A continuum theory (CT) of physical nature: towards a new 'ground floor' for physics and astronomy, including gravitation and cosmogony, with major tangible support

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Abstract

The theory of Relativity was, in effect, based upon throwing out one of the elements of the then-existing physical theory 'basement', namely the existence of an elastic aether, the need for which had been uniquely secured by Maxwell's equations for the transmission of transverse electromagnetic waves (TEM-waves). By so doing, transmission effects were axiomatically excluded, which was seen as desirable. We explore the implementation of Maxwell's aether in the form of a massless superfluid continuum of (negative) electric charge and adduce four kinds of evidence that it is in random motion, with corresponding, widely observed transmission effects upon TEM-waves, one of which is a redshift proportional to path length. To characterize and quantify that random motion it is proposed that fundamental particles are 'made of aether' in the form of rotational configurations within it. This yields a continuum theory (CT) of physical nature in which the Universe is devoid of singularities, in stark contrast to the current wholly particulate physical paradigm. The resulting 'particle-tied' character of the aether motion gives it, and the resulting TEM-wave effects, a dependence upon the temperature and density of the propagating medium. The particle-tied character is hugely reinforced when the particle bears a charge.

A systematic examination of the various kinds of observation forming the supposedly unique support for Relativity suggests that they are undeserving of that destinction in the new context. In particular, the 'relativistic mass increase' thought to be observed in particle accelerators appears to have been an over-eager assignment to the Relativity prediction, overlooking that the pushing mechanism employed - the communication of two electromagnetic fields - has a c-limited terminal velocity and pushing efficiency.

This recognition enables the mass property of any particle to be regarded as a stable quantity upon which to design the provision of that property, with an outcome that offers exciting new insight into the nature of the process of gravitational interaction. In respect of the charge property, to make electrons and positrons (for example) 'out of aether', one of them incorporates more, and the other less, aether, so such pairs are easy to make, as observed, and the mean aether density must exceed 3 x 10^{29} coulombs/cm^3, this being the (excess or defect) density in their cores, based on their LEP-determined 'sizes'. To equip particles with the mass property their rotational aether motion is deemed to have a vortical aether-pumping property which makes them 'suck' themselves towards one another. On the smallest scale, partial closure of the aether-pumping circuit (e.g. 3 quarks) may be the source of the strong nuclear force and of the reduction of mass (less external aether flow) when particles fuse. On a macro scale the result is a reduction of aether charge density within the body; this is a (positive inwards) radial electric field, here called the gravity-electric (G-E) field, which consequently is predicted to co-exist with all gravitational fields, thereby rendering Newtonian gravitation an incomplete description of gravitational action, another difference being that the communication, now seen as electromagnetic in character, is retarded.

Evidence of such electric fields is ubiquitous, both as a repulsion upon ionic plasma - Earth's ionosphere, solar wind, stellar winds and perhaps even galactic winds - as a substitute or supplement for radiation pressure and also for the acceleration of cosmic rays, attaining 5 GeV from the Sun and their ~10^{20} eV maximum from the G-E fields of neutron stars. In a new scenario for forming the solar planetary system the G-E field played a major dynamical role in several respects. This scenario sees the protoplanetary disc material and an outer layer for the Sun as a secondary acquisition by quasi-polar infall, some time after the protoSun had been formed in a previous dust cloud, the new disc flow being driven outwards by the solar G-E field, assisted by magnetic coupling. Protoplanetary nucleations near the Sun (where this coupling ensured the prograde vorticity preserved in their rotations) were pushed outward successively by the field-driven plasma. This process increased the angular momentum of the planetary material without drawing any a.m. from the Sun, offering a quantitative solution of the well-known problem that its mean specific a.m. is ~137,500-fold greater than that in the Sun. In the new scenario, the temporary dust-jacket around the Sun would have shielded the forming protoplanetary nuclei from solar radiation, explaining how some gas-giant exoplanets occur very close to their star.

In stellar evolution the G-E field is a major additional overburden-support mechanism, enabling fusional evolution to proceed more slowly and perhaps explaining the solar neutrino deficiency. In CT, TEM-waves cannot exhibit the mass property but the gravitational deflection of light, or microlensing, is qualitatively attributable to refraction by the radial aether charge density gradient that is the G-E field which, in turn, is proportional to the gravitational potential. The solar redshift, with its steep dependence upon path length in the solar atmosphere, even for near-vertical paths, is not a gravitational effect but a transmission one, as originally suggested by Freundlich.

Overall, the CT model for the Universe which emerges has an inherent cosmogonical/creative property and originated as an infinite, mass-devoid randomly moving aether an undefinable time ago. The energy of that motion was the resource from which all mass has progressively been formed, zero-point energy and the CMB being probable manifestations but tenuous measures of its current level. There was no Big-Bang and the Universe is not expanding. The various demands for CDM are removed or much diminished. Quasi-axial infall of cosmogonically young material is a major factor in the build-up and morphological evolution of galaxies, especially that of barred galaxies which constitute an important step on the route to the triaxial elliptical end-product. A new quasar model based on velocity-dependent inertia has superluminal circulations able to generate intrinsic redshifts up to at least $z = 5$ and cause the Lyman α forest of absorption lines. Its intense accretionary and squashing power may offer light element nucleosynthesis and, at high masses, mass annihilation, with a possible GRB outcome, black holes being inconsistent with the finite size of mass-bearing particles in CT.

In brief, the recognition of Maxwell's aether in the form of a high-charge-density continuum that is in particle-related random motion has wide observational support at all scales. The velocity $\boldsymbol{c}$ of TEM-wave propagation by it is not immutable but depends on its physical parameters. These two results render Relativity Theory inappropriate. Development of the centuries-old speculation that material particles are 'made out of aether' offers insight into the internal dynamics of mass-bearing particles and thence to a major

Contents

break-through in studying the gravitational process, which has very tangible support in the dynamics that formed our planetary system.

1. Introduction.

Current physical theory recognizes a total dichotomy in nature, namely particulate matter (including photons) and the space between. To most physicists the question of whether the latter is occupied by some sort of aether (this spelling is preferred on priority grounds) or whether for most purposes it may be regarded satisfactorily as totally void must seem somewhat esoteric because it is thought of as being a wholly inert conveyor of electromagnetic, and perhaps gravitational, communication, and therefore as not having much effect upon results. Indeed Einstein concluded his 1920 University of Leyden address, entitled "Aether and the theory of relativity", with the words 'The idea of motion may not be applied to it.' (*Aether und relativitätstheorie*, Springer, Berlin, 1920). From this it appears that he specifically excluded the displacements that would be imposed upon it by the transmission of transverse electromagnetic (TEM) waves conforming to Maxwell's equations, the conclusion being that such transmission occurs without the agency of 'his' aether.

My work on CT began in 1959 with my wholly serendipitous discovery of **an aether-based theoretical interpretation** of an otherwise puzzling but well-observed high-flight-altitude (5-10km) daylight sky feature encountered in the design of an airborne astro-navigation system**.** This interpretation saw the aether as directly responsible for TEM-wave transmission and to be in 'particle-tied' random motion, and resulted in my first document[1] on the present topic, circulated to F. Hoyle, W.H. McCrea, H.Bondi and E. Finlay-Freundlich at that time.

The theory which has emerged is truly a continuum theory of the Universe, in that everything in it, both particulate matter and the spaces between, are regarded as 'made of aether', the difference being that the former are seen as locations of highly specific configurations of aether mainly-rotational motion, of which only the stable forms survive for long. Of necessity such particles have finite size and their boundaries merge with the surrounding aether. The Universe is therefore devoid of singularities of any kind. This viewpoint removes the need for the 'charge renormalization' procedure which has caused so much anguish. But it is the complete antithesis of the current paradigm, wherein everything is treated as a singularity, even TEM-waves, all inhabiting a 'perfect vacuum' (strangely managing to possess finite physical properties[2] and a high degree of random energy), and has implications, not least, for black holes and for the Big-Bang, in both of which mass or its corresponding energy is currently regarded as compressible without limit.

My aether-based interpretation, mentioned above, concluded that the sky sunlight was being transmitted by an aether in random motion. By recognizing that such motion, some measure of which might be primordial, must necessarily generate associated rotational motions, some of which might turn out to be of a stable character, CT is seen to have cosmogonical potential whereby the entire material Universe may have come, and still be coming, into being. In that case the origin of the Universe lies in a randomly moving aether continuum of charge whose motional energy content was the resource from which all that lies within it has been 'created'. Moreover, the concept of ongoing cosmogony[3] has the philosophically immensely satisfying result that the creation process is potentially observable today and must conform to the 'laws' of physics to which everything else conforms. This is in stark contrast to the Big-Bang philosophy, in which a whole new set of 'laws', and changing ones at that, has had to be conceived as applicable to first 10^{-30} second, or whatever, but not for long thereafter. The vigour with which ultra-fine features of the cosmic microwave background (CMB) have been seized upon as potential controls upon such theorizing is a recognition of the delicacy of this problem. On the other hand, CT appears to offer an alternative but Big-Bangless interpretation of the CMB, using existing 'laws'.

Another branch of the CT road has led to what appears to be the most tangibly significant of its many observable results. This is an insight, for the first time, into the physical mechanism by which particles are individually endowed with the physical attribute of their mass, and hence of the nature of gravitational action-at-a-distance between assemblages of such matter. Never before, it appears, has such a fundamental level of enquiry been attempted in the course of gravitational theory, the starting point hitherto having always been to enquire as to the external effects of that property but not its cause. The new insight springs from a deeper but still very crude perception of the internal nature of particles made possible by recognizing their finite size. The surprising result (also that negative gravitation cannot occur) is that Newton's law of gravitation is an importantly incomplete description of the process, there being generated simultaneously a radial electric field gradient around and throughout every gravitationally retained assemblage. In its most spectacular supporting manifestation, it will be outlined that, without it, the solar planetary system and, by corollary, probably exoplanetary systems also, simply could not have been constructed with its observed dynamical arrangement. Further corollaries of the 'gravity-electric' (G-E) field include a contribution to driving stellar mass-loss, cosmic ray acceleration and galactic winds, a major effect upon stellar evolution rates and a lensing-deflecting mechanism for massless TEM-waves (to substitute the gravitational light deflection of Relativity).

It seems that the difficulties in reaching an accommodation between quantum mechanics and Relativity may have arisen because of rather independent starting-points and aims, lacking a common 'ground floor' able to constrain their primary development. CT is offered here as a potential contender for providing such a 'ground floor', so the purpose of this paper is to assemble, summarize and especially to review the present status of CT and its findings, based on my various conference contributions on CT since 1996[4].

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1 **Osmaston, M.F**. *A medium theory of physical nature: Preliminary synopsis of the proposed paper.* June 1960. 16p Unpublished.

2 In the preface to his monumental work, *History of the theories of aether and electricity: Vol.1. The classical theories* (Thomas Nelson, London, 1951) **E.T. Whittaker** wrote "It seems absurd to retain the name 'vacuum' for an entity so rich in physical properties, and the historical word 'aether' may fitly be retained".

3 The term 'cosmogony' has often been generalized to apply to the formation of the solar system but its use herein will be restricted to mean the process of formation, or creation, of the material contents of the Universe.

4 **Osmaston** (1996a). *Implications and evidence of a particle-tied aether: steps towards a deeper foundation for physics and relativity*. Proc. 5th Intl. Conf. on 'Physical Interpretations of Relativity Theory' (PIRT V), British Society for the Philosophy of Science; Imperial College, London, 6-9 Sept 1996. Late Papers, 182-198.

Osmaston (1996b). *An interim outline of some research under the heading: Some aspects of a continuum theory of physical nature,* (with 3 Appendices) A. *Random transverse velocity (RTV) redshift*. B. *Random transverse velocity (RTV) scattering - deflection scattering.* G. *Random longitudinal velocity (RLV) line broadening and frequency dispersion*. Ibid. Supplementary

2. Basic development

2A. **Maxwell's aether as a perfect fluid continuum of electric charge.**

For more than a century the aether, when considered to exist at all, seems to have been regarded by most physicists as a wholly passive component of physical nature, conceptually needed only for the conveyance of action at a distance. In the afore-mentioned contributions I have considered, physically and quantitatively, a new version of the aether, compatible with that conceived by James Clerk Maxwell (1861-2)[5] in his famous equations, still universally employed as a valid and precise description for the propagation of transverse electromagnetic (TEM) waves. The implementation of Maxwell's aether has faced the difficulty, hitherto, that by identifying light waves as transverse waves it calls for elasticity in shear, a property of solids but not of a fluid clearly demanded by the observed free motion through it of material particles.

In the 1878 edition of Encyclopaedia Brittannica, in what may have been his last published discussion of the aether (he died a year later), cited *in extenso* by Winterberg (2002)[6], Maxwell wrote the following remarks:

> "the magnetic influence on light discovered by Faraday ..... indicates a rotational motion in the medium when magnetized. .... If there is any motion of rotation, it must be a rotation of very small portions of the medium, each about its own axis, so that the medium must be broken up into a number of molecular vortices. ...we conclude that the molecular vortices do not require a continual expenditure of work in order to maintain their motion.... No theory of the consititution of the aether has yet been invented which will account for such a system of molecular vortices being maintained for an indefinite time..."

I was unaware of these remarks until most of this paper had been written. They seem to strike remarkable resonances with much of what follows but it is not clear whether, at this juncture, he regarded his 'molecular vortices' as synonymous with material particles or as distinct entities within or forming the bulk of the aether. The concept of superfluidity as a real physical phenomenon, though admittedly in the context of a particulate medium (which the proposed aether certainly is not), has long been recognized as characterized by an absence of viscosity. Significantly in this context, von Helmholtz (1858)[7] had noted the persistence of vortices in a perfect fluid, while Fitzgerald (1885)[8], in his discussion of the vortex-sponge model of the aether put forward 5 years earlier by W. Thomson (Kelvin), noted that vortices cannot be created or destroyed in a perfect fluid. We return to this point below.

Although the word aether is of Greek origin ($\alpha\iota\theta\eta\rho$) the scientific use of the term for the luminiferous medium really began with René Descartes in the early 17th century. He considered[9] the aether to be infinitesimally particulate, with no spaces between, such that any local motion involved a circular train of adjustments, which he likened to vortices. He regarded it (as does the present author) as 'desirable to imagine a mechanical model of every physical phenomenon' but he and most of his successors for the ensuing >200 years were inclined to regard such vortical motion as giving rise to centrifugal forces, i.e. with our scientific hindsight, that the particles of aether possessed inertial mass. This is a pitfall we must be careful to avoid in a paper committed to investigating the origin of the mass property. It is also scarcely consistent with a view that mass-bearing particles are in some way different from run-of-the-mill aether.

Accordingly, the CT aether identified here is a massless superfluid continuum of negative electric charge whose 'elasticity' for the purpose of Maxwell's equations is provided by the self-repulsion of its charge to restore uniformity and by the energy storage action of the magnetic field that results from any displacement of its charge. That displacement

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Papers. p. 241-256. [continued at foot of next page

Osmaston (1998). *Continuum Theory, further developments: the nature of mass-bearing particles, evident properties of the resulting gravitation, and an outline cosmogony*. Sixth Intl. Conf. on 'Physical Interpretations of Relativity Theory' (PIRT VI), Brit. Soc. for the Philosophy of Science. Imperial College, London, 11-14 Sept 1998. Proceedings, p. 248-250.

Osmaston (2000a). *A particle-tied aether. Indications of a deeper foundation for physics and relativity.* PIRT VII, Brit. Soc. for the Philosophy of. Science., Imperial College, London, 15-18 Sept 2000. Late Papers, p.230-240. M.C. Duffy (ed.), PD Publications, Liverpool, UK. ISBN 1 873 694 059.

Osmaston (2000b). *A new scenario for forming the solar planetary system; dynamics, cores and chemistry.* 13th Annual V.M. Goldschmidt Conference. August 2000, Oxford, UK. *J.Conference Abstracts* **5** (2) 762 (CD ROM).

Osmaston (2002). *Continuum Theory (CT): major implications of the 'particle-tied aether' concept for gravitation, rotational effects and the strong nuclear force.* Physical Interpretations of Relativity Theory VIII, Brit. Soc. Philos. Science. Imperial College 15-18 Sept 2002. Proceedings II. p.355-385. M.C.Duffy (ed.), PD Publications, Liverpool. ISBN 1 873 694 07 S. [N.B. This record contains 13 one-line printing omissions. A corrections list appears on:- [http://osiris.sunderland.ac.uk/webedit/allweb/news/Philosophy_of_Science/PIRT2002/Physical%20Interpretations%20of%20Relativity%20Theory.htm]

Osmaston (2006). *A new scenario for forming the Sun's planetary system (and others?): dynamics, cores and chemistry (pt 2).* 16th Ann. V.M. Goldschmidt Conf., 27 Aug-1 Sept 2006, Melbourne, Australia.(Abstr No 462.00); *Geochim.Cosmochim. Acta*. **70,** 18S, A465 (2006). doi:10.1016/j.gca.2006.06.935

5 **Maxwell, J.C.,** *Phil. Mag.* **xxi**, pp.161, 281, 338 (1861); **xxii**, pp. 12, 85 (1862).

6 **Winterberg, F**., *Maxwell's aether, the Planck aether hypothesis and Sommerfeld's finestructure constant.* Physical Interpretations of Relativity Theory VIII, Brit. Soc. Philos. Science. Imperial College 15-18 Sept 2000. Proceedings II. p. 652-662. M.C.Duffy (ed.), PD Publications, Liverpool. ISBN 1 873 694 07 S. (2002).

7 **von Helmholtz, H.,** *J. für Math.* **lv**, 25 (1858).

8 **Fitzgerald, G.F.,** *Scient. Proc. Roy. Dublin Soc*. **iv**, 407 (1885).

9 **Descartes, R.,** *Principia philosophiae,* Amsterdam (1644).

is a direct implementation of Maxwell's 'dielectric displacement current *in vacuo*', a vehicle for which has hitherto been lacking but is widely regarded as the key element in the success of his equations. Apart from the motion thus involved in the transmission of TEM-waves the aether is seen additionally to be in very small-scale random motion (see 2B below), a possibility not considered by Poincaré, Lorentz or by Einstein, but which causes the waves to experience a variety of propagation effects, invalidating the Relativity axiom that TEM-waves can be regarded as perfect messengers between frames. The nature of these effects is discussed in Section 4 and summarized in Table 1.

2B. Charge density and polarity of the aether continuum.

2B.(i) ***The nature of elementary particles.***

Mass-bearing elementary particles are envisaged as being "made out of aether", their motions thereby endowing the aether with random motion and effectively defining its magnitude (any primordial component being very small in most circumstances but needing to be borne in mind). As noted above, however, motions in superfluids are potentially highly localized because there is no viscous shear stress to provide connection with adjacent fluid. But our aether is a charge continuum, whose displacements are electric currents; so it is suggested that the resulting magnetic fields do the job of motion linkage within the aether. In this way, 'random motion' would otherwise be confined to linear displacements, but can now be seen to involve rotational ones too.

Particles are seen here as mainly-rotational configurations of aether motion. Although conceived independently, this picture bears some similarity to earlier ones. Maxwell[10] seems to have regarded particles as mere modifications of the aether. Larmor[11] regarded electrons as nuclei of aether rotational (static) strain but later, in the face of H.A.Lorentz's insistence[12] on a dichotomy between aether and ordinary matter, came to visualize them as perfect-fluid rotational "nuclei of beknottedness in some way", with an external influence indefinitely co-extensive with that of others[13]. Milner[14] regarded aether as a "fundamental substratum of matter from which we can imagine particles are formed".

The continuity of the aether with particles made from it provides, in effect, a particle-tied aether with the potential, in principle, to satisfy the Michelson-Morley result[15] at the limited precision of that experiment though, as will be shown, this may not adequately solve the problem. For observational reasons given later, the polarity of the aether's charge is seen to be negative, in conventional terms. Given an aether possessing only one type of charge, the problem of providing elementary particles with both positive and negative charge can be resolved if they incorporate lower or higher aether density, respectively, within their configuration, relative to an environmental mean aether density (Fig. 1).

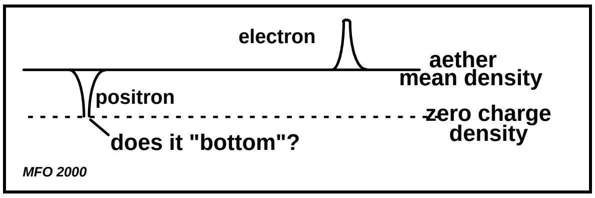

Figure 1. Notional aether (charge) density profiles that would equip otherwise-similar(?) electron and positron aether dynamical configurations with equal and opposite amounts of electric charge (aether). The diagram is drawn for an aether with negative polarity. Less than 'zero aether' is not an option.

This explains (for example) both the ease with which electron-positron and other matter-antimatter pairs are created in high-energy situations and the recoverability of that energy when they collide. On similar conservation grounds it also explains why, in circumstances in which the amount of externally added rotation is minimal or zero (such as when such pairs result from β-decay), their spins are in opposite directions. High-energy particle scattering experiments with the Large Electron-Positron Collider (LEP) at CERN show that electrons and positrons do have finite size, and appear to contain the highest known charge densities, their charge of ± 1.6 x 10^{-19} coulombs being contained within a volume 10^{-16} cm across, and possibly much less[16].

