason, my work on an alternative cosmological model has appeared in obscure publications. I wish to point out that decreasing velocity of light with the age of the universe was discussed more than a decade ago (Tiwari 1980), and its implication for quasar redshifts was also suggested (Tiwari 1985). Using elementary mathematics some interesting consequences of the space-time interaction hypothesis have been obtained in these papers; a brief account is given in Tiwari (1988) also. The main results are as follows: (*i*) the time is the cause of the creation of the manifest universe from the source space; (*ii*) the initial dimension of the universe is of the order of 10^8 cm; *i.e.* there is no singularity; (*iii*) the Planck length is created at the present age of the universe; (*iv*) the radial expansion rate determines the velocity of light and decreases with the age of the universe; (*v*) gravitation is an apparent attractive force caused by the natural tendency of energy (matter) to attain homogeneity; and (*vi*) quasars are the boundary regions of the universe with large redshifts due to a decrease in the velocity of light. Since discrete time interval and integral values of spatial dimensions characterize this model, intuitively I expect a possible non quantum-mechanical explanation of the recently observed redshift quantization based on this model. A definite calculation in this respect will be presented in the future.

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From the Publisher's notebook

Dr. Tiwari's remarks concerning speculative ideas in cosmology, and his own contribution to speculation, are illustrative of the confusion reigning in the minds of many students of cosmology, and warrant a brief commentary.

Dissatisfied with the Big Bang's inability to answer such fundamental questions as "What was the state before the universe was created?" and "Where does the universe expand?" (Tiwari 1980), Dr. Tiwari has sought an alternative cosmology. Yet his alternative, which relies on a subtle reinterpretation of the concepts of space and time, represents little more than a variant of the Big Bang. He proposes that the universe originated from a 10^{-8} cm diameter continuum of "Superspace" populated by a perfectly homogeneous, undifferentiated "fundamental energy" (the nature of which is not—by definition, cannot be—illucidated), rather than from a hot, infinitely dense primordial singularity. The trigger of the expansion process is furnished by a "space-time interaction", which occurs when time, "something which operates upon the state Superspace", spontaneously converts the "fundamental energy" into known forms of energy, this spontaneous event marking the creation of the universe. Only when this "space-time interaction" has primed the cosmic pump can we speak of actual measurements of profane space and time.

Thus, for Dr. Tiwari, the question of what came before the Big Bang is answered by invoking special, unsupported and unprovable—hence, unphysical—concepts. Not so long ago, Hoyle (1975) wrote of the metaphysical foundations of the Big Bang:

> *...The physical laws are therefore considered to break down at $\tau = 0$, and to do so inherently. To many people this thought process seems highly satisfactory because a "something" outside physics can then be introduced at $\tau = 0$. By a semantic maneuver, the word "something" is then replaced by "god"...*

While the older breed of cosmologists were generally content to accept the theological interpretation described by Hoyle, in one or another quasi-secular form, of the creation of the universe (Hawking's flirtations with "the mind of God" may be seen as the final gasp of this fashion, which has become somewhat of an embarassment to some), the younger generations of "quantum" cosmologists appeal to a more prosaic fluctuation of "quantum space-time foam" to jolt the universe out of its primordial slumber. Tiwari's solution introduces a novel twist into the latter fable; yet, for all its ingeniousness, the assertion that time, transmogrified by Dr. Tiwari into a mathematical operator, should be invested with the miraculous properties enumerated above (*viz.* the ability to bring the universe into existence by spontaneously creating "activity"), remains just as fictitious as the space-time foam hypothesis of quantum mechanics and the absurd "space-time continuum" and "primordial singularity" of general relativistic persuasion.

It is important to identify the roots of the alchemic nonsense that has passed for physics much of this century, and of which Dr. Tiwari's scheme only the latest variant. Surely the greater part of the blame must be placed at the feet of Einsteinian relativity, which, by subverting the grammar of physics, has rendered scientific discourse unintelligible and largely meaningless. In the language of relativity, the precise, conceptually very distinct older notions of "eternity", "duration" and "instant" are reduced to a chameleon-like, plastic "time", an amalgam possessing qualities borrowed *ad libitum* from elements of the original Newtonian triptych (analogous outrages are committed against the concept of space); space is then miraculously dissolved into time, and vice versa, while this metaphysical hybrid is surreptitiously endowed with properties from the material vacuum, the ether.