Assuming, conservatively, that this 'size' is spherical, the spatial charge density in them is at least as great as ± 3.1 x 10^{29} coulombs/cm^3, with a higher value than this mean at some point in the cross-section. Now a positron contains the *least* aether, as defined above, so in the limiting case that aether density in its core does not (cannot?) go 'below zero' the **'normal' environmental aether density must be at least 3.1 x 10^{29} coulombs/cm^3 of negative charge**. The aether charge density in the core of an electron, assuming an otherwise similar dynamical structure, is then twice that; this high charge density may give it more stability, which would explain its numerical predominance compared to positrons. Thus the (charge) density of the aether throughout the Universe determines the size of unit charge, the basic building block of atomic structures, which therefore is uniform if the mean charge density of the aether is uniform. This, in principle, offers an explanation of how, as spectra indicate, atoms are similar throughout the Universe. This is especially important in the context of ongoing cosmogony, as favoured here, in which there is no intimate communication between different parts such as is provided at an early stage in the Big-Bang frame.

Note that the very high charge density of the aether does *not* make it near-perfect electrical conductor. That would

10 **Maxwell**, **J.C.,** *Phil. Trans. R. Soc.* **155**, 459-512 (1865) @ p.464; **Maxwell**, **J.C.,** *Treatise on Electricity and Magnetism, 1st edn.* Clarendon, Oxford. 2 vols.(1873).

11 **Larmor**, **J.** *Phil. Trans. R. Soc.* **185**, 810 (1894); **Larmor**, **J.** *Phil. Trans. R. Soc.* **190,** 210 (1897).

12 **Lorentz**, **H.A.** *Archives Néerl.* **25,** 363 (1892). @ p.432 ff.

13 **Larmor**, **J.** *Phil. Mag.* Ser. 6, **7**, 621-625 (1904) @ p.623.

14 **Milner**, **S.R.** *Phil. Trans. R. Soc.* **A253**, 185-226 (1960).

15 **Michelson, A.A. & E.W. Morley,** *Phil. Mag.* **24**, 449 (1887).

16 **G.E. Kalmus**, pers. comms. 1991, 1996. That scattering occurs at all confirms that the effective size is not zero.

require that the charge could easily be displaced, whereas the elasticity demanded of it (above) for the propagation of TEM-waves shows that this is not the case, the self-repulsion of its component charge providing a powerful restoring force for any displacement. We will see later that this force-capability is central to the provision of the huge forces involved in gravitation. This same reasoning also means that 'external' magnetic fields can also be superimposed upon the aether without experiencing the constraint of inducing large electrical currents within it.

To prevent the charge self-repulsion from causing the aether to fly apart requires that it be under considerable restraining pressure. This constraint would be hard to envisage in a Big-Bang context in which the Universe is supposed to be expanding into absolute space (whatever that may mean). In the case of the non-expanding Universe to which CT leads us, the problem is overcome by the Universe being infinite and therefore without an 'escape route'; there is just more of the same. Put in another way, 'pressure' is only meaningful when there is somewhere to contrast it with, as the student of ocean-bottom life well knows.

2B.(ii) ***An irrotational aether.***

An immediate result of its prodigiously high charge density is that, although free to undergo linear relative displacement, the aether must be *virtually* irrotational, except on the particle scale, because of the huge magnetic constraints that rotation would produce. This could be the mechanism whereby direction-sensing systems - Foucault pendulum, gyroscopes and laser ring gyros[17] (which use the Sagnac effect) - relate to a 'fixed stars' (i.e. sidereal) reference frame and not to one that rotates with the Earth. It is stressed that such a reference frame should not be regarded as absolute because slow rotations of the aether might indeed be responsible for such as galactic magnetic fields. In that the pendulum and mechanical gyroscopes are inertial devices, this perception suggests a link between the aether and the still-sought mechanism of inertial force. We return to this in Section 8.

2B.(iii) ***The Sagnac effect***.

The Sagnac effect, indeed, can readily be explained in terms of an irrotational aether. A proof has been given by Reut (2002)[18] except that his irrotational reference frame was that of the laboratory. The Sagnac effect is widely cited as a relativistic effect and as being proportional to the area within the 4-sided interferometer light path, but it is neither. It is a first order effect which can be of either sign, whereas Relativity prescribes effects only of the second and higher quadratic orders which therefore do not change sign.

On the 'area' story, the experimental evidence is that the magnitude of the fringe displacement is actually proportional to the path length, i.e. to the time of flight of the waves. Michelson & Gale (1925)[19], whence the area story originated, set up two large rectangular light paths in conjunction with the Earth's rotation. Both rectangles had N-S legs the same length, the comparison of fringe displacements being between one with very short E-W legs and the other which had much longer ones. The bigger displacements in the latter were therefore interpretable as either an area dependence or an E-W leg-length dependence, though Michelson & Gale apparently did not appreciate that. The experiments of Dufour & Prunier (1941, 1942 and references therein)[20] enable the 'area' choice to be eliminated; they found that if they kept the total path length constant but varied the shape of the path, changing its area projected onto the plane of rotation, the fringe displacement was unchanged. As a time-of-flight dependence, the effect depends on how much the observation point in the apparatus moves rotationally while the waves are in transit, just as was proposed by Petit & Wolf (1994)[21]. The internationally applied (CCIR) terrestrial time signal correction for the longitude difference between transmitter and receiver appears to be an explicit proof of this explanation. This correction[22], at the equator, is calculated *pro-rata* on the basis of ± 207.4 ns for a complete 360 degree (longitude) path, according as the wave travels eastwards (+) or westwards (-). We consider the westward path case. If the waves travel in an irrotational aether and the Earth spins in it, the receiver gets closer to the transmission departure point in the aether while the wave is in transit. The quantity 207.4 ns corresponds to the travel-time shortening due to this motion of the receiver while the wave, travelling at its normal velocity in the irrotational aether reference frame, is doing a (almost) complete circuit of the globe. There is no reason whatever to argue that the velocity of TEM-wave propagation is altered (relativistically or in any other manner) by the rotation; it is the positions of the source and receiver points that change, not the speed of light. To argue otherwise would force one to detach the velocity of light from the properties of the medium that is propagating it, as SR (Special Relativity) tries to do.

2B.(iv) ***A 'particle-tied aether' with the Earth 'spinning in it'; a contradiction?***

Both these phrases have been used in the preceding paragraphs, so can they be reconciled? The Michelson-Morley experiment was only designed to detect, if present, the Earth's 30km/s orbital motion relative to an aether and famously

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17 **Aronowitz, F.,** The laser gyro. In: *Laser applications, vol.1*, M. Ross (ed.), Academic Press, New York, 134-199 (1971).

18 **Reut, Z.,** *Explanation of Sagnac effect in classical framework*. Physical Interpretations of Relativity Theory VIII, Brit. Soc. Philos. Science. Imperial College 15-18 Sept 2000. Proceedings II. p. 443-445. M.C.Duffy (ed.), PD Publications, Liverpool. ISBN 1 873 694 07 S. (2002).

19 **Michelson, A.A. & H.G. Gale,** *Nature*, **115** (2894): 566 (1925).

20 **Dufour, A. & F. Prunier** *Comptes Rendues Acad..Sci.* **208**: 988-990;(1939): *Journal de Physique* **3** (9) 153-161 (1942)

21 **Petit, G. & P. Wolf,**. *Astronomy & Astrophysics*, **286:** 971-977 (1994)

22 see, for example, **Allan, D.W., M.A. Weiss, & N. Ashby**, Around-the-world relativistic Sagnac experiment, *Science*, **228**, 69-70, (1985)

failed to do so. Brillet & Hall (1979)[23] repeated the M-M experiment with much higher precision; although not reported by Brillet & Hall themselves, closer analyses of their results (Aspden 1981; Hayden 1991)[24] and other repeats of the M-M experiment (Kennedy & Thorndyke 1932; Hils & Hall 1990)[25] all found a fringe shift which they associated with the Earth's rotational velocity (~ 350 m/s at mid-latitude).

If the Earth's particles were truly 'tied' to all the (irrotational) aether, the Earth would be unable to spin. This means that, as we show later from other observations, the amount of aether charge that is actually carried around by being 'tied' to each particle, most of them being electrically neutral, is many orders less than the total aether charge at any one place. This is how the previous paragraph's explanation of the Sagnac effect manages to be valid; but it leaves unanswered why, in the M-M experiment, TEM-wave propagation apparently operates in the particle-tied aether frame for the Earth's orbital velocity but not for its rotation. Since it is unreasonable to expect the aether to have such contradictory properties I suspect that the problem may lie in some aspect of the M-M observational method - that we are not observing what we think we are - two other cases of which appear elsewhere in this paper; the Sagnac observations discussed above and the disparate measures of ***c*** (Section 4G). Something better than SR is needed to sort this one out but the matter will not be pursued here, our main focus being upon recognizing the aether-related character of diverse other phenomena.

2B.(v) ***High aether density and available force levels.***

A further result of the aether's high charge density is that most observed phenomena, particularly those susceptible to laboratory experiment, must involve only trifling variations of local aether density but, if the means exist for its substantial modification, then there is the potential for huge forces to be developed. This leads us to the topic of the gravitational process.

2C. The nature of mass and of the gravitational process - the gravity-electric (G-E) field.

2C.(i) ***Particle design to give them the mass property - a visit to the particle factory.***

It is clear from their gyromagnetic properties that at least those fundamental particles that can be so observed are polar entities. This accords with our supposition that they are basically rotational configurations of aether motion. Note that aether, *per se,* is massless and is a perfect fluid so it is able, in the presence of even the slightest degree of external confinement (in this case, the rest of the aether), perpetually to pursue circular motions without flying apart. This offers perpetual stability for certain configurations, but only in the absence of external disruption of a sufficient kind. The decay lifetimes of the less stable configurations should thus no longer be seen as absolute constants of that particular object but as being subject, in greater or less degree, to action in the form of pervasive aether motion. We return to this later.

Conversely, the continual search by particle physicists, using higher and higher energy equipment, for more and more massive particles with ever shorter lifetimes, may in fact be constructing those particles. Hence the 'permutation table' of particle characteristics that has resulted. Accordingly it would not be surprising if the massive and so-far-fabulous Higgs boson (from which all lesser particle fry are thought to derive), or maybe an even heavier one, is indeed produced (or 'found') but that would not necessarily be a measure of what Nature can do on her own.

It is further envisaged (Figure 2) that the internal motions of those particles that exhibit the mass property are vortical in character, passing aether continually in at one pole, its 'sucking' pole, and out at the other, its 'spitting' pole.

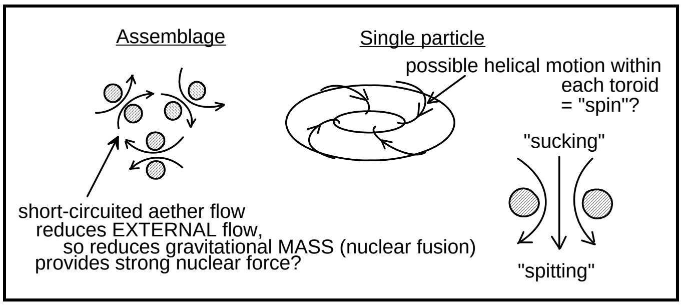

Fig. 2. Basic CT conceptual model of fundamental mass-bearing particles and assemblages of them. The right-hand image represents a cross-section of the central image. The mass of a particle or particle assemblage is measured by its ability to generate gravity. Two quarks (= mesons) are unstable ($<10^{-7}$ sec) because aether short-circuiting is poor (strong nuclear force is insufficient). One easy variation of this basic concept when building up more complex versions to meet requirements is that 'spin' direction, as illustrated, can reverse without reversing the

These vortices cannot be analogous to those with which we are familiar macroscopically. The latter are of mass-bearing materials, so are dominated by centrifugal action and low pressure ('sucking') is common at the centre, but there is no 'spitting' pole. Our 'vortices' are represented by helical motion around a torus, a motion readily established if 'an intruder' passed through the centre of a simple rotational or spiral motion, roughly as seen in smoke rings.

If, conceptually, you throw a bunch of such randomly oriented particles 'up in the air', one's first impression is that the spitting and sucking actions of these self-orientable objects will cause some to scatter and some to converge. The

23 **Brillet, A. & J.L. Hall,** Improved laser test of the isotropy of space. *Phys. Rev. Lett.,* **42** (9) 549-552. (1979)
24 **Aspden, H**., *Physics Letters*, **85A**: 411-414 (1981); **Hayden, H.C.,**. *Physics Essays*, **4** (3) 361-367. (1991)
25 **Kennedy, R.J. & Thorndyke, E.M**.,. *Phys. Rev.*, **42**: 400-418 (1932); **Hils, D. & J.L.Hall,** *Phys. Rev. Lett.,* **64**: 1697-1700. (1990)

operation of the inverse square law of force, however, means that a given infinitesimal amount of convergence has more force-effect than the same amount of divergence, so convergence will come to prevail statistically, because moving away from one particle means moving closer to another. The moment that this begins, the self-orientation of the objects will to some extent, on top of any random motions, align their sucking poles with the developing aether density gradient which the sucking generates, so as to propel them in the convergence direction. During this, and particularly when any constraint upon further motion of the particle in that direction is encountered, this sucking action will lower the aether density within the developing assemblage. Aether being a continuum of electric charge, such a density gradient is an electric potential gradient, with defect of (negative) aether density representing positive potential. This is the newly identified 'gravity-electric' (G-E) field to which reference was made in the Introduction. Such a potential gradient will not be confined to the interior of gravitationally retained assemblages but will continue outside it, due to the gravitational interaction with the rest of the Universe. It would only cease at the boundary of the assemblage if the Universe were otherwise empty. In this sense Fitzgerald (1894)[26] seems to have been correct in saying 'Gravity is probably due to a change in the structure of the aether, produced by the presence of matter'.

This mechanism helps to explain why there is no such thing as 'antigravity', and can never be. For a start, if one has two bodies, each being (normal) gravitationally retained assemblages, it would be wholly illogical to contemplate that they (i.e. every particle of each) might suddenly 'decide' to repel one another. In more detail, those particles that move apart when you throw them up in the air (to use our analogy) are indeed exhibiting antigravity but their dispersal will mix them with others that are not, causing the individuality of their action to disappear without trace as self-orientation takes over.

Before considering the G-E field in more detail we may take a brief look at the other possible products of the CT particle factory - neutrinos. As is made clear below, the applicability in CT of the $\boldsymbol{E = mc^2}$ relation to the determination of mass is *not* universal but is restricted to those situations/particles in which the mass property, as developed in the manner described above, can otherwise be demonstrated or expected. So if a neutrino demonstrates an energy content, this should be taken at face value and not automatically ascribed to the possession of mass. We show below that aether motion, not surprisingly, has a very high energy content, so such a particle can reasonably be regarded as an energetic vortex or eddy of the aether, without the aether-pumping attributes of real gravitational mass. A lack of electric charge can likewise easily be seen as implying that the eddy does not incorporate an excess or deficiency of aether relative to the local mean. Even the observation (Fukuda *et al* 2001)[27] that some solar neutrinos show a 3% day-night variation in abundance does not, on this view, necessarily mean that they, or some of them, possess some true gravitational mass. Scattering seems possible without that, particularly if we accept, as for other particles, a non-zero size for the eddy.

2C.(ii) *The gravity-electric (G-E) field in action*.

A primary consequence of the G-E field is that, in the neighbourhood of any major body, neutral particles will experience only the gravity field, but positive ions will experience a repulsive force that depends on their charge:mass ratio, while electrons will experience attraction. This can provide light-isotope enhancement of that repulsion, many examples of which are present in the solar wind, being particularly great in the case[28] of $^3He/^4He$, as would be expected. Another example of the G-E field appears to be the observation that the Earth's ionosphere is streaming away on the dayside, where ionization is due to solar EUV, but does not stream on the night side. In the case of similar streaming in both the polar zones, where the ionization is caused by solar particles guided in by the Earth's magnetic field, the freed electrons being the cause of the aurorae, (Mukai 2003)[29] wrote "It is well established that discrete auroras are caused by electrons accelerated by the field-aligned electric fields existing in the cavity region at altitudes of 1-2 Re. Its generation mechanism is one of the most outstanding problems in space physics, and a large number of theoretical models have been proposed, but it still remains unresolved". Magnetic agency has been the traditional starting point for the interpretation of many such phenomena, partly because an electrical option was not available and partly, no doubt, because the physical intertwining of electrical and magnetic phenomena makes it difficult to distinguish between cause and effect. Closer still to home, thunder clouds are typically, though not universally, negative with respect to the ground[30].

It was proposed by Bailey (1960)[31] that the solar wind is driven by the Sun having a positive charge but this was dismissed[32] on the grounds both that a large Stark effect would be observable in the solar spectrum, but is not, and that the Sun would become negatively charged over time and cease to expel ions. The first is no longer valid because my present estimate of the G-E potential gradient at the solar surface is of the order of a few tenths of one volt/cm, at least four orders of magnitide below Stark effect detectability in the presence of actual line widths. The second is resolved in CT by the huge charge density of the aether present in the interparticle spaces in the Sun. Solar export of charge occurs

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26 **Fitzgerald, G.F.,** Fitzgerald's *Works,* p.313.

27 **Fukuda, S.,** ***et al*** **(The Super-Kamiokande Collaboration),** Solar ^8B and *hep* neutrino measurements from 1258 days of Super-Kamiokande data, *Phys. Rev. Lett.,* **86**, 5651-5655, (2001).

28 **Lin, R.P**. Exploring the enigma of solar energetic particles. *EOS: Trans. Am. Geophys. Union* **75**: 457-66 (1994).

29 **Mukai, T.** Temporal variability of the field-aligned particle acceleration above the auroral oval. IUGG 2003, June 30 - July 11, 2003. Sapporo, Japan. Abstracts, A.304. (2003).

30 **Williams, E.R.,** Problems in lightning physics - the role of polarity asymmetry. *Plasma Sources Sci. Technol*., **15** , S91-S108. (doi:10.1088/0963-0252/15/2/S12):(2006)

31 **Bailey, V.A.** Existence of net electric charges on stars. *Nature* **186**, 508-510 (1960): Reply in *Nature* **189**, 43-44 (1961)

32 **Oster, L. & K.W. Philip,** Existence of net electric charges on stars. *Nature* **189**: 43 (1961).

in two forms - ions export positive charge; outflow of aether (due to the aether-pumping that is the gravitational field) exports negative charge, creating an aether density defect (equivalent to positive charge) in the interior. There is a supply of more than 10^{66} coulombs of *negative aether* inside the Sun (neglecting the reduction of aether density in its interior). Pumping it all out would create the same amount of positive charge, whereas the total supply of *protons* in the Sun contains only about 10^{26} coulombs of positive charge. This means that the export of ALL the protons in the Sun would affect the effective electric potential of the Sun to a wholly negligible extent. (This of, course, is an oversimplification because the export of those protons would diminish the size of the Sun and the aether volume contained within it, but the point is well made nonetheless.)

It is upon this electrically positive behaviour of the Sun that my determination of the negative polarity of the aether continuum is based.

The action of the solar G-E field upon electrons is importantly present too. The low-FIP (first ionization potential) ions which dominate the solar wind (principally Na, Mg, Al, Si, Ca, Fe, with first ionization potentials in the range 5.1 - 8.1 eV, e.g. Allen (1963)[33]) derive their initial ionization at ~9-10 kK in the lower chromosphere, not far above the ~7 kK photospheric surface. The high opacity there that gives the Sun its visual 'surface' was identified by Wildt (1939)[34] as due to a high abundance there of the negative H ion (H with an *extra* electron), on account of its easy photo-ionization (IP = 0.755 eV). Since H is far less abundant there and is not ionized (FIP = 14 eV) (Strömgren 1951)[35], it cannot be the source of those electrons, implying that the low-FIP ions of the solar wind leave their electrons behind, separated from them by the electric field. Gray (2005 at p.154)[36], indeed, states explicitly “The extra electrons needed to form the H^- come from the ionized metals”. The welter of electrons present in the solar wind that reaches us must relate to the much higher ionization levels that are produced by accelerated particles higher in the solar atmosphere and corona.

This explanation of the ionically selective ‘FIP effect’ displayed by the Sun shows that the lower chromosphere is the site of this effect, so stars with hotter chromospheres will ionize a wider range of elements and the FIP effect will be less clear. In stellar coronas, on the other hand, the higher ionization achieved but not the coronal composition, will depend more upon the stellar mass, which controls the strength of the G-E field in which the ions have been accelerated. There is evidence to support this. The F5 star Procyon, hotter and more massive than the Sun, displays no solar-type FIP effect in its coronal emission[37], but those of two late-type (G) supergiants, much cooler like the Sun, do[38].

In the solar corona, too, the G-E field operates a degree of ionic selection based upon ionization level. Raymond *et al* (1998)[39] noted that in a streamer the Fe ions did not rise so high as the Si, based on observation of Fe^{XIII} and Si^{XII} emission lines. The radial support by the G-E field depends on the ionic charge:mass ratio; this is 1/4.67 for the Fe^{XIII} ion and 1/2.55 for the Si^{XII} ion, making it clear why the Fe ion lacked G-E field support. These authors, thinking only of the ionic mass, were also puzzled that the abundance of heavy elements in streamers is so high and is maintained for months, whereas gravitational settling time is of the order of a day. The G-E field is the obvious answer.

2C.(iii) *TEM-waves are the wrong kind of aether motion to have mass.*

It appears that a failure to understand how the property of mass arises has led to the indiscriminate application of the $E = mc^2$ equality. If the foregoing outline correctly defines the nature of mass-bearing particles and their gravitational interaction, it follows at once that TEM-waves are not the right kind of aether motion to have mass. In CT, therefore, it is illegitimate to ascribe mass to the energy content of TEM-waves, so we will need to review in this light the various phenomena upon which the mass-bearing photon concept is thought to be sustained. A good starting point is that, although seldom mentioned these days, Planck’s original derivation of the black-body spectral function was a thermodynamically based argument achieved without resort to quanta as propagating entities[40]. Secondly, radiation pressure, nowadays commonly referred to as a photon momentum effect, is actually equally derivable in TEM-wave terms from Maxwell’s equations[41].

From a practical point of view, no observation of TEM-waves in transit is possible - observation is always dependent upon some physical interaction with matter. It is suggested that it is this interaction, commonly involving jumps between

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33 **Allen, C.W.** *Astrophysical Quantities, 2nd edition*, Univ. London, Athlone Press. (1963).

34 **Wildt, R.** Negative ions of hydrogen and the opacity of stellar atmospheres. *Astrophys. J.* **90**: 611-620. (1939).

35 **Strömgren, B.** The growth of our knowledge of the physics of the stars. In: *Astrophysics: a topical symposium, commemorating the 50th anniversary of the Yerkes Observatory and a half century of progress in astrophysics*. J. A. Hynek. (ed.) New York, McGraw Hill**:** 172-258 (1951).

36 **Gray, D. F.** *The observation and analysis of stellar atmospheres*. Cambridge University Press, Cambridge. 533 pp. (2005)

37 **Drake, J.J., J.M. Laming, K.G. Widing, J.H.M.M. Schmitt, Haisch, B. & Bowyer, S.** A first look at the elemental composition of stellar coronae: absence of FIP effect in the corona of Procyon. *Science*, **267**, 1470-1473 (1995); also as:- Center for EUV Astrophysics, Berkeley. Publ. No 610.

38 **Garcia-Alvarez, D., J.J. Drake, B. Ball, L-W. Lin & Kashyap, V. L.,** Evidence of the FIP effect in the coronae of late-type giants. *Astrophys. J.* **638** (2), 1028-1040 (2006); prepublication as:- arXiv:astro-ph/0512494 v1. (2005)

39 **Raymond, J.C., R. Suleiman, J.L. Kohl & G. Noci**, Elemental abundance in coronal structures, In: *Solar composition and its evolution - from core to corona*, edited by C. Frölich, M.C.E. Huber, S.K. Solanki, & R. von Steiger, *Space Sci. Rev*. **85**, 283-298 (1998).

40 **Kangro, H.,** *Early history of Planck's radiation law.* Transl. from German by R.E.W.Maddison, revised by author. Taylor & Francis, London (1976): **Planck, M.,** *The theory of heat radiation*. Dover Books, 135 pp. (1959): **Whittaker, E.T.** *History of theories of aether and electricity, **Vol 2**. The modern theories 1900-1926.* Nelson, London. p. 79-83 (1953)

41 **Maxwell**, **J.C.,** *Treatise on electricity and magnetism, 1st ed.* Clarendon, Oxford. 2 vols. At §792 (1873): **Ditchburn, R.W.,** *Light*. Blackie, London, 680 pp. @ pp. 557-9. (1952).

atomic internal stability configurations, that is responsible for the evident ‘packaging’ of energies. There is no evidence whatever for the quantized transmission of electronically generated (e.g. broadcast) TEM-waves. It is only when the wavelength approaches the atomic scale that apparently quantized behaviour has been detected. This is the famous wave-particle duality which, I suggest, is a function of generation or reception devices, not a property of TEM-waves in transit. The ‘spotty’ emission of electrons from a photo-emitter exposed to low light levels was thought by Einstein to prove the quantized nature of light, but we discuss later the perspective that everything, including atomic interiors, is subject to pervasive low-level disturbance by the random motion of the aether. In the photo-electric case, the light-wave energy has only to tip that disturbance beyond the available constraints to cause an emission; it does *not* mean that the entire energy input occurred just then and there[42]. At other places the TEM-wave input will ‘fall upon fallow ground’, maintaining an apparent balance between energy input and electron emission.

2C.(iv) ***Retarded gravitational communication in CT; some effects.***

The gravitational process outlined above involves the mutual sensing of two bodies by reason of the aether density gradient set up by each. Since, in CT, gravitation is an electric phenomenon, any change in gravitational action implies the movement of electric charge, so is an electromagnetic phenomenon. Thus it is to be expected that such changes will be propagated at velocity $\boldsymbol{c}$ or some simple function of it. This finite velocity of communication leads to a number of predicted effects in the case of orbiting and rotating bodies.

Firstly the gravitational force between two bodies will always be a bit out of date and this will show up as an out-of-date magnitude if the distance between the bodies is changing. In Section 5C we will argue that the perihelion advance of Mercury, one of the famous ‘empirical proofs’ of Relativity, is accountable in CT on this basis. Qualitatively, but not examined further in this paper, the higher-than-positionally-appropriate solar-directed gravitational pull experienced by the Pioneer 10 and 11 spacecraft as they sped out of the solar system[43] may, at least in part, be a further example of this effect.

A further group of these effects arises from the particle-to-particle nature of the interaction in CT. Each part, for example, of a central body (C), develops its own interaction with an orbiting body (A). If, as is usual, the rotation of C exceeds the orbital angular velocity of A the effective centroid, on C, of the gravitational interaction will get carried - ‘aberrated’ - forward of the line C-A. This will result in a gravitational analogue of a tidal effect, causing the transfer of angular momentum and the orbiting body to recede. Note that from the viewpoint of A the ‘far’ side of C is moving the other way, so the effect nearly cancels unless the diameter of C subtends a substantial angle at A. In Section 9C(i) it is suggested that this effect may contribute to producing the flat tangential velocity profiles of spiral galaxies.

On an important theoretical note, this entry of retardation into the process of gravitational *communication* means that in dynamical situations it is no longer fully accurate to treat the action as being between two centres of gravity, as is done in Newtonian field theory. Further, we may note in passing that Poincaré (1905)[44] considered that if Relativity is true then gravitation must act at velocity $\boldsymbol{c}$.

2D. Aether charge density and the velocity *c* of TEM-wave propagation.

The effect upon $\boldsymbol{c}$ of the charge density of the aether will be shown very important. The density measures the aether's state of elastic charge-compression, so a reduction in aether density would reduce its elastic modulus and would reduce $\boldsymbol{c}$ in Maxwell's equations. On the other hand, the ‘dielectric constant of free space’, or permittivity, often written as epsilon in Maxwell's equations, clearly controls Maxwell's dielectric displacement current and hence should be proportional to aether charge density. Now $\boldsymbol{c}$ varies *inversely as the square root* of epsilon, whereas $\boldsymbol{c}$ varies *directly* as the elastic modulus of the aether, so, as we are dealing with small differences on a big number, it seems that the net effect on $\boldsymbol{c}$ should be half that of the elastic modulus alone.

2E. Neutrons, quarks, the mechanism of the strong nuclear force and the $E = mc^2$ energy of aether-pumping flows.

In the CT frame, for a particle to have mass but no charge, it must have an internal configuration with an external aether-pumping capability but no overall excess or deficiency of aether within it. The fact that, when outside an atomic nucleus, neutrons decay to a proton plus an electron in about 19 minutes has always been taken to mean that a neutron embodies one of each, regarded as individual entities while inside the neutron, and this still seems probable here. The fact that neutrons are pretty stable when inside a nucleus suggests that here they are somewhat shielded by the electron shells from the disruptive action of random aether motion. According to CT the mass of a particle assemblage (proton+electron in this case) is the measure of its *external* aether-pumping capability. The fact that the mass of a neutron is less than the sum of a proton and an electron is thus a measure of the degree to which the aether-pumping flow of the two particles follows a short-circuit within it. This mass reduction, on an $\boldsymbol{E = mc^2}$ basis, measures the energy released when a neutron is created, as when a neutron star is formed ; but it also records the difference in aether-pumping

42 This overcomes the objection (**Meyer, E. & W. Gerlach**, *Archives des sci. phys. et nat.*, **36**, 253, (1914)) that the observed time lag between initiation of a low light level and the emission of an electron is too long for classical accumulation of the (photon) energy. One would like, however, a more modern confirmation of this.

43 **Anderson, J.D.** ***et al***. *Astrophys. J.* **448,** 885 (1995)

44 **Poincaré, H.** *Comptes Rendues Acad. Fr*. **CXL**, 1504 (1905)

energy associated with the two configurations, thus providing, possibly for the first time, a mechanistic basis for the $E = mc^2$ relation, illustrating the prodigious amounts of energy locked up in aether motions.

This relation, widely attributed to Einstein, was actually first presented by Poincaré (1900)[45] and was noted by Olinto De Pretto (1903)[46] who expressed astonishment at the huge concealed energy thereby implied. But neither was mentioned by Einstein. Acknowledgement of sources was not the norm that it is today. It seems a pity that Poincaré has lacked acknowledgement for such a very fundamental matter.

The short-circuiting of the particle-pumped aether flow is proposed here as the principle of the mechanism of the **strong nuclear force** (Figure 2). In effect it is gravitation on an intimate particle scale. A similar example is provided by the inferred observation that three quarks form a stable configuration but two do not (mesons). It is obvious that if the particle axes can form a triangle, the opportunity for aether internal circuiting is far superior to when two have to be arranged in antiparallel. In that the amount of pumped aether flow available externally is what determines the gravitational mass of the assemblage, this short-circuiting of the flow provides insight into why particle assemblages held together by the strong nuclear force do weigh less than the sum of their parts. It raises, by extension, the surprising prospect that astronomical bodies in general should exert less gravitation than the sum of their parts would do individually. Something of this sort may have been observed by Majorana (1921)[47], a respected experimentalist, but reticence about his method, to achieve the claimed sensitivity, seems to have prevented the matter being pursued.

2F. Neutrinos and the applicability of $E = mc^2$.

Emission of neutrinos is one of the mechanisms by which nucleosynthetic and decay processes discard energy, the other being radiation. They certainly come with differing energy contents, according to the process involved, and recent work has equated this with having different masses, on the $E = mc^2$ basis, though they betray but slight signs of gravitational interaction. Einstein appears to have been so concerned with discerning that the Creator had operated to a grand design that he insisted that energy in all its forms be interchangeable with mass, on that basis; and this is the view that has persisted. In CT, the logic is different and that interchangeability is regarded as limited to those objects equipped to behave as gravitational mass by their aether-pumping construction, as outlined above.

Accordingly, as noted in Section 2C.(i), we may envisage neutrinos basically as being aether rotational entities (or ‘eddies’) that have little or no vortical aether-pumping property, nor do they incorporate additional or deficiency of aether, which would give them charge. Thus their energy is primarily incorporated in their aether rotation. The important matter of the solar neutrino deficiency is dealt with next.

2G. Stellar evolution, the G-E field, the solar neutrino deficiency and the age of the Sun.

Stellar evolution theory is centrally based on two balances, stars being unstable when these balances are not met. The first is that the (plasma) temperature in the deep interior must, together with radiation pressure, be enough to provide the pressure support for the external layers. The second is that the nucleosynthetic rate of energy generation must be able to escape through those layers, much of that escape being in the form of neutrinos, which do not heat the material they pass through. The G-E field in the solar interior, operating on the highly ionized material, will provide an extra support force for the external layers that has not been incorporated into stellar theory. Consequently, the solar interior need not be quite so hot as has been supposed. This, in turn, both reduces the nucleosynthetic rate required and might even favour a differently balanced set of reactions appropriate to the lower temperature. This would alter both the neutrino production rate and the kinds of neutrinos produced.

A further consideration is that, because of the lowered aether density in the solar interior, the particles (and here I include neutrinos) actually produced in the stellar interior will probably incorporate that lowered aether density. While this would affect the reactions there, probably degrading reaction rates, it does not seem impossible that, upon emergence from the Sun into an environment having ‘normal’ aether density, equilibration with that might restore them to ‘normality’; if it did not, the neutrino energy population would be correspondingly affected.

But this is not all. My contributions (2000b; 2006 and Section 6 of this paper) set out a scenario for the formation of the solar planetary system and for planetogenesis in general in which the parent star is formed in one cloud, but the planets are formed from the second disc it acquires when, at some later time, the star flies into a second cloud. Details of this are given later because, in the case of the solar planetary system, it illustrates the essential dynamical part in its construction played by the G-E field around the Sun. It may be noted here, however, that in this scenario the material acquired from the second cloud also ‘contaminated’ the solar convection zone with high metallicity material, so the spectrally determined solar metallicity[48], which is appreciably higher than the regional norm for similar stars (Rocha-Pinto & Maciel 1996)[49] is no longer a suitable measure of the evolutionary state of the solar interior. It means, in

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45 **Poincaré, H.,** *Archives Néerlan.* **[2] v.** 252 (1900)

46 **De Pretto, O.** *Ipotesi dell’ Etere nella via dell’ Universo.* Presented 29th November 1903; *Proc. Veneto Roy. Inst. Sci. Lett. Arts A.A.* **63** (2) 439-500 (1903-4).

47 **Majorana, M.Q**., On the absorption of gravity (transl from French), *Comptes Rendus de l'Académie des Sciences. Série 2*, **173**, 478-479 (1921).

48 Conventionally measured logarithmically in terms of the [Fe/H] ratio, normalized to the solar value.

49 **Rocha-Pinto, H. J. & W. J. Maciel**. The metallicity distribution of G-dwarfs in the solar neighbourhood. *Mon. Not. R. Astr. Soc.*, **279**: 447-458 (1996).

fact, that since the Sun is well recognized as an unmixed star, the 2.5%, or so, of the solar mass constituting the convective zone that lies above the tachocline at ~0.71 R⊙ is of higher metallicity than that which lies below.

It has been a long-standing feature of helioseismological profiles of the solar interior that, compared to the prediction of Standard Solar Models (SSM), a sharp interiorward increase in excess velocity appears just below the tachocline, peaking (in different models) at between +1% and +0.4%, and not recrossing the SSM prediction (into slightly negative territory) until core-burning levels at ~0.3 R⊙. This feature, recognized as suggesting a need for the model to provide more opacity, caused Turck-Chieze (1998)[50] to suggest that the metallicity below the tachocline might have been underestimated in SSMs. SSMs, however, being based on surface abundances, will do just the opposite if the new planetary formation scenario is correct, so we must look elsewhere.

Rogers & Iglesias (1998)[51] take up the point that even the best SSMs seem, throughout much of the deep interior, not to provide enough opacity, line-broadening being one of the factors that can increase opacity. A further CT effect may provide this opacity. In Section 4C we show that transmission of TEM-waves through a randomly moving aether (which would especially be the case at the pertinent temperatures of 2 MK and above in the Sun) has a major line-broadening property, such that in one experimental case a temperature of probably no more than 250 kK was mistaken, on line-breadth grounds, as being 5 MK.

Bahcall *et al* (2001)[52] carried out an extremely thorough re-evaluation of the SSM, acknowledging the 'robust' nature of the sub-tachocline velocity departure (now reduced to +0.4% at its peak) but concluding that "the excellent agreement between helioseismological observations and the solar model calculations has shown that the large discrepancies between solar neutrino measurements and solar model calculations cannot be due to errors in the solar models." In fact, I suggest, it does no such thing; the fit is illusory. The seismic velocity in the interior depends upon the square root of the temperature whereas, as Bahcall himself remarked (2001)[53], the neutrino production rate depends on the 25th power of the temperature. So the reduction in the burning-zone temperature needed to support the outer layers in the presence of the G-E field might easily be enough to explain the observed ~60% neutrino deficiencies but have a wholly undetectable effect on the seismic velocities.

The original solar neutrino observations[54] showed a >50% deficiency relative to the numbers expected on the basis of the spread tolerated by uncertainties in the Standard Solar Model, the equipment being geared to the detection of various types (energies) of neutrino. As at 1998 the mean observed deficiencies were:- 47% for low energy - 0.23 MeV, 69% for mid-energy - 0.8 MeV, and 54% for high energy - 6 Mev and above. This deficiency pattern, greatest in the mid-range, showed that since temperature affects the high-energy neutrinos the most a simple lowering of temperature is not the answer. So further, and very expensive, tests with heavy-water equipment (the Sudbury Neutrino Observatory) were undertaken. These (as Ahmad *et al* 2001[55] acknowledge) seem not greatly to have affected the overall deficiencies in numbers but do suggest a difference from the predicted distribution of types; the explanation offered[53, 55] being that some of the expected neutrinos had 'transmuted' ('oscillated' is the term used) into different kinds during their passage from solar core to Earth. An interesting outcome of the Japanese work (Fukuda *et al* 2001)[56] is that a 3.3% day-night variation was seen, suggesting a limited degree of gravitational interaction, which could indicate a limited mass property for these neutrinos.

The CT-based resolution of this problem, offered here, is that, due to the G-E field in its interior, the Sun is indeed evolving much more slowly (as measured by the neutrino output) than has been thought and that the Earth-observed population of different neutrino types may actually be what is being generated inside the Sun and emerging from it, the difference from expectation being due to the rates of and difference in the processes operating in the solar interior. Remarkable support for the G-E field being a controlling factor in the neutrino output is the very tight observed correlation[57] between the neutrino flux and the solar wind mass flow, which is seen here as being driven by the G-E field also.

To be correct, this solution might be thought to lead to two wholly unacceptable results. One is that the Sun must be very much older than has been thought, based on the ~4.57 Ga age of the solar planetary system obtained from meteorites. The other is that the ages of all other stars must be correspondingly older too, including those in globular clusters, running well past the ~14 Ga buffer supposedly set by the Hubble-derived age of the Big-Bang.

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50 **Turck-Chieze, S.,** Composition and opacity in the solar interior, In *Solar composition and its evolution - from core to corona*, edited by C. Frölich, M.C.E. Huber, S.K. Solanki & R. von Steiger, *Space Sci.Rev*., **85**, 125-132 (1998).

51 **Rogers, F.J., & C.A. Iglesias**, Opacity of stellar matter, In *Solar composition and its evolution - from core to corona*, edited by C. Frölich, M.C.E. Huber, S.K. Solanki & R. von Steiger, *Space Sci. Rev.* **85**, 61-70 (1998)

52 **Bahcall, J.N., M.H. Pinsonneault & S. Basu**, Solar models: current epoch and time dependences, neutrinos and helioseismological properties, *Astrophys. J.* **555**, 990-1012, (2001). Also:- arXiv:astro-ph/0010346 v2.

53 **Bahcall, J.,**. High-energy physics: neutrinos reveal split personalities. *Nature* **412**, 29-31. (2001)

54 **Berezhinski, V**. The solar neutrino problem 1995. *Nuovo Cimento C,* **18C,** 671-684 (1995); **Dziemboski, W.A**., Shortcomings of the standard solar model, In: *Solar composition and its evolution - from core to corona*, edited by C. Frölich, M.C.E. Huber, S.K. Solanki, & R. von Steiger, Space Sci. Rev., **85**, 37-43 (1998).

55 **Ahmad, Q.B., *et al*. (The Sudbury Collaboration),** Measurement of the rate of nu_e + d --> p + p + e^- interactions produced by 8B solar neutrinos at the Sudbury Neutrino Observatory. *Phys. Rev. Lett.*, **87**, 071301, (2001). Also as: arXiv:nucl-ex/0106015.

56 **Fukuda, S., *et al* (The Super-Kamiokande Collaboration),** Solar ^{8}B and *hep* neutrino measurements from 1258 days of Super-Kamiokande data, *Phys. Rev. Lett.*, **86**, 5651-5655, (2001).

57 **McNutt, R.J., Jr.,** Correlated variations in the solar neutrino flux and the solar wind and the relation to the solar neutrino problem. *Science,* **270** (5242) 1635-1639 (1995).

As already indicated above, and elaborated in Sections 4A and 9A, CT does not recognize that there was a Big-Bang, the Universe, or more specifically the mass within it, having been created progressively over a very long time that is by definition indeterminate. So the greater age of the solar interior just means that there was a much longer interval between formation of the protoSun and it flying into the second cloud and forming the planets.

3. Some problems with Relativity and their resolution in CT

3A. The relativistic 'mass increase'.

The growth in kinetic energy of a particle under acceleration is supposed in Relativity to increase its mass increasingly as velocity ***c*** is approached. Experimental experience with particle accelerators has long seemed to support this view, in that acceleration becomes increasingly difficult to achieve as velocity ***c*** is approached. My experience (1950) linked to the construction of a 4 MeV linear accelerator showed that then, as now, what one is effectively doing in such equipment is to chase a bunch of charged particles with the front of a TEM-wave that is caused to accelerate along the axis of the equipment. This process involves the intercommunication of the apparatus-based wave with the electromagnetic field of the particle, a process clearly limited to velocity ***c***, so the pushing efficiency will drop accordingly as the particle approaches ***c.*** Conversely, if such a high-speed particle tries to enter the electromagnetic field structure of a particle assemblage, the ability to slow it down will be similarly impaired by the limited speed of communication, so it will penetrate further, giving the impression of large mass and momentum. Heaviside (1889)[58] showed theoretically that high relative velocity produces a drastic modification of the field shape and a resulting effect on the force experienced.

Futher demonstration that one electromagnetic field can only be imposed upon another at the TEM-wave velocity exists in the near-universal application, in research, of the Çerenkov shock-wave-like display angle for the determination of particle speeds, by firing them into a medium of refractive index such that the velocity of TEM-waves in it is lower than that of the particle.