Once relativity had accomplished its mission of dethroning Newtonian absolute time and "abolishing" the ether, it was a simple matter to suppose that the universe began at some point, a supposition which led the monstrous conclusion that space and time, now treated as finite quantities, might have an "origin". This byzantine logic eventually prevailed over the protests of calmer heads (Hubble never acquiesced in the velocity interpretation of redshifts), even those who worked within the framework of general relativity. Hubble's collaborator, Richard Tolman, issued this warning:

> *... I think we have to begin by putting the phrase "age of the universe" in quotation marks, since I see at present no evidence against the assumption that the material universe has always existed. For me all that such a phrase could mean is the estimated time back to some important large-scale event, for which we have evidence...*

Diametrically opposed to the viewpoint of creation *ex nihilo*, or of a universe that leaps into being out of a mathematical test-tube labelled (in Dr. Tiwari's laboratory) "Superspace", is a materialist tradition in science and philosophy that traces its origins to the Greek Presocratic philosophers and Anaximander of Miletus, for whom all things came from and returned to the apeiron (the infinite) in an eternal cycle (Kirk & Raven 1973). One of the most illustrious proponents of this tradition was Friedrich Engels, who, in a well-known polemic, ridiculed the idea that motion may be injected from outside into an initially immobile, unchanging nature. Engels, we may note in passing, anticipated the central role of the redshift phenomenon for the development of physics:

> *... in some way, which it will later be the task of scientific research to demonstrate, it must be possible for the heat radiated into space to be transformed into another form of motion in which it can once more be stored up and become active."* (*Dialectics of Nature*)

The question posed by Engels was answered in the early years of this century, at least qualitatively, by William MacMillan, who proposed

> *...that radiant energy can and does disappear into the fine structure of space, and that sooner or later this energy reappears as the internal energy of an atom.... Indeed, with an infinite sequence of physical units, no smallest one and no largest one, each an organized system of smaller units, and none eternal, one can hardly escape the hypothesis that energy runs up and down the entire sequence, and that on the whole as much energy is ascending as is descending.*

MacMillan then sketched a framework for an understanding of the cosmological redshift in an infinite, static universe:

> *The rate at which radiant energy is being absorbed in space, and consequently the rate at which atoms are being formed, must be very small relative to the standards of the physical laboratory.... Assuming the rate of loss of energy to be proportional to the distance travelled, we find that the radiant energy decreases according to an exponential law, and since the reliable distances are certainly very great the rate of loss must, with equal certainty, be very low.*

In this century, the torch has been carried forward by a small group of researchers. Among the more celebrated of these scientists are Nobel laureates Louis de Broglie and Hannes Alfvén. It is appropriate to close with a lengthy quote from an essay by the latter (Alfvén 1977); Alfvén's words should serve as a beacon to all those who seek a scientific approach to cosmology:

> *The Big-Bang conjecture is a myth.... But nothing is gained if we try to place another myth in the place which the Big-Bang myth occupies now, not even if this new myth is adorned with still more beautiful mathematical formulas.*
>
> *The scientific approach to cosmology is necessarily drastically different from the mythological approach. First of all, it must be absolutely clear that if a scientist makes a guess about the state of the Universe some billion years ago, the chance that this guess is realistic is negligible. If he takes this guess as the starting point for a theory, this is unlikely to be a scientific theory but very likely will be a myth. The reason why so many attempts have been made to conjecture what the state was several billion years ago is probably the general belief that long ago the state of the Universe must have been simpler, much more regular than today, indeed so simple that it could be represented by a mathematical model which could be derived from some fundamental principles through very ingenious thinking. Except for some vague and unconvincing reference to the second law of thermodynamics, no reasonable scientific motivation for this belief seems to have been given. This belief probably emanates from the old myths of creation. God established a perfect order and "harmony" and it should be possible to discover which principles He followed when He did so. He was certainly intelligent enough to understand the general theory of relativity, and if He did, why shouldn't he create the Universe according to its wonderful principles...*
>
> *To try to write a grand cosmic drama leads necessarily to myth. To try to let knowledge substitute for ignorance in increasingly larger regions of space and time is science.*

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