In 1960 I wrote an unanswered letter to H.Dingle, pointing out that if the relativistic mass increase were real also, this would double the observed effect, but that I had heard no mention of any sign of this.

The conclusion here, therefore, is that the supposedly observed velocity-related increase of particle mass is due to a failure to appreciate the nature of the experimental process involved, combined with an eagerness to recognize it as the relativistic prediction in view of the remarkable coincidence that relativity predicted something that looks (almost?) exactly the same, within the limits of observation, all compounded, perhaps, by the persistent but mistaken assumption that electrons are singularities. This result has been fundamental for developing the CT view of the nature of the gravitational process outlined above, for, instead of the mass of a particle being a will-o'-the-wisp quantity, depending upon the relative speed of the observer to it, we now have a definite and specific mass for that particle as a basis for its 'design', knowing that it will always behave like that.

Note that the masses (and therefore their inferred apparent mass-energies) of high-velocity particles that emerge from impacts are commonly assessed on a penetration basis so will convey the impression of having possessed much more energy than is actually the case, seeming in turn to support that the primary particle had the high energy content implied by the relativistic mass increase assumption. Nevertheless the velocity of the particle does indeed reflect the acceleration effort that it has undergone, however inefficiently; it could not otherwise have acquired that velocity. This point is important in the case of cosmic rays (see Section 7).

This result could also be very important when considering any apparently relativistic velocities of stars moving around a supposed black hole. Their masses will not have been increased by their speeds and the gravitational force of the inferred central mass does not need to be nearly so great. There is a further effect here if inertia (responsible for centrifugal force) is velocity-dependent, see Section 8.

3B. Nuclear decay rates, the weak nuclear force and the apparently relativistic time dilatation of fast meson decay.

As remarked earlier, the decay rates of particle assemblages seem likely to be affected by the random aether motion that reaches them from outside. So it is likely that their so-called decay 'constants' may actually not be quite so immutable as has been thought. In this sense therefore this susceptiblity is an inverse measure of the decay-restraining function hitherto ascribed to the Weak Nuclear Force. Shielding by surrounding electron shells is one form of protection from aether-borne electromagnetic disruption; very high velocity, as noted above, is another. The observed slower decay of unprotected mesons when travelling at 'relativistic' velocities is suggested here as being due to this protective effect of high speed, rather than to 'time dilatation'. Neutrons, likewise, decay in 19 minutes (half-life) when 'outside' but are rather persistently stable while shielded within an atomic nucleus.

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58 **Heaviside, O**., On the electromagnetic effect due to the motion of electrification through a dielectric. *Phil. Mag.* **XXVII:** 324-339 (1889); also *Electrician* 23 Nov (1888). My reading of the discussion of this and subsequent work on this topic by Searle and Morton given by **E.T. Whittaker** (1951) v.1 (see footnote 2) pp.307-310 is that the finite size of the electron, now recognized in LEP (footnote 16), results in a major redistribution of its field in the fore-and-aft direction as the velocity is increased and that the factor $(1- v^2/c^2)^{½}$ is indeed involved though not explicitly as force control, which was not discussed.

3C. The supposed proof of the GR clock paradox.

Under General Relativity (GR) a clock moving westward around the Earth should run slow, and run fast if it travels eastward, to an extent depending in both cases upon the velocity of travel. In 1972, Hafele & Keating, in a very widely cited paper[59], published the results, but none of the important details, of an attempt to check this by flying a group of four caesium clocks around the world, first eastwards and then westwards, claiming that the relativistic prediction had been successfully demonstrated. Kelly (1995, 1996, 2005)[60] however, having obtained from the US Naval Observatory a detailed internal report[61] of the experiment and observations written by Hafele four months before submission of the 1972 paper, was enabled to conduct a thorough re-examination of this result. In this 1971 report Hafele actually wrote "Most people (including myself) would be extremely reluctant to agree that the time gained by any one of these clocks is indicative of anything"..."the difference between theory and measurement is disturbing". These reservations do not appear in the 1972 paper. Kelly's analysis finds, *inter alia,* that fourteen 'corrections' (one of them being 5.5 times the predicted change being sought) had been applied to the in-flight observations before publication, including 'corrections' to the most erratic clock (Ser no 120) to whose final result most weight had then been assigned. As Kelly remarks, any properly conducted scientific experiment would have excluded that clock straight-away from any contribution to the result. This event needs to be seen in the context of great pressure at that time to come up with a positive result because Herbert Dingle, formerly a staunch proponent of Relativity, had (as recounted in his book[62]) recently been expressing what he saw as the 'absurdity' of the clock paradox. Kelly (1996, p.14) concludes "The scatter in the test data shows that an improvement of two orders of magnitude in the changes in relative drift rate of such portable clocks would be required before meaningful tests could be undertaken."

Unless and until that or a similar experiment can be repeated with enough improvement it seems appropriate here to regard the paradox as unproven and GR as correspondingly weakened. This would be purposeless if CT, in which time dilatation is not an issue, were to be preferred for the other reasons set out in this paper.

3D. Stellar aberration.

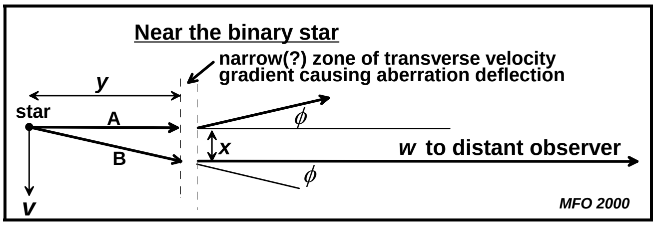

Figure 3. Aberration diagram for a distant orbiting binary star in the presence of a transmitting medium (aether).
Distance y may be of the same order as the binary orbit radius.
The aberration angle is:-

$$\phi = \tan^{-1} v/c \quad \text{and} \quad x/y \approx \tan\phi.$$

The observer sees light ray B instead of A.
The observable angular displacement is thus:-

$$a_{obs} = \tan^{-1} x/w \approx (y/w) \tan^{-1} v/c$$

which will commonly be too small to detect. In very favourable circumstances it might just be possible to do so using VLBI techniques. Note that the associated Continuum Theory redshift ("aberration-related (or AR) redshift", see text), equivalent to the "transverse Doppler effect" of Relativity Theory, depends only upon the actual aberration, wherever it occurs, not upon its perceived amount. Repeated from Osmaston 1996a, 2000a.

Stellar aberration, discovered by Bradley in 1728, is the 20.6 arcsec apparent displacement of stellar positions due to the Earth's orbital velocity. Seen as the result of a velocity triangle, of which adjacent sides are the Earth's orbital velocity and the velocity of light, the hypotenuse resultant is therefore greater than ***c***. To obtain two independent relative velocities for such a triangle one requires three reference frames, one of which is the light-transmitting medium, the aether in our case. Relativity denies that this is available, so insists that the hypotenuse is velocity ***c***.

In the relativistic interpretation, only the relative velocity of source and observer is deemed significant; Relativity can see no difference between the situation for a near-by source and that for a very distant one. First noted by Ives (1950)[63], is a well-established observation, however, that the transverse velocities of binary stars, in their orbits, do not give rise to a detectable aberration of their apparent position among their neighbours. If this were not so, binaries currently known only spectroscopically would have been detected long ago by their aberrational to-and-fro displacements (apparent proper motions). An extreme case, though not a binary, is the 8000 km/s of an O-star near to the Galactic centre

59 **Hafele, J. C. & R. E. Keating**. Around-the-world atomic clocks: predicted relativistic time gains. *Science* **177,** 166-168; Around-the-world atomic clocks: observed relativistic time gains. *Ibid.* 168-170 (1972).

60 **Kelly, A. G.** *Time and the speed of light - a new interpretation,* The Institution of Engineers of Ireland, Monogr.No. 1**:** 16pp (1995);
Kelly, A. G. *Reliability of relativistic effect tests on airborne clocks*, The Institution of Engineers of Ireland, Monograph. No. 3**:** 14 pp. (1996).
Kelly, A. *Challenging modern physics; questioning Einstein's relativity theories*. BrownWalker Press, Boca-Raton, Florida. 309 pp. (2005). The reader is particularly recommended to read pp. 271-274.

61 **Hafele, J. C.,** Proc. 3rd Annual Precise Time and Time Interval Strategic Planning Meeting, 16-18 Nov. 1971, US Naval Observatory, Department of Defense, Washington D.C. pp.261-288. (1971).

62 **Dingle, H.,** *Science at the crossroads*. Martin Brian & O'Keefe, London. (1972).

63 **Ives, H. E.,**. *J. Opt. Soc. Amer.* 40:185 (see his footnote). (1950)

(thought to conceal a very large mass), recently determined from its transverse proper motion. If, as is commonly to be expected, the velocity of the source is primarily with respect to a fairly local, aether-provided reference frame close to the far end (Figure 3), the aberration observed will be reduced by the distance ratio:- frame-to-source/frame-to-observer, thus usually reducing the quantity reaching the solar system to near zero, where the Earth-orbit aberration for a moving Earth observer is then added. For the latter, the full aberration is observed presumably because the reference frame is close-by, provided by the aether which is near the Earth but not participating in its orbital velocity. The location of the aberration process at this distance from the Earth explains why a water-filled telescope observes the same angle.

The classical velocity triangle treatment of Bradley leads to an aberration angle $\tan^{-1} v/c$, and the relativistic treatment gives $\sin^{-1} v/c$, where v is the transverse velocity of the observer relative to the source. At the small angle produced by the Earth's 30 km/s orbital velocity it is currently not practical to distinguish between these formulations (10^{-7} arcsec difference), thereby to distinguish CT from Relativity. In any case, our uncertainty as to the precise distance at which the aberration occurs also introduces a variability.

3E. Applicability of the Lorentz transformations.

Early in 1941, in a paper scarcely ever cited, Ives & Stillwell (1941a)[64] demonstrated both experimentally and theoretically, by observing gravity wave interference patterns on a moving pool of mercury, that the Lorentz transformations were indeed present, but only if one analyzed the patterns on the assumption that the composition of velocities, resulting in a vector relative to the observer faster than that of the gravity waves, was unacceptable, as in Relativity. But if you admit of the composition of velocities, the velocities being that of the mercury and that of wave propagation upon it, they found the patterns to be perfectly described without the transformations. Thus the need for the Lorentz transformations in Relativity is solely the product of denying the availability of an intermediate reference frame for the propagation of the waves, such as the mercury in this case, or the aether in the TEM-wave case studied here. The velocity c in this case was the velocity of gravity waves on mercury, demonstrating that there is nothing special about the velocity of light if there is an aether to propagate it.

3F. The ‘empirical foundations’ of Relativity, in the light of CT.

Two of these, the clock paradox and the relativistic mass increase, have already been discussed. Another, the supposedly ‘gravitational’ redshifts of the Sun and stars, is dealt with in the next Section as a transmission effect, as is the cosmological redshift. A further three, the Mössbauer-effect observations of redshift, gravitational lensing and the perihelion advance of Mercury are dealt with in Section 5.

4. TEM-waves and an aether in random motion.

4A. Four expected effects.

See Table 1 for a summary. There are three effects that one may expect to be imposed upon transmitted TEM-waves and one radiative one which is inherent in the aether motion itself. First, relative to the line of sight, the transverse components of the random motion will locally move the wave-train orthogonally[65], thus lengthening its path, stretching the wave and yielding a ‘redshift’, here called Random Transverse Velocity (RTV) redshift. Second, with respect to a given propagation path, the longitudinal components of the aether random motion will modulate the TEM wavelength, causing wavelength dispersion of a formerly monochromatic wave. This we will call Random Longitudinal Velocity (RLV) (spectral) line-broadening or dispersion. Third, random transverse deflection of the wave constitutes a scattering mechanism (RTV deflection scattering). Fourth, the random modulation of aether local density, whether associated with the aether’s inherent random motion or due to the random motions of particles, implies random acceleration of electric charge, so is sure to give rise to a low level of random TEM radiation. We will discuss, successively, each of these and the evidence for them.

But before that we must note four points:-

(1) Because of the charge nature of the aether continuum, the motion of a charged particle will have an enormously greater effect upon the surrounding aether than an uncharged one, whose effect is confined to aether pumping. This factor is the ratio of the electrical force to the gravitational force between two identical particles. This ratio is $\sim10^{42}$ for electrons and $\sim10^{36}$ for protons. Hitherto there has not been an understood reason for these huge ratios. A corollary of this point is to render tenable the picture (Section 2B) of TEM-wave propagation around an Earth spinning in an irrrotational aether. The Earth is composed of predominantly neutral particulate assemblages, so the amount of aether charge which is ‘particle-tied’ to them and carried around in the rotation is limited to their aether-pumping function and is like only a very small ‘contamination’ of a very deep (irrotational) pool of aether. It is the latter which dominates the propagation of the time-signal transmissions, though they can hardly be *wholly* unaffected by that contamination.

64 **Ives, H.E. & G.R.Stillwell**, Interference phenomena with a moving medium. *J. Opt. Soc. Amer.* **31**, 14-24 (1941a). This paper has been completely overshadowed by their paper in JOSA later in the same year (1941b, discussed below), in which they firmly espoused Relativity in an experiment designed to detect the transverse Doppler effect of Relativity.

65 N.B. NOT *along* the wave front if it is curved.

(2) The factor governing the size of any transmission effect upon TEM-waves is the ratio of the aether motion velocity to that of wave propagation. For a particle-tied aether and a gas obeying Maxwell-Boltzmann statistics, the effect will therefore vary as $(\boldsymbol{T/m})^{½}$, where $\boldsymbol{T}$ is the absolute temperature and $\boldsymbol{m}$ is the particle mass.

(3) The effects, per unit path length, depend also on the number of repetitions, i.e upon $n^{1/3}$, where $\boldsymbol{n}$ is the particle number density in the gas.

(4) Because the influence of a particle upon its surrounding aether is to be regarded as indefinitely extensive the aether at any point therefore derives its velocity from the contributed influences of many particles in the neigbourhood and the velocity of the aether continuum acquires a somewhat-smoothed and lower amplitude random variation along any spatial traverse. This diminution is on top of that inferred in (1) above.

4B. Random Transverse Velocity (RTV) and Aberration-related (AR) redshifts.

The transverse component of the aether random motion produces a situation analogous to that of repeating aberration - the wave is stretched because the hypotenuse of successive velocity triangles is always longer than the direct path. In Relativity this stretching, or redshift, in the aberration case is recognized under the name of 'transverse Doppler effect'. It has been commonly accepted that Ives & Stillwell (1941b)[66] successfully demonstrated the transverse Doppler effect, notwithstanding that the line of sight used in their experiment made an angle of only 7deg (instead of 90deg) to the line of motion of the emitting ions. A subsequent refinement of the same experiment (Mandelberg & Witten 1962)[67] still only achieved a precision of 5%. Because the difference between the velocity triangles as seen in Relativity and in CT is so small at the velocities involved, these experiments equally demonstrated a single 'episode' of RTV redshift. In recognition of their differing theoretical bases and because the difference becomes significant at sufficiently high velocities I will refer to the CT-based form as Aberation-Related (AR) redshift. The latter is of central importance in the CT model for quasars (Section 8).

There is no way that a transverse velocity component could produce a wave-shortening (blueshift), so repeated operation will cause the redshift to grow in direct proportion to the number of repetitions, i.e. directly proportional to the path length under consideration, though individual increments will, of course, vary statistically according to the velocity statistics of the particles controlling the aether motion. I reason below that this mechanism has the propensity to explain the cosmological redshift and therefore to eliminate Big-Bang cosmology from consideration. In anticipation of this result, depriving the Hubble redshift of its primary cosmological significance, I will henceforward refer to it as the 'cosmic' redshift, though it remains a measure of distance.

Although RTV redshift does involve making the transmission path longer, note particularly that this lengthening is entirely because the composition of velocities makes successive velocity triangle hypotenuses greater than $\boldsymbol{c}$ (or its equivalent in the medium concerned). So it has no effect upon the transmission time.

The exact mechanism of the transverse deflection of the wave requires comment. In previous work (see footnote 4) I have proposed that the waves suffer angular deflection because the transverse motion, at this scale, of the aether relative to an adjacent point along the wave path, resulted in a small rotation of the aether and of any wave-front riding upon it. Recognition (above) that the huge charge density of the aether must render it virtually irrotational makes this proposal hard to sustain. I therefore suggest the following. Random motion of the aether, induced by the motions of particles within it, must result in random local variations of aether charge density, though (as previouly noted) very small in relation to the mean. As noted in Section 2D, the velocity of TEM-wave propagation, as specified in the CT embodiment of Maxwell's equations, varies with aether density, so it follows that the transverse gradients of aether density will bend/refract the propagation vector accordingly. This is an effect of the required kind, though not quantitatively so directly related as the other to the parameters of the aether motion. In the interests of continuity, for the present paper the effect will nonetheless continue to be referred to as the RTV redshift and this is done in Table 1 also.

It appears that a very similar interpretation can be applied to the Compton redshift associated with the non-colinear motion of an emitting electron following a collision.

4B.(i) *Ground-level observation of the RTV redshift - the Sadeh et al experiment and the Hubble expansion.*

It appears that, unrecognized by them or by their readers, Sadeh *et al*. (1968)[68], from the US Naval Laboratory, Washington, D.C., observed this redshift using caesium clocks and radio waves over ground-level paths. They took five caesium clocks from Washington. They left two at Cape Fear, N. Carolina, their ticks being coupled to a radio transmitter. The other three were put on a truck, sited for one week at successive sites along a northeasterly path up to 1500 km from Cape Fear, eventually reaching Yarmouth, Nova Scotia, and their ticks compared with those received by ground wave from C. Fear. The clocks were intercompared at each site, to check for stability, and with the US master clock upon return to Washington. It was found that the received tick rate at the truck was progressively and approximately linearly slower than the truck clocks, the greater the distance. Comparison between C. Fear and Washington, a 500 km northwesterly path, provided a result closely fitting the relationship. Reading from their plot of results I get an approximate redshifting rate $\underline{\boldsymbol{R_1} = \mathbf{1{\cdot}75 \times 10^{-20}}}$ **<u>per cm</u>** with <25% uncertainty.

Sadeh *et al*., though admitting to puzzlement, offered to interpret their results as an effect of mass, but their

[66] **Ives, H.E. & G.R.Stillwell**, *J. Opt. Soc. Amer.* **31**, 369-374 (1941b).

[67] **Mandelberg, H.I., & L.Witten,** Experimental verification of the relativistic doppler effect, *J. Opt. Soc. Amer.*, **52** (5), 529-536 (1962).

[68] **Sadeh, D., S. Knowles & B. Au**, The effect of mass on frequency. *Science*, **161**, 567-569 (1968).

reasoning is very obscure and apparently distracted most people from discussing their results.

Now it is readily shown (see Appendix A of Osmaston 1996b listed in footnote 4) that the path-stretching (redshift) increases as the *square* of the transverse displacement, so actually depends on ***T/m***, not on its square root. Accordingly in 1972 I perfomed a crude trial extrapolation of the expected value of the Hubble parameter $\boldsymbol{H_0}$ derivable from the Sadeh *et al* result, using the relation

$$R_{egs} \;=\; R_1 \;.\; \frac{T_{igs}}{T_a} \;.\; \frac{m_a}{m_{egs}} \;.\; \left[\frac{n_{egs}}{n_a}\right]^{\frac{1}{3}}$$

where the suffix *a* refers to air and the suffix *egs* refers to extragalactic space, by which I intended to mean the vast voids seen to exist between the skeins rich in clusters of galaxies. The parameter values used for air were standard pressure, 290K and molecular weight 29 and, for 'space', they were the then-accepted[69] Friedmann expanding universe density 10^{-28} g/cm^3, cosmic microwave background (CMB) temperature 2.75K, and $\boldsymbol{m}$ = 1 (monatomic H). Maxwell-Boltzmann velocity statistics were assumed for both. The result was

$$\boldsymbol{H_0}_{\text{estimated}} = 59.5 \text{ km/s/Mpc}$$

seemingly a remarkable encouragement[70].

In fact, of course, the Friedmann density was a hypothetical *mean* for the entire Universe whereas we need the certainly much lower extragalactic space value, occupying the majority of any long-distance sightline. However, we have noted above the immensely enhanced effect (up to a least 36 orders) upon aether motion that ionization of the gas can play. The foregoing extrapolation carried the implicit assumption of identical, and probably low, ionization in air and in extragalactic space, but it seems likely that a quite moderate degree of additional ionization in extragalactic space could suffice to enable the density there to be as much as eight or more orders below the value used, while still achieving an acceptable Hubble parameter agreement. As rough guidance on acceptable density levels, Hoyle *et al* (1993)[71] were prepared to consider 10^{-27} g/cm^3 as the mean density in clusters of galaxies. As to the validity of using the CMB temperature, the discrepancy that would be introduced by interpreting (as many people have) the Lyman α forest of absorption lines in quasar spectra as due to numerous hot clouds at intervening distances can be avoided in the new quasar model (Section 8). Further justification for my use of the CMB temperature, as being the real black-body temperature of extragalactic space, as also argued by Marmet (1995)[72], is discussed below. Strictly, of course, what we really need for an RTV redshift calculation is the gas kinetic temperature but that is a difficult problem.

Provisionally, therefore, I conclude that the Sadeh *et al* experiment demonstrated the cosmic redshift process and that this is RTV redshift. The experiment should be repeated, preferably under several differing conditions, to check the dependence upon temperature and ionization. Indeed Sadeh *et al* did conduct a single further test using a SW-directed path, obtaining a higher redshifting rate, but there is no way of distinguishing temperature from ionization in this case. It is significant that the redshifting rate for air, determined from their experiment, can be roughly estimated to have been only about 10^{-13} of the rate which would have resulted if the transverse motion of each molecule along the path had produced its full corresponding transverse transport of all the aether at that point. This factor is a measure of the extremely dilute action of those particle motions upon the aether as a whole, and would support our earlier inference that the redshift is not a direct result of the transverse motions but is a refraction process associated with the aether density variation resulting from its random motion.

Note that because the redshifting is a compound incremental process the magnitude should grow exponentially with distance. To achieve the near-linear character of the Hubble law, as observed, other factors must be present with the opposite effect. Consequently an imbalance of these factors will result in a variation of the cosmic redshift rate with distance. In that redshift is a stretching of the wave energy into a longer spatial volume, the received amplitude will vary inversely as the square of the redshift ratio. This attenuation in the energy arrival rate at the receiver is due to the scattering associated with TEM-wave transmission. In a quantum theory context, the continuous variation of quantum energy during transit, implied by RTV redshift, would present a major problem and is one aspect of why quantum theory of electromagnetic waves *in transit* is incompatible with the continuum theory proposed herein. Indeed, McCrea's criticism[73], on a quantum theory basis, of Freundlich's 1954 redshift proposals (discussed below) drew attention to just this difficulty by arguing that the energy reduction of the redshifted waves should (but do not) turn up as a lot of radio-frequency quanta. A similar failure applies to the non-Doppler redshift proposals of Marmet[74]. He had assembled a valuable and even more extensive collation of redshift examples than had Freundlich or can be discussed below, but he again invokes a quantized inelastic transmission of photons.

4B.(ii) ***What happened to the 'lost ticks'?***

In the Sadeh *et al* experiment, and indeed in all cases of purely RTV redshift, the source and receiver remain, in principle, the same distance apart, so fewer waves or ticks arrive than left the source in a given interval of time. This

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69 **Allen, C.W.** *Astrophysical Quantities, 2nd edition*, Univ. London, Athlone Press. 291 pp. (1963).

70 The use of 2 (molecular hydrogen) for the particle mass quadruples the density requirement for achieving this figure.

71 **Hoyle, F., G. Burbidge & J. V. Narlikar** A quasi-steady state model with creation of matter. *Astrophys. J.* **410**: 437-457. (1993).

72 **Marmet, P.,** Origin of the 3^0 K radiation. *Apeiron* **2**(1):1-4. (1995).

73 **McCrae, W.H.,** *Phil. Mag., Ser.7,* **45**, 1010-1018 (1954).

74 **Marmet, P.** A new non-Doppler redshift. *Physics Essays* **1**(1):24-32 (1988); Redshift of spectral lines in the Sun's chromosphere. *IEEE Trans. Plasma Sci.,* **17** (2):238-244 (1989); Non-Doppler redshift of some galactic objects. *IEEE Trans. Plasma Sci.* **18** (1):56-60 (1990).

apparent nonsense is attributable to the RTV deflections directly associated with the redshift process (Section 4D, below). Each transverse deflection involves a stretching of the wave, so the wave train is being stretched in a manner analogous to a separative motion of source and receiver. The energy of the 'lost ticks' has gone into the scattered waves, the aether at each RTV action point acting as a re-transmitter of the result. More precisely, since in the Sadeh *et al* case each 'tick' was probably made up of lots of waves, each of whose wavelength became longer, the duration of each 'tick' became longer, because the receiver circuitry was probably designed to count a prescribed number of waves to construct as an individual tick.

4B.(iii) ***Redshift-velocity conversion; the relativistic Doppler effect.***

The redshift observations[75] have long indicated a broadly linear increase of *redshift* ($z = \delta\lambda/\lambda$) with distance. That is in fair accord with what RTV redshift does in CT. Since velocity is not involved there is no problem with a $z = >1$ redshift, in which the waves have been stretched to $1 + z$ times their emission lengths.

More precisely, sampling two redshift intervals from the redshift (z) versus apparent magnitude (m) plot of 56 Type 1a supernovae assembled by Narlikar *et al* (2002, Fig.2)[76] gives the following approximate readings:- m = 17.5, 22, 25.5; z = 0.04, 0.33, 1.77. Interpreting, for each interval, the magnitude differences as distance in straight-forward inverse square law attenuation terms (i.e. neglecting scattering and dust) it is seen that, for the nearer interval, a 7.95-fold distance increase is accompanied by a 8.25-fold increase in z. For the more distant interval the corresponding ratios are 5.013 and 5.3. Unless the inequalities are due to observational uncertainty both intervals show that the redshift ratio increases slightly faster than the apparent distance. This may support the compound incremental character of the RTV redshift mechanism. Allowance for more rapid attenuation would have the opposite effect.

In the Big-Bang-plus-Relativity frame, however, a problem arises when the redshift is converted to recession velocity by the relativistic Doppler effect formula $[1+Z]^2 = \frac{1+v/c}{1-v/c}$. As seen in the table below, this imposes a non-linearity in the z-velocity relation to prevent a velocity > c being inferred.

Z	0	0.25	0.5	1	2	3
Inferred v/c	0	0.22	0.38	0.6	0.8	0.88

The result is an apparently faster increase of velocity with z, or distance, yielding larger H_0 at the near end of the range, with the implication, much discussed recently, that the rate of expansion of the Universe has apparently been increasing. This has a complicating implication for the cosmological constant Λ, a theoretical parameter introduced by Einstein to provide for the study of varying expansion behaviour over time. Not the least of the complications (apart, of course, from needing to find a mechanism to bring the variation about) is to avoid arriving at a conclusion that would depart from the philosophically desirable Copernican view that we do not occupy a privileged location in the Universe in which 'our patch' is expanding differently from the rest. Differences in look-back time avoid this being an inevitable result but would arise if the gradient of the expansion rate were too steep.

Fortunately, as noted, the situation is much simpler in CT, so a single comment will suffice. In CT the cosmic redshift (as RTV redshift) depends on the density and temperature along the path. So the observed grossly non-uniform distribution of galaxies and clusters encourages one to expect variations in redshifting rate along any given path and along different paths. Observationally, van den Bergh (1992)[77] appears to have been the first to draw attention to differences in the Hubble parameter obtained along different sightlines (to Virgo and to Coma clusters) and to the problem it raises for the expansion rate interpretation. There is in CT (or in any other theory) no *a priori* reason, however, to avoid seeing some such variation as true Doppler effect due to real relative motions.

4B.(iv) ***Stellar examples of RTV redshift. (1) - The solar redshift.***

This was an important aspect of Freundlich's (1954)[78] argument for a new kind of redshift. Twenty-four years earlier[79] he had found that the absorption line redshift present over most of the solar disc is less than half the GR prediction of 0.635 km/s (use of Doppler-equivalents avoids involving the wavelength) at the solar surface, but that along all radii this rose steeply in the outer 10% of the disc radius, apparently heading for a value in excess of the GR value at the limb itself. He had even (as we now do below) proposed that the redshifting mechanism was transmission-path dependent, varying with $\mathbf{cosec}\ \theta$, θ being the solar zenith angle of emergence.

Extensive work by Adam and her colleagues[80] using a sophisticated Fabry-Perot interferometer has confirmed and elaborated this picture at wavelengths ranging from 4400-6270A. Outstanding is the large variation in redshift from line

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75 **Hubble, E.,** A relation between distance and radial velocity among extra-galactic nebulae: Proceedings of the National Academy of Sciences (USA), **15**, 158-173 (1929): **Sandage, A., A. Saha, G. Tammann, L. Labhardt, N. Panagia & F. Macchetto,** *Astrophys. J. Lett.,* **460**, p. L15. (1996).

76 **Narlikar, J. V., R. G. Vishwakarma & G. Burbidge**. Interpretations of the accelerating Universe. *Pub. Astron. Soc. Pacific* **114**:1092-1096. (2002)

77 **Van den Bergh, S**., The age and size of the Universe. *Science* **258,** 421-424 (1992).

78 **Finlay-Freundlich**, **E.,** *Phil. Mag., Ser.7,* **45**, 303-319 (1954); *Proc. Phys. Soc.* **67A**, 192-193 (1954); see also **E. F.-F.** *Scientia (Asso)* **94,** (8),181-187 (1959).

79 **Freundlich, E.F., A. von Brunn & H. Brück**, *Zeits. f. Astrophys.* **1**, 43 (1930).

80 **Adam**, **M.G.**, Interferometric measurements of solar wave-lengths and an investigation of the Einstein gravitational displacement *Mon. Not. R. Astron. Soc.* **108**, 446-464 (1948); *Mon. Not. R. Astron. Soc.* **112**, 546-569 (1952); *Mon.Not.R.Astron.Soc.* **115**, 409-421 (1955); *Mon.Not.R.Astron.Soc.* **119**, 460-474 (1959); **Nichols, S. & S.V.M.Clube**, *Mon.Not.R.Astron.Soc.* **118**, 496-503 (1958).

to line, even for closely similar wavelengths, thus ranging from 5-170% of the GR value near the centre of the disc. The only correlation for this variation is a strong one with (absorption) line strength. Near the limb the redshift rises and at the limb can attain at least 120% of the GR value, with a further rise just beyond the limb, attributed to "chromospheric scattering". Specifically, Adam (1948) was able to discount the often-cited hypothesis of St.John (1928)[81] that the departures from the Relativity value could be explained in Doppler terms as motions in the Sun's atmosphere.

Nevertheless, the popular GR-supporting statement today is that the GR redshift is present in the solar observations. The GR prediction of solar redshift is based upon regarding light as photons possessing mass, which makes the photons lose energy as they rise against the pull of gravity. As noted already, CT does not recognize TEM-waves as representing the right kind of aether motion to provide them with the mass property. CT does, however, offer the alternative that it is *all* RTV redshift, the variation across the disc being due, as Freundlich basically envisaged, to zenith-angle variation of the transmission distance through the solar atmosphere but combined with a further limb effect due to refraction increasing the path length but routeing more of the path at a higher, cooler level in the atmosphere. This could explain the further rise in redshift, just beyond the limb, mentioned above.

A further feature, reported in the later investigations[82], is that the lines are asymmetrical. The GR interpretation can neither explain the large line-to-line variation of redshift nor the evident change of redshift along the build-up path of individual absorption lines, because the possible range of gravitational potential within the photosphere is far too small. However, it could readily be explained qualitatively in terms of RTV redshift, representing variations in depth to the line's reversing level in the photosphere, with a corresponding variation in the path length for redshift build-up. This matter needs more quantitative examination than can be given here.

The form of the redshift rise towards the limb enables the radial thickness of the redshifting layer (assumed uniform for simplicity) to be estimated to be less than 14,000 km. The redshifting rate in this layer must therefore be >100 times that obtained by extrapolation from the Sadeh *et al* (1968) result for air, using pertinent (but approximate) gas parameters (***P, T, m***). This relates, not surprisingly, to the presence of a much higher degree of ionization than in air. The surprise is that the factor is not higher. A more rigorous estimation would be interesting.

A further observation, possibly of RTV redshift, that forms a link between this section and the next is that of Tchimoto & Kurokawa (1984)[83], who reported that redshifts in Hα at solar flare onset are frequently seen.

4B.(v) ***Off-limb extension of the solar redshift***.

If, as inferred above, the solar redshift is indeed RTV redshift, namely a transmission effect as the light passes through the solar atmosphere, an off-limb continuation of that effect should be observable if TEM-waves from a distant object are viewed through the inner corona. This effect appears to have been observed in the 2.292 GHz carrier signal from Pioneer 6 as it passed behind the Sun ('superior conjunction') in 1968 (Merat *et al* 1974)[84]. The communications TEM-wave carrier from the spacecraft had been successfully monitored during this passage until it was lost when its transmission path came to within a solar diameter of the solar limb. From a point where the path had passed 4.25 solar diameters above the limb the received frequency (after removal of a steady transmitter drift) progressively decreased, exhibiting a redshift rising to 11±0.4 m/s Doppler-equivalent at the signal-lost point. The effect was repeated symmetrically as the spacecraft emerged on the other side of the Sun after occultation. Interpretation as a continuation of the solar disc RTV redshift is reinforced by the observed concurrent widening of the carrier's (initially monochromatic) spectral content (Goldstein 1969)[85] thus representing the RLV dispersion uniquely associated by CT with the RTV redshift process (see Sections 4C, 4E below). The explanation offered by Goldstein for this dispersion was electromagnetic turbulence in the corona but a mechanism for achieving this was not elaborated upon. The carrier redshift was some two orders of magnitude bigger than the pulsar *pulse* delays observed by Shapiro *et al* (1971)[86] in connection with the increase in path-length associated with the solar gravitational light deflection. The lack of any effect upon the delays caused them to doubt the reality of the Pioneer redshift but such absence is to be expected because, as noted earlier, the RTV redshift process affects the wavelength but *not* the transmission time. It is clearly desirable to repeat this experiment with a sightline getting even closer to the sun's limb, to see if there is continuity with the solar disc and limb redshift.

4B.(vi) ***Stellar examples of RTV redshift. (2) - Other stars***.

Many stars have much more extensive and much hotter atmospheres than the Sun. The existence of a stellar-class-dependent excess redshift, referred to as the K-effect, or K-term, has been recognized for more than 60 years and was one of Freundlich's reasons for proposing a new redshift mechanism in 1954. The K-term (Allen 1963) is large for Wolf-Rayet (W-R) stars and for O-stars, decreasing for A and F and reappearing as a small value for M-supergiants. On the basis of masses determined in other ways, the redshift is almost always well above what could be attributed to a GR redshift, but uncertainties about star-streaming effects[87] have enabled doubters to evade the idea of intrinsic stellar

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81 **St. John, C.E.,** *Astrophys. J.* **57**: 195 (1928).

82 **Adam, M.G., P.A.Ibbetson & A.D.Petford**, *Mon.Not.R. Astron.Soc.* **177**, 687-708 (1976).

83 **Tchimoto, K. & Kurokawa, K.** *Solar Physics* **93,** 105 (1984).

84 **Merat, P., J-.C.Pecker & J-.P.Vigier**, Possible interpretation of an anomalous redshift observed on the 2292MHz line emitted by Pioneer-6 in the close vicinity of the solar limb. *Astron.Astrophys* **30**, 167-174 (1974).

85 **Goldstein, R.M**. Superior conjunction of Pioneer-6. *Science* **166**, 598-601 (1969).

86 **Shapiro, I.I. & 7 others**,. *Phys.Rev.Letters* **26**, 1132-1135. (1971).

87 **Weaver**, **H.F.**, In: A.Beer (ed.), *Vistas in Astronomy, Vol.1,* Pergamon, London. 228-238 (1955).

redshifts. Anyhow, when faced with the possible existence of a new process, statistical arguments of this sort carry less weight for, in principle, it only needs one well-proven example to prove the case.

Convincing support for intrinsic redshifts arises when there is a good reference object for velocity comparison. A good example is the apparent different recession velocities of the O and B stars relative to the Orion Nebula in which they are embedded (Johnson 1965)[88]. In the galactic cluster NGC 3293 Feast (1958)[89] found that radial velocities of recession, relative to interstellar lines, increased strongly with absolute magnitudes brighter than -4.5. Rubin (1963)[90] decided the K-term is a real effect for cepheids and O and B stars.

A much better velocity standard is available in the case of binary stars, for which the true (median) velocity of each member must be the same. Relativists have widely claimed that the redshift of the white dwarf Sirius B, the binary companion of Sirius A, exhibits the GR redshift. The Sun, seen at stellar distance, would also appear to do so. In fact, Sirius B appears unique in this regard, most white dwarfs so far observed having masses some 20% too small to explain their redshifts on a GR basis[91]. Because white dwarfs are so hot, variations in the not-very-great depth of their atmospheres could have a big effect on the redshift. At the other end of the size scale, it is now well established[92] that the extremely hot W-R stars, when found in binaries, exhibit excess redshifts of 100 - 200km/s, relative to their companions which themselves range in class from B1 to W-R. This means that the true intrinsic redshift of W-Rs is the sum of those of the W-R component and its companion, possibly taking the value to around 250km/s.

Another approach was that of Trumpler (1935)[93]. He applied the Relativity gravitational redshift formula to the K-term determined for various O-stars, yielding masses in the range 75-340 $M_\odot$, placing them well away from the Eddington mass-luminosity curve, especially for M_{bol} = -5 and brighter. He also found, within a number of star clusters, bigger K-terms for O than for B stars, casting doubt, on a velocity interpretation, upon the long-supposed longevity of such clusters.

CT brings fresh light to bear on this problem because of the predicted RLV line broadening associated with RTV redshift. We deal with that next.

4C. RLV line-broadening.

Whereas RTV redshifting is a unidirectional effect, RLV line broadening is a random effect, so here it is the variance that gets built up in proportion to the number of repetitions.

It has long been recognized (e.g. Struve)[94] that O and B stars, in particular, exhibit line widths far in excess of that expected on the basis of other indications of temperature (colour, excitation levels). This excess has generally been attributed to rotational broadening, although some studies have favoured a contribution from atmospheric turbulence with a Maxwellian velocity distribution. On this basis Struve (*loc. cit.* p.130) derived equatorial velocities which showed a “startling decline at F5 [which] is unquestionably real”. The problem of how to remove all this angular momentum has remained unresolved.

In the CT context the excess line width of such stars, with its similarly varying K-term redshift, suggests that there may be no need to invoke excess rotation at all, both being parts of the same process in deep hot atmospheres, which decline sharply at around F5, possibly as the growth in metallicity increases the radiative efficiency.

In Britain in 1958 two early experiments in plasma containment for thermo-nuclear fusion, named ZETA and SCEPTRE III, encountered observational conflicts as to the temperature attained[95]. Spectral line widths of O^{V} and N^{IV} used for temperature observation were, in both cases, inferred to show that ~5 MK had been attained. But this conflicted with four other forms of observation. Not nearly enough energy had been put in; the electrical conductivity and He^{I} ionization suggested no more than 0.25 MK; the neutron output was found not to be isotropic, so that few of them could have had a thermal origin.

Spitzer[96] became interested but could find no clear solution, commenting that the matter could be “of great interest in basic physics”. I have not followed these matters subsequently but this appears to be a clear case of RLV line broadening along the sightline in the plasma, giving a greatly excessive indication of temperature. This inference could be significant in view of continuing work on nuclear fusion.

A further situation in which RLV line-broadening will surely need to be taken into account is, as indicated in Section 2G, in stellar interiors, where the effect is to increase opacity.

4D. RTV deflection scattering.

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88 **Johnson**, **H.M.**, *Astrophys.J.* **142**, 964-973 (1965).

89 **Feast**, **M.W.,** *Mon. Not. R. Astron. Soc.* **118**, 617-630 (1958).

90 **Rubin**, **V.C.,** *Astrophys.J.* **138**, 613-615 (1963).

91 **Weidemann**, **V.**, *Ann. Rev. Astron. Astrophys.* **28**, 103-137 (1990).

92 **Kuhi, L.V., J-.C. Pecker & J-.P.Vigier**, Anomalous redshifts in binary stars. *Astron. Astrophys.* **32**, 111-114 (1974); **Marmet, P.,** *IEEE Trans. Plasma Sci.* **18**, 56-60 (1990).

93 **Trumpler, R.J.,** Observational evidence of a relativity redshift in class O stars, *Pub. Astron. Soc. Pacific*, **47**, 249-256, (1935); *Ibid* pp 234-248 (1935)

94 **Struve**, **O.**, *Stellar Evolution.* Princeton U.P, Princeton, N.J. 266 pp. (1950).

95 **Thoneman, P.C. & 11 others**, *Nature* **181**, 217-220 (1958); **Kaufman, S. & R.V.Williams**, *Nature* **182**, 557-558 (1958); **Rose, B., A.E.Taylor & E.Wood,** *Nature*, **181**, 1630-1632 (1958).

96 **Spitzer, L. Jr.,** *Nature* **181**, 221-224 (1958).

As recorded in the Introduction, an apparent example of this phenomenon was the trigger for my early development of CT in 1959-60.

Comprehensive measurements, required for the development of airborne astro-navigation, showed that at heights of 5-12 km the sky brightness distribution could not be explained by a Rayleigh scattering theory, even when modified for the effects of ground reflection, dust and haze[97]. The most notable discrepancies between the modified Rayleigh theories (developed for lower heights)[98] and these observations are the unpredicted large increases in intensity, both as the sight line approaches the direction of the Sun and as it approaches the anti-solar point. The latter effect appears, when the Sun's altitude decreases below 40^0, as an upward bulge of the isophotes from a previously horizon-parallel disposition. Also the observed intensity, even at right angles to the Sun, is generally greater than can be attributed to a plausibly impure atmosphere. These discrepancies seem to increase with the height at which the observations are made, which is not to be expected if airborne impurities are the cause. Moreover, the phenomenon appears to be manifest in space as the *gegenschein*, a well-known brightening of the night sky around the antisolar point but for which no material cause has been found. [Note that the zodiacal light is not in this position and is a wholly different phenomenon.]

These discrepancies were the motivation that enabled me to make substantial (unpublished) progress with this matter (see footnote 1). This used an embryonic form of the present proposals, in which it was assumed that random motions of the aether, induced by the atmospheric molecular motions, produced *deflection* scattering of the sunlight propagation direction. The argument runs like this (a full treatment was given in Appendix B of Osmaston 1996b - see footnote 4).

The random transverse displacements involved in RTV redshifting produce random changes in the propagation direction. If θ is the angle beteen the source-line from the observer and the direction of arrival of the scattered light, the light from a (impossible!) point source reaches an observer from a cone of ever-increasing angular range (2θ), the further the light has been transmitted. The probability of such arrival, however, decreases strongly as θ increases. But as θ approaches 2π all those probabilities converge and the intensity rises. Rigorous treatment shows that if the number of scattering actions tends to infinity the sky intensity distribution will be dominated by the product of an attenuation function (of θ and ***cosec*** θ)which has infinities at the source direction and 2π. There are further infinities at 4π, 6π, etc. but the attenuation function will, in the practical case of a source point of finite size and intensity, probably make their contributions negligible. It is important to note that the light directed towards the observer from an annulus of radius θ and width $\delta\theta$ continues to be scattered in both the increasing-θ and decreasing-θ directions until it actually arrives. The probabilities for the latter all converge upon the source and increasingly overprint the original image. Thus the precision of this overprint (limited only by the amplitude of individual scattering actions) ensures that detail of the source is not lost and a much-attenuated (and redshifted; also spectrally dispersed) virtual image of the source appears at the anti-source point. Thus the present proposal, by producing a very large number of very small individual scattering actions, escapes the source-blurring consequence that killed the quite different redshifting proposals of Finlay-Freundlich (1954, 1959), which involved a very coarse form of scattering.

Deflection scattering, with its complete independence of wavelength and its antisource point brightening, is thus very different from Rayleigh scattering, with its fourth-power dependence on wavelength. Just as with RTV redshifting, ionized media have much greater RTV scattering capability than neutral media. The Sun is our only source with enough brightness, relative to available antisource point luminance, able to manifest this effect.

The scattering action deprives the source of apparent intensity faster than is to be expected on the normal inverse square-law with distance. So it emerges in the astronomical situation that both the redshift goes up and the intensity down with distance faster than 'normal', thus (in the case of the cosmic redshift) adding to the impression of a linear Hubble law.

4E. Relationship between these effects.

All three of these phenomena, RTV redshift, RLV line-broadening and RTV scattering, derive from the same feature of the aether, namely its random velocity structure, so a close relationship between them in any given situation is to be expected. That between RTV redshift and RLV line-broadening is particularly worthy of comment. Unfortunately a direct numerical relationship between them is not simple to obtain because, as commented above, they depend on slightly differing parameters of the aether motion; the redshift depends on the aether density movements whereas the line broadening depends directly on the aether random velocity. Nevertheless, consideration of their relative build-up rates is instructive. For any given aether velocity statistics and magnitude (e.g. for any individual transmission path), if $\boldsymbol{R}$ is the basic RTV redshift rate per unit distance and Δ^2 is the basic rate of growth of line-width variance, the initial ratio $\boldsymbol{R}/\Delta^2$ will be a fixed quantity. The incremental rate being so small, both parameters will initially display an approximately linear increase but subsequently will be seen to grow exponentially with distance when the build-up of the effect has become substantial. Observationally, however, interest lies in the r.m.s. line-width, not the variance, so redshift will progressively outstrip line-broadening the more the processes are repeated. This will make the RTV redshift

97 **Tousey, R. & E.O.Hulburt,** *J. Opt. Soc. Amer.* **37**, 78 (1947); **Packer, D.M. & C. Lock,** *J. Opt. Soc. Amer.* **41**, 473 (1951);..... 97 contd.........**Barr**, **N.L.,** *Brightness of the atmosphere.* U.S.Naval Medical Research Institute Report (March 1953).

98 **Chandrasekhar, S.,** *Radiative Transfer*. Clarendon, Oxford. 393 pp (1950) ; **Chandrasekhar, S. & D. Elbert,** *Nature*, **167**, 51-55 (1951).

progressively easier to observe, despite the RLV line-broadening, and is relevant to the observation of the cosmic redshift. On the other hand, over relatively short paths at very high temperature the RLV line broadening will tend to swamp the RTV redshift, rendering its detection difficult. The solar corona offers a probable example, as did the nuclear fusion experiments discussed above, making it important, where possible, to look for disparities between line-width 'temperatures' and excitation temperatures. Even these, however, may depend more upon ion speeds due to the G-E field than to thermal ones. Thus true coronal temperatures may actually not be nearly so high as those quoted on the assumption of local thermodynamic equilibrium (LTE) even though this has seemed to be supported by the high ionization levels exhibited by emission lines. Emission lines, notably of O^{VI}, in the uppermost solar chromosphere are reported to be both redshifted and broadened[99] in what appears to be a clear combination of RTV redshift and RLV broadening. For ions characteristic of ~10^5 K the redshifts reach 10 km/s with line broadening 5-10 km/s, rising to 35 km/s at ionizations characteristic of 3 x 10^5 K. Anderson-Huang remarks that if the redshift were to be interpreted in velocity terms the corona would be emptied 'in a matter of days', asking And where is the corresponding upflow?

4F. Radiation generated by the aether's random motion - the cosmic microwave background (CMB).

This mechanism seems to give an appropriate qualitative account of the CMB, in the CT context. The efficiency of radiation generation will be extremely low, so the energy content of the CMB is a very poor measure of the energy content embodied in the random motion of the aether. This is important if, as proposed here, that energy content has been and still is the resource for continuing cosmogony, though now much depleted from its primordial level. In CT, there being no expansion, the drop in its temperature is solely the result of converting energy into mass. Both in Big-Bang cosmology and in CT the Universe has to be equipped with energy 'to get it going'. The difference in CT is that the resource is drawn upon slowly, not explosively. The present 2.73K temperature of the CMB radiation must represent a big drop from its primordial level but, I imagine, nowhere near the Big-Bang temperatures, so light element nucleosynthesis must be achieved in some other way. The perfection of the black-body distribution seems thermodynamically reasonable in that an infinite Universe, all doing the same, provides a surrounding for any part of it which is indistinguishable from a perfect cavity in which all radiation is re-radiated from the walls. Could the observed very slight and angularly local increments in the CMB temperature[100] then be a consequence of higher temperature contributions from the distribution of galaxies in those directions?

It is not clear to me whether the Maxwell-Boltzmann, or Bose-Einstein (as the case may be) statistics of the extragalactic medium are a material factor in this model of the CMB's black-body character or whether continuous RTV redshifting of the emitted radiation will obliterate this inheritance.

4G. The effect of RLV dispersion upon measurements of *c*.

As recounted by textbooks such as Ditchburn (1952)[101], a new determination of the velocity of light by Essen (1950)[102] suddenly made the accepted velocity of light increase by about 16 km/s in a remarkable but unexplained way. It may now be possible to explain this. Prior to that date all determinations, from Michelson onward, had used a shuttering method which chopped the light into pulses. Initially this was done with a toothed wheel but later a Kerr cell was used. With these the median determined velocity had generally fallen in the range 299,772 to 299,776 km/s. Close examination of the experimental accounts shows that they all effectively used an extinction method to determine the precise time difference that would fit the received pulse gaps between the transmitted ones. Essen, however, used microwaves in what might be called a whole-wave superposition mode, and obtained a figure close to 299,792 km/s, close to today's accepted figure, repeatedly determined by the same method.

The effect of the RLV dispersion mechanism in the case of a single pulse or wave is slightly to randomize their transmission time. This means that they acquire a blurring which spreads the front and back of the mean received pulse or wave. The backward spread then causes the extinction method to measure the statistically slower transmissions than average. The superposition method, however, places equal weight upon the front and the back of the wave, so gets a true mean value. A persuasive point as to the method-related nature of the velocity discrepancy is, as Ditchburn pointed out, that a Kerr cell determination carried out after Essen's publication again obtained the lower figure. The consistency of the velocity difference, despite differing experimental conditions (though probably similar temperature), suggests that variations of atmospheric refractive index, known to astronomers as 'seeing', were not the principal cause, but a deeper investigation is clearly warranted.

5. Other items in the 'empirical foundation' of Relativity.

5A. The Mössbauer-effect observations of 'redshift'.

99 **Warren, H.P., J.T. Mariska, K. Wilhelm, and P. Lemaire**, Doppler shifts and non-thermal broadening in the quiet solar transition zone: O IV, *Astrophys. J. Lett.*, **484**, L91-L94, (1997);
Anderson-Huang, L.S., The chromosphere-corona transition, In: *Solar composition and its evolution - from core to corona*, edited by C. Frölich, M.C.E. Huber, S.K. Solanki, & R. von Steiger, *Space Sci. Rev*., **85**, 203-213(1998).

100 E.g. **Coles, P.,** The end of the old model universe. *Nature*, **393**: 741-744 (1998).

101 **Ditchburn, R.W.,**. *Light*. Blackie, London, 680 pp. (1952)

102 **Essen, L.,** Velocity of light and of radio waves. *Nature*, **165**: 582-583. (1950).

The proposed abandonment in CT of the idea of photons with an equivalent mass raises questions about the terrestrial experiments[103] that have seemingly verified, rather precisely, the existence of the gravitational redshift of GR using the Mössbauer effect in ^{57}Fe and ^{57}Co. The method exploits the extremely narrow bandwidth of the 14 keV gamma rays emitted from the ^{57}Co nucleus and absorbed by ^{57}Fe, such that a very small change of the wavelength reaching the absorber will make the process go "off tune". It was found that vertical separation of source and absorber in the Earth's gravitational field caused the process to go off tune by the amount expected in GR. The 1963 experiments showed a similar effect to occur if centrifugal acceleration was substituted for gravitational, acclaimed as support for the GR principle of equivalence. But this is to be expected if, see below, the effect actually depends in both cases upon physical deformation by these forces.

At that time I wrote to a well-known weekly journal to point out that the gamma wavelength involved is comparable with the nucleus-to-electron-shield distance, both being of order 10^{-8} cm, and that this ‘cavity’ might provide resonance responsible for the narrow emission and absorption bandwidth rather than the current interpretation[104] that it is due to exceptionally small nuclear recoil upon emission. In that case, I suggested, since the support of the nucleus in any acceleration field would be bound to render the nucleus eccentric within the electron shells and make the "upward cavity" larger and the downward one smaller, it would have corresponding effects on the resonance wavelengths. The effect upon the gamma rays would thus be one of modification to the processes of emission and absorption[105], and not the in-transit modification implied by GR.

A referee replied curtly that "there is no place in atomic theory for an eccentric nucleus". My reaction then, as now, is that there certainly should be if experiments to this degree of precision are to be contemplated. It would indeed be a remarkable coincidence if my proposal yielded the same quantitative result as GR, but this cannot be ruled out until some atomic physicist has calculated whether the nuclear displacement stiffness is of the right order. The GR interpretation assumes the constancy of atomic properties under acceleration to a far higher precision (parts in 10^{-15}) than has been needed for (electron-structure-related) spectral calculation hitherto. If it were found that some such effect is to be anticipated, big enough even measurably to affect the result (a reliably precise calculation is unlikely to be feasible at this stage), then the GR interpretation would be vulnerable by reason of the close match with observation.

5B. Gravitational light deflection and lensing.

In GR this effect is associated with photons having mass, a view excluded in CT because TEM-waves do not give the aether the right motion to generate the mass property. But we saw in Section 2C that gravitation generates a radial aether density gradient - an electric potential gradient, the G-E field - around gravitationally retained assemblages, and we have noted (Section 2D) that under Maxwell’s equations a lower aether charge density lowers ***c*.** Consequently, TEM-waves following tangential paths will be refracted. Since the magnitude of the G-E field relates directly to the gravitational one, it is clear that the lensing in CT depends on the same parameters, including big-***G***, as that invoked in GR, but present uncertainty as to the exact gravity/G-E proportionality hampers further formulation. Experiment No.1 (Section 11) could help to clear that up if successful.

5C. Perihelion advance of Mercury.

This phenomenon has long been thought of as being exclusively explained by GR, but that is not correct. Many physicists[106] seem to feel that gravitational communication at velocity ***c*** is implicit in the relativistic formulation. Indeed Einstein himself considered that small changes were so communicated. In CT, as outlined above, gravitational communication is dependent upon propagation of an aether density gradient (= an electric field), with a build-up time to stabilize the result, since a step change of aether density is impossible. It is the sensing, by each particle, of the new aether density gradient that is regarded, in CT, as producing the statistical degree of reorientation that is the gravitational response. This means that the effective speed of communication is a bit less than ***c*.** In the case of an eccentric orbit a finite velocity of gravitational communication can have two effects. The first is a purely velocity effect and has long been known[107] to result in advance of only about 14 arcsec/cy (of the observed ~43 arcsec/cy). The second only arises if the gravitational pull is a specific response by the central body, as in CT, and means that the *magnitude* of the pull on the body at an instant is slightly out-of-date, corresponding to a slightly earlier separative distance. This is readily shown to

[103] **Pound, R.V. & G.A.Rebka, Jr.,** *Phys. Rev. Lett.* **3**. 439-441 (1959); **Champeney, D.C., G.R.Isaak & A.M.Khan,** *Nature* **198**, 1186-1187 (1963): **Pound, R.V. & J.L.Snider**, *Phys. Rev.* **140**, B788- B803 (1965).

[104] No reason seems ever to have been given as to why the supposed ‘recoil’ is so small in this case and in a few others, especially ^{67}Zn and ^{107}Ag , both with decay energies close to 93 keV, see **Greenwood, N.N. & T.C. Gibb,** *Mössbauer Spectroscopy*. Chapman & Hall, London, 659 pp. (1971). In my own experience it is usual for any conducting ‘cavity’ in the right size range to exhibit sharp resonance modes at a number of discrete frequencies, so the difference between thes e cases and Fe and Co is not a contradiction.

[105] Here, as elsewhere in this paper, I have had in mind that nuclear processes might, in slight degree, be susceptible to external influence and not inviolate properties (‘constants’) of that nucleus. In this case, since CT is not locked into the idea of a fixed photon energy being emitted by that decay, we can accept a resonance-controlled small modification of emission frequency, equal and opposite in the up and down directions.

[106] As did **Poincaré, H.** (1905) see footnote 44.

[107] See **Whittaker, E.T.** (1951) at p.208 (as cited in footnote 2).

result in additional angular advance of the orbit. In 1898 (republished in 1917), Paul Gerber[108], on the assumption that gravity is a communicated interaction, in the manner just described, at velocity ***c***, derived a formula for the advance that was identical with that incorporated 17 years later by Einstein (1915)[109] in his GR proposal based on space-time distortion, namely:-

$$\frac{d\omega}{dt} = \frac{6\pi G M_{sun}}{Pac^2\,(1-e^2)}$$

(period ***P***, major axis ***a***, eccentricity ***e***)

In fact Gerber inverted the problem, by inserting the then-measured value of Mercury's perihelion advance rate and got a value for ***c*** of order 300,000 km/s which he naturally interpreted as the velocity of light. Gerber's achievement was to make the treatment of gravitational potential both time- and route-dependent, as distinct from that of Weber which depended on position only. This means that straight-forward (Newtonian) field theory is no longer appropriate. In the case of Mercury, the prediction of the formula is well supported by observation[110], and the proposed mechanism of gravitational communication in the CT context renders this version of the 'gravity at velocity ***c***' interpretation appropriate.

Both the objections to Gerber's approach raised by Roseveare (1982)[111] in his attempt to demonstrate that of GR as being uniquely acceptable are invalid within CT. One was that Gerber's theory needed to be joined by an electrodynamic theory in which TEM-waves are regarded as particulate and mass-bearing, dependent upon velocity (concepts specifically excluded here), which would add a further perihelion advance, on top of the correct value. The other was that, again by treating TEM-waves as mass-bearing particles, an incorrect solar gravitational deflection of starlight would result. In CT, on the contrary, the view, as shown above, is identical in its effect to that adopted in GR, namely that the velocity of light becomes dependent upon the gravitational potential.

Note also that Roseveare's derivation of Gerber's result is confused. He purports (p.137) to be assuming a field-propagation-rate theory[112], in which gravity falls with recession velocity, and would result in perihelion retard, but then (p.137-138), apparently realizing his mistake, swaps (without saying so) to an intercommunication-response-time theory (like CT) and obtains the correct relation, thus actually validating Gerber's derivation. It is remarkable that this important *non-sequitur* was not picked up before publication.

6. The G-E field; essential element in a scenario for forming planetary systems.

6A. The solar planetary system.

My studies (Osmaston 2000, 2006, see footnote 4) of the dynamics of the Solar System have recognized the need to abandon the Kant-Laplace Single Contracting Solar Nebula (SCSN) model for its formation, as emphasized successively (but virtually unavailingly) by Jeans (1919)[113], Lyttleton (1937)[114], Gold (1981)[115] and M.Woolfson (many papers since 1960). Primary problems in this respect are (1) the tilt of the planetary dynamical plane, the 'invariable plane', relative to the solar equator (5deg 59min, using modern data[116]), (2) the 137,500-fold greater mean specific angular momentum (a.m.) of planetary material than the mean solar material from which it is supposed simultaneously (in SCSN) to have been formed and (3) the predominantly prograde rotations of the planets[117], notwithstanding that vorticity in a Keplerian disc is retrograde. Various attempts to solve (2) by seeking mechanisms that would partition a.m. outward from the Sun (e.g. Alfvén & Arrhenius 1972; Lynden-Bell & Pringle 1974)[118] have not demonstrated anywhere near enough partition

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108 **Gerber, P.**, Die räumliche und zeitliche Ausbreitung der Gravitation. *Zeits. f. Math. u. Phys.* **43**, 93-104 (1898); abstract in *Ann. d. Phys.* **22**, 529-530 (1898): republished (1917) as "Die Fortpflanzungsgeschwindigkeit der gravitation" in *Ann. d. Phys.* **52**, 415-441 by its editor, indignant that Einstein had failed to acknowledge this priority. In 1912 Einstein had written a principal obituary of Ernst Mach who in the later editions of his famous book (footnote 134) had referred to Gerber's work.

109 **Einstein, A.,** *Berlin Sitzungsberichte,* 831 (1915).

110 **Nobili, A.M., & C.M.Will**, *Nature* **320**, 39-41 (1986) though they noted that ephemerides calculations now assume its accuracy rather than looking for any discrepancy.

111 **Roseveare, N.T.,** *Mercury's perihelion from Le Verrier to Einstein.* Clarendon, Oxford. 208 pp**.** (1982).

112 In fact he proposes to use the form of delayed gravitational action-at-a-distance considered in the literature in which the 'central' body sends out a stream of 'gravitons' in all directions at finite speed and in a manner unaffected by the presence of any other body. The lack of interaction of the matter in one body with that in the other, but only with the distribution of moving gravitons, carries with it the hallmarks of a field theory.

113 **Jeans, J.H.,** *Problems of cosmogony and stellar dynamics*. Adams Prize Essay. Univ. Oxford, Clarendon Press, 293 pp. (1919).

114 **Lyttleton, R.A.,.** On the origin of the solar system. *Mon. Not. R. Astr. Soc.,* **101**: 216-226. (1941)

115 **Gold, T**., The early solar system and the rotation of the Sun. *Phil. Trans.R. Soc. London*, **A313**: 39-45. (1984)

116 **Davies, M.E., V.K. Abalikin, M. Bursa, T. Lederle, J.H. Lieske, R.H. Rapp, P.K. Siedelman, A.T. Sinclair, V.G. Tiefel, & Y.S. Tjuflin**, Report of the IAU/IAG/COSPAR working group on cartographic coordinates and rotational elements of the planets and satellites: 1985, *Celestial Mechanics,* **39**, 103-113, (1986).

117 In fact, this predominance is greater than has been generally recognized. As will be reasoned more comprehensively elsewhere, if the >90deg axial inclinations of Uranus and Pluto are treated as the result of impact actions, and are restored so that their satellites orbit them in the same directions as is overwhelmingly the case for the other planets, then 8 out of 9 planets are prograde.

118 **Alfvén, H. & G. Arrhenius**, Structure and evolutionary history of the Solar System III. *Astrophys. Space Sci.* **21**:117-176. (1973); **Lynden-Bell, D. & J.E.Pringle**. The evolution of viscous discs and the origin of the nebular variables. *Mon. Not. R. Astr. Soc.* **168**: 603-37 (1974).

capability and anyway are unavailing because the planets must have been formed from a total mass of 8 or more (some suggest up to 100) times their final mass, all of which must have had similar a.m. The Sun could never possibly have had all that a.m.; it would have spun to bits. So where did all that a.m. come from? It is futile to discuss the origin of the relatively minor a.m. incorporated in the planetary spins (3) until this question has been answered. A further well-known and very severe dynamical problem[119] is that viscous drag effects in a nebular disc will cause any protoplanet nucleus to spiral into the Sun in far less time (thousands of years) than it takes to build a planet, so an outwards push mechanism is essential to counteract this effect.

Efforts to circumvent this difficulty by arguing for the construction of the planets from solids after the nebula had been expelled have not elucidated the mechanism of that separation, and in any case there are strong chemical reasons (Osmaston 2006 (footnote 4) and in prep) for constructing them during the presence of the nebula. Another reason is that meteorites tell us that the major asteroids were already substantially complete at or around the time at which the nebula departed.

A new scenario under CT is proposed in which the protoSun was formed, quite possibly in an SCSN mode, and underwent thermonuclear ignition in one dust cloud. Somewhat later it then 'flew' into another with different dynamical axes, and an typical temperature of ~10 K, from which it acquired an outer addition to itself and a cool, high-density disc of new material from which the planets were formed. Uniquely, CT enables the dynamics of this acquisition to be that of quasi-polar infall, with quasi-equatorial outflow, in which the G-E repulsion of the dust-laden plasma pumps up its a.m. as it pushes the material outward in the disc, providing its hugely increased a. m. without drawing any from the Sun's rotation. A Keplerian orbital velocity structure does not apply at this stage because this is by definition a gas-dense disc situation. Although apparently not previously recognized, a similar a.m.-creating propensity is possessed by radiation pressure, much invoked (but not always convincingly) for driving the near-ubiquitous stellar mass-loss winds, but it is wholly inadequate here.

In this scenario the planets were *successively* nucleated as gravitational condensations in this disc outflow but much closer to the Sun, where magnetic coupling to the solar rotation ensured that vorticity was prograde (it is retrograde in a Keplerian disc). Each was then pushed outward by aerodynamic forces derived from the electrically-driven plasma flow, feeding smaller objects (growth material) past the larger ones. The planetary succession is thus a crude profile of the cloud through which the proto-Sun was passing, the duration of which now replaces nebular collapse times that apply in SCSN.

The scenario confers many benefits in the understanding of meteorite data. One is that the outward motion within the disc (the opposite of SCSN) explains why the refractory objects known as CAIs, which need to have had a prolonged baking close to the Sun, are characteristically ~2Ma younger than the chondrule melt droplets, formed in the asteroid belt, among which they are embedded (e.g. Hutchison 2004)[120]. This direction of movement is supported by the STARDUST finding[121] of a CAI fragment in the tail of comet Wild-2. Another is that the through-put feature (whereas SCSN is a once-for-all acquisition) can explain the acquisition and recording in CAIs of active ^{41}Ca (150ka half-life) which needs to have been produced in a stellar event not more than ~1Ma previously. This CAI record is in meteorites that come from the outsides of asteroids and is therefore among the last material to have been accreted by them, so may have been a feature of the late input from the cloud, but would constitute a very tight constraint upon SCSN completion time. This through-put ended when the Sun emerged from the second cloud and disc material then present was expelled to the cometary regions, without the reversal of flow implicit in the SCSN-T-Tauri wind scenario. Remarkably, as suggested later, similar dynamics appear relevant to the morphological evolution of galaxies.

A further feature of this scenario is that it explains the enhanced metallicity exhibited by the solar spectrum, to which reference has been made earlier. This enhancement must have come from the second dust cloud; the suggestion being, as discussed in Section 2G, that only the ~2.5% of material above the tachocline at ~0.71 $R_\odot$ would have been 'contaminated' in this way. Another compositional matter relates to the problem of the observed 160-fold depletion of lithium, relative to CI chondrite, exhibited by the photosphere[122], whereas Be and B are not depleted. Evidently the Li depletion postdates formation of the planets. Consideration of the FIP of Li offers an immediate answer; its FIP of 5.39 eV is below the 5.9-7.9eV range of the major elements that form the bulk of the solar wind, whereas Be (9.3eV) and B (8.3eV) lie well above it. Clearly, in the presence of the G-E field, Li ions have been subject to selective export from the Sun throughout its life, as a component of the solar wind, but the depletion we measure is what has happened during the past 4.5 Ga, following possible augmentation from the second cloud.

The main conclusion drawn is that the solar planetary system could not have been constructed in its observed dynamical form in the absence of the G-E field of the Sun. The same applies to some, at least, of its chemical aspects.

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119 **Lin, D.N.C., J.C.B. Papaloizou, C. Terquem, G. Bryden & S. Ida.** Orbital evolution and planet-star tidal interaction. *In*: Mannings, V., Boss, A. P., Russell, S. S. (Eds.), Protostars and Planets IV. Univ.Arizona Press, Tucson. 1111-1134 (2000).

120 **Hutchison, R.,**, *Meteorites: a petrologic, chemical and isotopic synthesis,* Cambridge Planetary Science: Cambridge, Cambridge University Press, 506 p. (2004).

121 **McKeegan, K.D., and the STARDUST preliminary examination team**. Isotopic compositions of cometary materials returned by the STARDUST mission. 16th Ann. V.M. Goldschmidt Conf., Melbourne, 27 Aug-1 Sept, 2006, (a CD) Abstr. No 01540; to be published in a supplement of *Geochim. Cosmochim. Acta*; see also *http://stardust.jpl.nasa.gov/news/status/060512.html*.

122 **Grevesse, N., & A.J. Sauval**, Standard solar composition, In: *Solar composition and its evolution - from core to corona*, edited by C. Frölich, M.C.E. Huber, S.K. Solanki & R. von Steiger, *Space Sci. Rev.*, **85** 161-174 (1998).

Dziemboski, W.A., Shortcomings of the standard solar model, In: *Solar composition and its evolution - from core to corona*, edited by C. Frölich, M.C.E. Huber, S.K. Solanki, & R. von Steiger, *Space Sci. Rev*., **85**, 37-43 (1998).

Some other points in this regard were discussed in Section 2C. More pointedly, it appears that the Earth owes its present 1 AU orbital distance from the Sun primarily to the action of the G-E field during its formation and this in turn is why the Earth has become a favourable site for us to develop and live upon. Further consolidation of the manifold part played by the G-E field among current observation of solar and solar system phenomena, based on Osmaston (2006, see footnote 4), is in an advanced stage of preparation.

6B. Exoplanetary systems.

Over the past 10 years of exoplanet searches it has become increasingly clear that a majority of exoplanet-harbouring stars exhibit enhanced metallicity (e.g Marcy *et al* 2000)[123], supporting the involvement of this new scenario. A second feature, repeatedly evident since the very first exoplanet discovery (51b Pegasi; Mayor & Queloz 1995)[124], is that many gas-giant exoplanets are seen so close to the parent star that they cannot have been there long. In the new scenario the star is enclosed by a dust-laden flow of material from near-pole to equator. This shields any close-in embryo planet from the intense stellar radiation until the star emerges from the cloud, the shielding dissipates and the system is revealed to us. A third feature is that the central star of such close-in planets is often, as in the 51b Pegasi case (~8 Ga on current stellar evolution timescales), far too old to have been formed with it in a single sequence.

These findings comprise strong support for the widespread action of the new scenario for planet formation, in which the G-E field plays an essential part. This, in turn, strongly and tangibly supports the new understanding of the gravitational process offered in Section 2.

Stellar binarity is such a widespread, nay almost universal, phenomenon that a link between planetary formation and the formation of binaries has long been sought, the problem being that capture requires either a third body or an energy loss mechanism. There are two principal classes of binarity; those of similar age and those of grossly disparate age. The former might be tackled via a pre-condensation fission route, so do not interest us here. The capture mechanism for those of disparate age could be approached via our two-stage scenario for disc acquisition. Such a disc, available a long time after that of the primary had gone, would provide a gas drag mechanism for capture of a passing star. Moreover, that passing star might be of any age, even a very young one, only just formed within the cloud from which the new disc had been formed. A possible example of such a system is Gamma Cephei, studied by Hatzes *et al* (2002)[125]. This is a very close-separation (18.5 AU) K and M-class binary, in which the larger of the stars (1.59 $M_\odot$) has a 1.7M_J planet, confirming (on our scenario) that the system has been into a second cloud. The substantial eccentricity of the planet's orbit may be due to the arrival of the second star but it introduces a point that we may note here in relation to our new scenario.

It appears that a substantial proportion of exoplanets pursue eccentric orbits, increasingly so for those of larger orbit radius and many increase in mass similarly (Marcy *et al* 2004)[126]. Gas drag during planetary formation is commonly thought of as a strongly orbit-circularizing influence, so the origin of this eccentricity needs consideration. In our scenario the direction from which the 'polar' infall streams arrive may actually be very oblique to the stellar axis. On the other hand the angular position at which the protoplanetary disc is initiated will tend not to depart substantially from low latitude on the star because of the need for assistance by magnetic coupling. Consequently the near-star flow from infall column to the disc may be quite a short cut on one side of the star and much longer on the other, resulting in correspondingly very asymmetrical flow strengths into the disc. This will progressively pump up the eccentricity of any protoplanet as it orbits and is pushed outward by the disc wind from its original close-in position. The planet will grow in mass as this proceeds.

7. The G-E field, neutron stars, pulsars, and the origins of cosmic rays.

One of the most remarkable aspects of star formation is "the presence of energetic outflows already during the earliest phases of protostellar evolution" (Königl & Pudritz 2000, p.759)[127]. The G-E field offered by CT is clearly a contender for driving such flows, but the question of whether radiation pressure is adequate to drive them is a topic of active debate, so will not be pursued here.

We turn, therefore, to a situation with extreme gravitational potential, namely the surface of a neutron star, with a correspondingly high expected G-E field. Based upon my observation-based estimates of the G-E field for the Sun and the Earth, I estimate the radial G-E field generated at the surface of a neutron star to be ~10^{10} eV/cm. Any protonic material on its surface will therefore be subject to extreme repulsive acceleration, gathering energy as it goes. Could this be the source of the highest-energy cosmic rays, those of lower energy coming from the G-E fields of stellar objects

[123] **Marcy, G.W., Cochran, W.D. & Mayor, M**.,. Extrasolar planets around main sequence stars. In: V. Mannings, A.P. Boss and S.S. Russell (Eds), *Protostars and Planets IV*. University of Arizona Press, Tucson, 1285-1311. (2000)

[124] **Mayor, M. & Queloz, D.,**. A Jupiter-mass companion to a solar-type star. *Nature*, **378**: 355-359. (1995)

[125] **Hatzes, A.P., W.D. Cochran, M. Endl, B. McArthur, D. B. Paulson, G.A.H. Walker, B. Campbell, S. Yang**, *Astrophys. J.*, **599**, 1383 (2003)

[126] **Marcy, G. W., R. P. Butler, D. A. Fischer & S. S. Vogt.** A Doppler planet survey of 1330 FGKM stars. In: *Extrasolar planets: today and tomorrow*, edited by J.-P. Beaulieu, A. Lecavalier des Etangs & C. Terquem, ASP Conference Series. vol. **321,** 3-14 (2004)

[127] **Königl, A. & Pudritz, R.E.,** Disk winds and the accretion-outflow connection. In: V. Mannings, A.P. Boss and S.S. Russell (Eds), *Protostars and Planets IV*. University of Arizona Press, Tucson, 759-787. (2000)

generating lower gravitational potential? The Sun is known, on directional evidence, to generate cosmic rays of up to no more than ~5 GeV energy[128]. Using this as a yardstick for what a neutron star might achieve, the figure should be greater by the surface gravity ratio, namely a factor of ~10^{11}, yielding 5 x 10^{20} eV.

Cosmic rays are all electrically positive, being predominantly single protons, with about 10% He nuclei and a few nuclei of all the known higher elements. An attractive feature for this origin is that the lower energy ones (up to 100 GeV) exhibit FIP-type abundances[129]. It has long been clear that their energies have a roof at around 10^{20} eV or a bit more[130], recently referred to as the 'Greisen-Zatsepin-Kuzmin cut-off'[131], with only a few exceeding that, but the source of their acceleration has remained a widely debated puzzle. The remarkable match of this top energy with our estimate suggests that the G-E field of CT is now by far the best available contender for this function, the field decreasing as the inverse square of distance, like the gravitational potential. On the other hand, the CT association of electric potential gradients with gravitational action means that, on a galactic scale, very large scale, but very gentle, electrical gradients should be present, so they might provide substantial occasional supplementation to the cosmic ray energies.

The emission of pulsar pulses has generally been attributed to spinning with a strongly off-axis magnetic field. The origin of such a strongly off-axis magnetic field is not without its problems and Hobbs *et al* (2004)[132], from a study of 374 pulsars, conclude that the slowing rates are not consistent with the magnetic pole rotation mechanism. The G-E field of the pulsar, basically a neutron star, may offer an alternative. If the formation of the neutron star had left on its surface a patch of protonic materials that had failed to find matching electrons with which to unite as neutrons, that material would be the source of a considerable, concentrated stream of outward-accelerating ions. Such a stream is an electric current, so it would generate a magnetic field and the synchrotron process might be possible, giving rise to the pulsar pulses of radiation. This mechanism, based upon protonic patches of different shapes, might explain some of the pulse shape differences and, if there were two patches, pulses whose spacing alternates. A diagnostic of this model would be that the protonic material could eventually become exhausted and the pulsar action fade out, but the timescale may be too long for us have much chance of seeing that happen to one of them.

8. A CT model for quasars.

Two considerations have been involved in the construction of this model.

8.(i) ***Superluminal velocities.***

In Relativity, superluminal velocity of an object *relative to an observer* is prohibited**.** This is not so in CT; the only absolute constraint is that the velocity cannot exceed ***c*** *relative to its adjacent aether* because that is the maximum speed of communication, ***c*** in turn being defined by the prevailing aether density in that region. Consequently, a sufficient and extended (along the sightline) gradient of transverse velocity can acceptably result in a superluminal proper-motion-determined transverse velocity at the far end. The large resultant aberration is not a problem, being effectively removed by the frame distance ratio in the same manner as was discussed earlier (Figure 3) for binary stars, but the associated aberration-related (AR) redshift will remain in evidence (see below). Proper-motion-determined transverse velocities are of course susceptible to overestimation unless any intrinsic redshift is removed from the distance estimate.

8.(ii) ***Origin of inertia.***

This continues to be a much-studied problem. Mach's Principle formulations rely upon communication at velocity ***c*** 'with the rest of the Universe'[133]. This has two properties. Firstly, in CT that communication is progressively restricted to smaller volume as ***c*** is approached, for exactly the same reason as we gave earlier in discrediting the relativistic mass increase with velocity, so inertial forces will fall correspondingly at 'relativistic' and superluminal velocities. Second, as noted by Haisch *et al* (1994)[134] such formulations imply a lack of instantaneity for which, it seems, there is no evidence.

Our model takes maximum advantage from the first but ignores the second in the hope that it can be overcome, bearing in mind that in CT the velocity of local communication, of any kind, is limited by the aether, so can never exceed ***c***. As noted earlier, the high charge density and consequently irrotational nature of the aether is linked to the inertial process by the Foucault pendulum and mechanical gyroscopes. This suggests that the high force-capability of the aether actually provides most of the restraint quite locally, restricting the volume of 'the rest of the Universe' sufficiently that the communicational delay is negligible.

8.(iii) ***Some features of quasars***.

The following are among the features of quasars that need to be explained[135].

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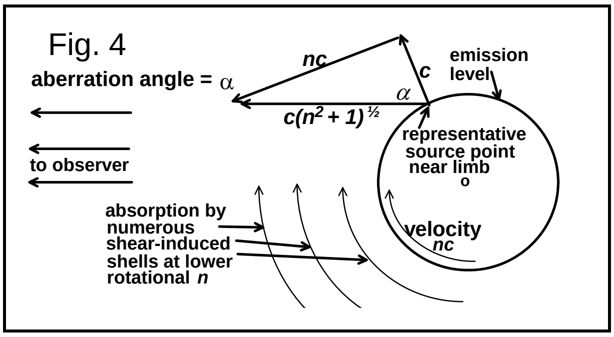
128 **Blackett, P.M.S.,** Cosmic rays and the Sun. In:A. Beer (Ed.), *Vistas in astronomy, v.2*, Pergamon, London. 820-824 (1956).
129 **Mogro-Campero, A. & Simpson, J.A**., Astrophys. J. **171**, L5 (1972).
130 **Greisen, K.** Phys. Rev. Lett. **16,** 748 (1966)
131 **Vasiliev *et al.*** *arXiv/astro-ph/0609486* (2006)
132 **Hobbs, G., Lyne, A.G., Kramer, M., Martin, C.E. & Jordan, J.,**. Long-term timing observations of 374 pulsars. *Mon. Not. R. Astr. Soc.,* **353:** 1311-1344 (2004)
133 **Mach, E.** *Die Mechanik in ihrer Entwickelung* (5th Edn) 249 pp (1904); English translation: *The science of mechanics*. London. 235 pp (1893).
134 **Haisch, B., A. Rueda & H. E. Puthoff**, Phys. Rev. A**, 48**, 678 (1994).
135 **Blades, J.C., D.Turnshek & C.A.Norman**, *QSO absorption lines: probing the Universe.* Space Tel. Sci. Inst. Symp. **2.** Cambridge, England.(1988) [This volume contains many papers on other relevant observations.]

1. Diminutive, star-like image size and an optical variability on a timescale of weeks that confirms their limited actual size.
2. Very broad Lyman α emission line, redshifted ($z = \delta\lambda/\lambda$) in the range <0.2 - >6.0, a recent highest value (photometrically determined) being 6.43 (Fan *et al* 2003)[136] though 4.89 was for long the maximum known, seen as the result of an apparent decrease in space density at high redshift[137], a tendency which is still evident (Cristiani *et al* 2006)[138] .
3. Numerous (up to >100) Ly α absorption lines - the so-called "Lyman α forest" - from neutral H, extending along the shortward flank of the main Ly α emission, implying many absorbers at decreasing redshifts.
4. Broad C^{IV} and N^{V}, and occasional O^{VI} absorption lines, implying temperature of ~$10^{4.5}$ K, at slightly lower redshift than the primary Ly α emission, that has been interpreted as possible approach/mass loss velocities of a few 10^4 km/s, the quasar being the source of the material.
5. The z of the highest-z members of the forest is often so close to the emission-line peak and to one another that they cannot arise in physically separate clouds, an inference supported by the similarity of the absorption profiles[139].
6. The numbers of forest lines increase much more than proportionately with z for $z > 2$ [140].
7. The column densities inferred from the absorption profiles demand some kind of containment not available in outer space.
8. Much more frequent spatial (on the sky) association with galaxies of relatively low redshift than is statistically appropriate[141], probably even allowing for image multiplication by gravitational lensing.



8.(iv) *The quasar model.*

In the sketch (Fig. 4) of the proposed model the velocity triangle represents the condition at the source point, relative to external matter/aether that is not involved in the quasar system.

Features of the model are:-

1. Velocity-dependent inertia, the result of recognizing that gravitational communication is at velocity ***c***, drastically reduces centrifugal force (but not gravitational force from the centre, because the distance is constant) when tangential velocity approaches and surpasses ***c***. This is because the effective volume of the "rest of the universe" responsible for provision of inertia, becomes drastically reduced by retarded-field action. So *superluminal* surface tangential velocities, due to gravitational shrinkage of high-angular momentum clouds, are possible.

2. It is possible for most of the redshift to be intrinsic to the body, being **not** of RTV character but of aberration-related (AR) type, (because of the extreme transverse velocities of the circulating material) and amounts to $z = \sqrt{(n^2 + 1)} - 1$. Neglecting any cosmic (RTV) contribution, z = 4.89 (the highest quasar redshift at the time this Figure was drafted) requires n = 5.8 and $\alpha = 80.2^{\circ}$. So such a high-z quasar could actually be 'on our doorstep'. So some apparently superluminal proper motions of quasars, such as those for 3C45 (a possible binary?) and 3C273 observed by Cohen *et al* (1977)[142] may actually be subluminal. Lensing effects may be responsible for others.

3. The excess Ly α emission-line breadth is primarily due to rotational, not RLV, broadening (n varies with latitude on the emission surface).

4. The "Lyman α forest", and the high-ionization C, N and O lines, are intrinsic absorptions. They are **not** due to clouds in intergalactic space, whose temperature can thus be the 2.73 K indicated by the cosmic microwave background (CMB), as already assumed in the treatment of the cosmic redshift as RTV redshift (Sect. 4B).

5. Their spatial association with (or in?) galaxies is entirely reasonable. The apparent requirement for a high angular momentum source cloud makes their occurrence in isolation less likely and their presence as AGNs more likely. Apperently isolated ones may merely be outshining their hosts; alternatively, they may have 'gobbled up' their hosts.

6. Increasing attenuation at high redshift is not necessarily due to distance, or to a reduction in space density but to the fall-off in luminosity as the visible source area is increasingly confined to a sliver at the equatorial limb (but more at

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136 **Fan, X., M. A. Strauss, D. P. Schneider, R. H. Becker *et al***. *Astronomical Journal* **125**:1649. (2003)

137 **Shaver, P. A., J. V. Wall, K. I. Kellerman, C. A. Jackson & M. R. S. Hawkins**. Decrease in the space density of quasars at high redshift. *Nature* **384**:439-441 (1996)

138 **Cristiani, S., D. M. Alexander, F. Bauer, W. N. Brandt, E. T. Chatzichristou, F. Fontanot, A. Grazian, A. Koekemoer, R. A. Lucas, J. Mao, P. Monaco, M. Nonino, P. Padovani, D. Stern, P. Tozzi, E. Treister, C. M. Urry & E. Vanzella**. High-redshift QSOs in the GOODS. *arXiv:astro-ph/0403494*. (2004)

139 **Burbidge, G.R. & E.M.Burbidge**, *Nature* **222**, 735-741 (1969).

140 **Carswell, R.F.**, *Nature* **374**, 500-501 (1995).

141 **Arp, H.,** *Quasars, Redshifts and Controversies*, Interstellar Media, Berkeley, California 198pp (1987) ; **Burbidge, G., A.Hewitt, J.V.Narlikar & P.Das Gupta,** *Astrophys. J. Suppl.* **74**, 675-730 (1990); **Hartwick, F.D.A. & D.Schade**, *Ann. Rev. Astron. Astrophys.* **28**, 437-489 (1990).

142 **Cohen, M. H., K. I. Kellerman, D. B. Shaffer, R. P. Linfield, A. T. Moffet, J. D. Romney, G. A. Sielstad, I. I. K. Pauliny-Toth, E. Preuss, A. Witzel, R. T. Schilizzi & B. J. Geldzahler**. Radio sources with superluminal velocities. *Nature* **268**:405-409 (1977)

higher latitudes, where ***n*** is lower).

7. As ***n*** rises towards and past unity during contraction, not only is there (in CT) no relativistic increase in orbital mass but centrifugal constraint (an inertial effect) upon shrinkage decreases. The consequent rapid gravitational compression will yield very high luminosity and superhigh ***P,T*** in the interior, perhaps with light element (D, He, Li, B, etc) nucleosynthesis, thus substituting for the Big-Bang in this regard, as required by our recognition of the cosmic redshift as a transmission effect. The greatly increased 'age of the Universe' (see next Section) should help with the abundance of He, which is made in stellar interiors. Nevertheless the intrinsic nature of much of the redshift means that the absolute luminosity and energy output is not nearly so great as hitherto inferred for quasars.

8. In more massive quasars the process may go further. Under CT a particle only possesses mass if there is room to accommodate the required aether dynamical configuration. Further compression will annihilate the mass, with enormous energy release - so the gravity exerted by that mass disappears too, contrary to current black hole models. Such quasars (and those in (6) too) may decay/expire on quite short time-scales, and start upon a stellar evolutionary course, degenerate or otherwise. Could this explain gamma ray bursts (GRBs)? Burbidge (2003)[143] suggests a link to quasars. Such expiry would in effect be recycling back into the plethora of aether motion the motion energy from which their masses were originally created (see the next Section); as GRBs they would be distributing into the Universe some of the light elements they had produced but which had escaped annihilation.

9. Quasars, on this model, have a special feature commonly attributed to black holes, namely very high orbital velocities around them, but in CT the finite sizes of mass-bearing particles is inconsistent with the unlimited mass compression invoked for black holes. As noted earlier (Section 3A), the absence in CT of a relativistic mass increase with velocity can much reduce the central mass inferred from those velocities.

10. An observed close association on the plane of the sky between quasars (sometimes several) and a galaxy of much lower redshift has long been recorded and is the topic of considerable ongoing observation[144]. The provision of large intrinsic redshift by this model offers to discount the argument for sightline superposition and the lower mass requirement reduces the difficulty of deriving one from the other but a reason for proximity, beit by ejection from the galaxy or otherwise, remains obscure. The morphological evolution of galaxies, as envisaged in the next Section but based upon the rather standard forms, contains no clue as to how such intense eddies could be spun out of them.

11. The remaining option might be that the quasars are the sites of intense cosmogonical creation from the aether, initiated by the presence of the galaxy as a result of the positive feedback process that we consider next. That would also potentially explain their widely suspected presence in Active Galactic Nuclei (AGN). Here, at least, intense rotation is almost certainly present if our own galaxy is any guide, but an ejection mechanism is again a problem.

12. The recent reporting (footnote 136) of quasars to (photometric) redshifts of $z > 6$ in no way conflicts with the new model unless these are demonstrably at short distance, requiring all the redshift to be intrinsic, the upper limit of which for our model is probably around $z = 5$ because of the drop-off in luminosity beyond that. The total redshift always includes both the cosmic and the intrinsic component so, with enough sensitivity, totals as high as 8, or even beyond, may be possible.

9. CT, cosmogony and the morphological evolution of galaxies

9A. Cosmogony/creation in CT.

Since CT, with its recognition of RTV redshift (Section 4A), renders the Big-Bang cosmology of an expanding Universe inappropriate we will now see if CT could lead to a substitute cosmology in which the observations of galaxy morphologies might figure more directly as controls.

9A.(i) *Previous approaches to extended cosmogony*.

The steady-state theory put forward in 1948 by Bondi & Gold and by Hoyle[145] was based on the idea of creating matter sufficiently to counteract the reduction in density of the Universe brought about by its expansion. This was evidently an attempt to avoid the looming imponderabilities of a Big-Bang cosmology. They chose, however, to use as a control the achievement of what they called the 'perfect cosmological principle' wherein the state of the Universe at any

[143] **Burbidge, G.,** The sources of gamma-ray bursts and their connections with QSO's and active galaxies. *Astrophys. J.* **585**:112. (2003).

[144] **Arp, H.**, *Quasars, Redshifts and Controversies*. Interstellar Media, Berkeley. (1987).
Arp, H., E. M. Burbidge, Y. Chu, E. Flesch, F. Patat & G. Rupprecht NGC 3628: ejection activity associated with quasars. (2002) *arXiv:astro-ph/0206411 ;* also appeared in *Astron & Astroph.*
Burbidge, G., E. M. Burbidge & H. Arp, The nature of the ultraluminous X-ray sources inside galaxies and their relation to local QSOs. *Astronomy &.Astrophysics* **400**: L17, (2003), also: *arXiv:astro-ph/0211139*.
Burbidge, E. M., G. Burbidge, H. C. Arp & S. Zibetti. QSOs associated with Messier 82. *Astrophys. J.* **591**:690-694, (2003) also:*arXiv/astro-ph/0303625*.
Arp, H., E. M. Burbidge & G. Burbidge The double radio source 3C343.1: a galaxy-QSO pair with very different redshifts. *Astronomy & Astrophysics.* **414**: L37, (2004) also: *arXiv:astro-ph/0401007*.
Burbidge, E. M., G. Burbidge, H. C. Arp & W. M. Napier, An anomalous concentration of QSOs around NGC 3079. (2005) *arXiv:astro-ph/0510815*.

[145] **Bondi, H., & T. Gold**, The steady-state theory of the expanding Universe, *Mon. Not. R. Astr. Soc.* **108** (3), 252-270 (1948).
Hoyle, F., A new model for the expanding Universe, *Mon. Not. R. Astr. Soc.*, **108** (5), 372-382 (1948).

time in past or future would be the same, and follow the same laws. This seems a rather whimsical assumption; why should Nature oblige for our convenience**?**

The quasi-steady state sequel offered by Hoyle *et al* (1993)[146], still acknowledging an expanding Universe, proposed a series of 'little big-bangs', of which the most recent was the one defined by the Hubble redshift, the expansion being driven by creation concentrated in already-existing centres of high gravity. But they did not elucidate the mechanism for this, beyond reasoning that it would be in the form of Planck masses (10^{-5} g each). In many other respects, however, their motivations and views had many resonances with those expressed in this paper. By creating mass where it exists already they aimed to explain the 'honeycomb' structure of the Universe, with its huge intervening voids. They emphasized, in line with the above remarks on the CT quasar model, that those who claim to be seeking black holes are actually only trying to find evidence of compact objects producing strong gravitational fields. They also acknowledged that, rather than accretion, the evidence is all of outflow, even citing Jeans (1929)[147] in this regard. They also stressed, as requiring ongoing creation, the evidence for galaxies with a wide range of evolutionary ages, rather than a single 'epoch of galaxy formation' that prevails in the present form of Big-Bang cosmology.

9A.(ii) *The CT approach*.

The CT picture of an aether of huge charge density embraces simultaneously the infinitesimal and the infinite because the self-repulsion of that charge demands that aether be under some sort of pressure. Rather than get involved with fruitless speculation as to 'bounding walls', etc, the preferred option here is to regard the Universe as truly infinite, thus ensuring that the aether pressure has no escape route. Consistent with this, in stark contrast to Big-Bang cosmologies, the picture outlined below sees no backward limit in time beyond which it is illegitimate to seek observable answers at all. There may well be a practical limit, however.

We noted (Sect. 2B) that by seeing elementary particles as rotational entities 'made out of aether' some insight is gained about the observed facility of pair production, a form of mass creation[148]. It is proposed, therefore, that even the random motions of the aether must have a non-zero potential for creating mass-bearing particles. The picture, then, is that the original state of the Universe, before any mass existed, was simply the aether in random motion. This motion must have been at a somewhat higher energy level than now, having been drawn upon ever since in the process of creating all the mass in today's Universe. The link between this motional energy and that of the mass created from it was suggested in Section 2C.

Quantitatively the primary locus of such creation, though at a low rate per unit volume, must originally have been, and still appears to be, in extragalactic space (there is so much more of it), though enhancement of the rate is to be expected within the much smaller and hotter volumes occupied by groupings of mass because that is where the aether's 'particle-tied' motions are at a high intensity. This 'reproductive-type' or 'positive-feedback' property is possibly the prime means of generation of the large-scale 'honeycomb' structure, made up of clusters of galaxies, as favoured by Hoyle *et al* (1993), discussed above. It could even be a major factor, together with gravitation, in the building of their component mass-concentrations, all the way, perhaps, down to globular star clusters themselves.

Support for this idea comes from the recent recognition[149] that the centre of the Galaxy has a large population of massive O-stars, inevitably young because of the rapidity with which such stars evolve, but the source of the material they are made of is a mystery, the stars further out being older and of higher metallicity. And what about star-burst events, so widely seen in distant galaxies? Are they sites of feedback-enhanced creation rate?

We saw (Section 2B) how the uniformity of the charge density of the aether throughout the Universe could have acted as a standardizing agent for the particles produced over time. Note that, as a random process, many other particle-like rotational configurations would have been produced, but only the stable ones would have survived, much like the endless trial-and-error with which life on Earth is presumed to have evolved.

9B. CDM (cold dark matter) in a non-expanding Universe?

In a Big-Bang Universe the primary function of CDM is to stabilize the expansion in conformity with redshift observations. Having no expansion in the CT Universe reduces the demand for CDM by ~90%. The remaining ~10% of the demand has come from three causes;

(1) tangential (orbital) velocities within most spiral galaxies, outboard of the central mass, remain remarkably constant out to the visible limit, not decreasing in Keplerian fashion, suggesting the presence of lots of mass outboard of that,

(2) to provide long-term stability for galaxy clusters in the light of their observed masses and apparent motions based on redshift variation,

(3) to constitute the extra mass needed to explain the observed gravitational lensing by clusters of galaxies, their visible masses being insufficient.

We will discuss these briefly.

Cosmology, and Big-Bang cosmology in particular, has long taken the view that there was a very early 'epoch of

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146 **Hoyle, F., G. Burbidge & J. V. Narlikar** A quasi-steady state model with creation of matter. *Astrophys. J.* **410**: 437-457 (1993).

147 **Jeans, J.H.,** *Astronomy and cosmogony, 2nd edition*, 428 pp., Cambridge, (1929).

148 Note that neither here nor in Big-Bang cosmology does the term 'creation' mean 'out of nothing' but out of a primordial energy source, but in the latter it is done on largely arbitrary 'equipartition' arguments.

149 **R. Genzel.** Plenary lecture 4th April 2006 to National Astronomy Meeting NAM2006. Leicester, UK.

galaxy formation' (from Jeans masses, or similar) and that contraction of each has been the evolutionary rule ever since, only punctuated by rare 'collisions'. Consequently, the idea of lots of mass still 'out there' around a galaxy has seemed anomalous. The argument for its being CDM instead has left unanswered why CDM should be concentrated there because nobody has had any idea whether it has any other properties upon which to base such a reason. In CT we argue (below) that the motion pattern in spiral galaxies is actually predominantly outward, contrary to the standard view but like that invoked above (Section 6) for forming planetary systems. In the latter case, the material pushed out to form the cometary belts might be a dynamical analogue of this outermost material of galaxies. Heavily over-exposed enhanced-contrast photographs prepared by Malin[150] do indeed show a very weak aura around galaxies extending to as much as 5 times further out from the normally visible extents. This 'aura' confirms the presence of matter/dust in this volume and I suggest that it is light scattered from the galaxy, not intrinsically luminous matter.

In Big-Bang cosmology the observed clustering of galaxies implies that the clustering is original, dating from the 'epoch of galaxy formation'. Tests of the longevity of clusters, by applying the virial theorem to the redshift-determined velocities within the cluster have frequently shown that the durability is insufficient unless more mass has been present, so CDM has been invoked. It seems clear, however, that the gas content of galaxies, particularly the bigger ones, should produce some amount of intrinsic RTV redshift, just as the deep atmospheres of stars do. So different types of galaxy should exhibit differing amounts of *intrinsic* RTV redshift, in addition to their cosmic (distance-related) RTV redshift. Holmberg's analysis[151] of 76 bright galaxies in the Virgo cluster (our nearest) yielded mean Doppler-equivalent redshifts in km/s for different forms as follows:- E-S0 (41 galaxies) 1002 ± 61; Sa-Sb (21) 1276 ± 108; Sc (14) 1669 ± 137. My own further splitting of the E-S0 group gives: E (23) 990; S0 (18) 1017. This correlation with type strongly supports the presence of intrinsic RTV redshift. Taking (arbitrarily) the mean intrinsic RTV redshift of these Virgo ellipticals as only 50 km/s, leaving a cosmic contribution of 940 km/s, the mean intrinsic component for the Sc's becomes 1669 - 940 = 729 km/s, with a maximum, for individuals, possibly at least 750 km/s. These being the brightest galaxies in the cluster, they would have had longer-and-hotter-than-average within-galaxy light transmission paths for the build-up of intrinsic RTV redshift and a study to fainter magnitudes[152] appears to dilute this core result. If the differences caused by intrinsic redshift were removed, a revised virial theorem calculation would show much less need for CDM. It might even remove it. (A similar situation, involving the differential intrinsic redshifts of stars in star clusters was discussed briefly in Section 4B.(iv)).

But in CT there is a further possible avenue for escaping this particular CDM requirement. As outlined below, galaxies and clusters of them were formed progressively over time, due to the auto-feedback nature of the creation process in CT. In effect, the reason the galaxies are in a cluster is that they were formed there successively from locally created material by construction as 'family offspring'. So there will be a very wide scatter of galaxy ages among the population, some quite young, rendering the virial theorem invalid in its present form for any age greater than that. On the other hand, however, not only is the length of time at issue (the 'age of the Universe') in CT now indefinitely great but our interpretation of the solar neutrino problem (Section 2G) has suggested that stellar evolution may take roughly twice as long as previously thought, greatly increasing the putative ages of ellipticals, for example, as measured by their stellar content and metallicities. This gives much more time for a given cluster to scatter, so would reduce the force of this argument.

Another matter to consider is the detection by the ESA XMM-Newton space vehicle of substantial auras of X-ray emission around distant clusters of galaxies, indicating the existence of matter in what hitherto has been considered empty. To regard it as CDM would breach its prime attribute, that of undetectability other than by its mass, and this would cause problems in other contexts. This matter might reasonably be the cosmogonically young material that we invoke below as the source of infall streams that appear to dominate the morphological evolution of galaxies, the extremely high temperature inferred from the radiation being due, not to LTE, but to ionic particles accelerated by the G-E fields of the galaxies, just like we have envisaged for the apparent solar coronal temperature.

The gravitational microlensing by clusters of galaxies may then be a measure of that *ordinary matter*. Indeed there is another observation to support this. It has been reported[153] that when the line of sight passes through rich clusters of galaxies the redshifts for those beyond are higher and "strongly support the existence of a dependence of redshift on the position of galaxies relative to concentration of matter, that is, clusters of galaxies". This could well be explained by extra RTV redshift along the sightline due to higher intergalactic density or temperature within the foreground cluster.

In summary, these considerations elude and confuse the CDM issue to such an extent that CDM may well be an unnecessary feature of the CT Universe.

9C. Galaxy formation and morphological evolution.

A fuller account on this topic was given in the Osmaston (2002) contribution (see footnote 4) so this one concentrates upon essentials, with slight revision.

9C.(i) *Outward motions and morphological evolution.*

Current views on the formation and evolution of galaxies have been based, just like the SCSN for the solar system,

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[150] **David Malin** website:- http://www.aao.gov.au/images/general/galaxies.html

[151] **Holmberg**, **E.** *Astron. J.* **66**, 620 (1961).

[152] **Huchra, J.P.**, The Virgo cluster redshift survey. In: O-G. Richter & B. Binggeli, (eds) *The Virgo cluster of galaxies.* ESO Conference and Workshop Proceedings No.20, 181-200 (1985).

[153] **Notale, L. & J-.P.Vigier**, *Nature* **268**, 608-610 (1977).

on a once-for-all concentration of a mass of gas, which then evolves through various phases of star formation. In the Big-Bang context the putative expansion involves progressive reduction of the density of the Universe, so the expectation is of an 'epoch of galaxy formation' when the temperature and density had reached an appropriate level for gravitational contraction of galaxy-sized Jeans masses. Subsequent mass-growth by acquisition of intergalactic material is largely discounted and growth by 'merger' amalgamation of galaxies is now a popular theme. In the sense that this recognizes that galaxies do not evolve in isolation it is also relevant to the arguments to be presented here. Recent advances in instrumentation (e.g. HST and Keck telescopes), however, have made possible the examination of galactic forms at high redshift, and therefore at large look-back times. This has revealed that an unexpectedly high proportion of these relatively early galaxies are of irregular form and exhibit young blue stars[154], lending support for an evolutionary interpretation of Hubble's original sequence of galactic forms, which can be summarily stated as: irregulars - spirals - triaxial ellipticals.

For the purpose of the present discussion reference will mainly be made to the sequence of galactic forms beautifully illustrated in the 1961 Hubble Atlas of Galaxies[155], of which I have a personal copy. For this reason the old Hubble classifaction sequence will be used here, as will the NGC numbers of individuals. At that time the evolutionary character of the Hubble sequence was already being favoured but its mechanism has remained obscure. I argue here that this is a true evolutionary sequence, driven by the continuous acquisition of additional material, much of it cosmogonically young, by the dynamics of that acquisition process and by the CT-related features of gravitational interaction. Usage of the Hubble sequence is justified by the presence of similar forms (except barred spirals, see later for the significance) out to extreme redshifts. The implication is apparently that galaxy initiation, like star formation, is an ongoing process, but with evolution then being driven at widely variable rates. A further implication is that the sheer irregularity of form and mass-variability of irregulars is hardly consistent with a starting point involving the tidy contraction of a Jeans mass. On the contrary, the process seems to need to start with wispy or clumpy concentrations of **pregalactic** dust and gas, the latter often showing ongoing (young-star) starburst activity. The archetype example of such concentrations is that known as 30-Doradus in the Large Magellanic Cloud. The cosmogonical-reproductive properties of the aether in the CT framework, outlined above, may be relevant here.

In spiral galaxies, as mentioned above, it is found (e.g. Rubin 1983)[156] that outboard of a central region the tangential/orbital velocity remains remarkably constant out to the edges of observability, not decreasing in Keplerian fashion. It seems to have escaped attention that this observation, or rather, the interpretation of it, also implies that the outer material (of whatever kind) must possess a huge excess of a.m. relative to that exhibited by the inner parts of that galaxy, a problem identical to that of the solar planetary system. If this outer material were what we now call Cold Dark Matter (CDM), as proposed by Rubin, the only way of imparting that a.m. would have to be gravitational, this being the only attribute of CDM. One option is to regard this as evidence of the outward build-up of a.m., with a flow pattern similar to that proposed (Section 6) for the solar system, fed by polar infall of potentially cosmogonically young material, continuous creation in intergalactic space being a continuing possibility under CT. Such a centrally provided flow pattern, indeed, with the same mass flow across every annulus, does produce the radial profile of density that Rubin inferred from her velocity profiles. But we still have to drive that flow. Ordinary matter, but not CDM, would be susceptible to the action of the gravity-electric (G-E) field generated by the galaxy’s central mass upon its ionized contentl (which includes stars, of course, but may entrain neutral material too). This action is precisely that of pushing the material outward without changing its orbital velocity - which is what has been observed. To the extent, therefore, that this radially-driven galactic wind is in control of the overall dynamics there may be no need for the presence of lots of mass outside the optical limits of the galaxy except, importantly, that the outward flow has to go somewhere. Many spirals seen exactly edge-on do show an optically dense ring of dust silhouetted against the luminous arms and bulge (4594/M104; 7331; 4565; 891; 253; 5907)[157]. Presumably its lack or deficiency of stars means that its physical density has become too low for star formation as it moved outwards, though its total mass may be very considerable.

Just as in the solar system case, an additional mechanism is required, to achieve the channelling of the flow into the plane of the disc, then to be acted upon by the G-E field. The G-E field on its own has no such preference. Because of its gravitation-linked fundamental mechanism its gradients will go hand in hand with (but generally in dynamical opposition to) those of the gravitational potential. To the extent that magnetic fields in the plane of the galaxy may couple its rotation to the plasma, providing a centrifugal force in that plane, the same will apply here. In galaxies, however, an additional outwards-moving action is present, but this one too is at the expense of the a.m. of the central mass, so is correspondingly limited. The large angle subtended by the central mass or bulge as seen from points on the arms would, in the presence of inward-increasing angular velocity that is characteristic of the central regions of spirals, make especially strong the aberration of the gravity vector and resultant outward transfer of a.m., attributed here to the finite velocity of gravitational intercommunication[158]. The resulting 'orbit' of individual elements is then an outward spiral, so

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154 e.g. see:- **Ellis, R.S., R.G. Abraham, J. Brinchmann & F. Menanteau,** The story of galaxy evolution in full colour. *Astron. & Geophys.* **41**, 2.10 - 2.16. (2000).

155 **Sandage, A.,**. *The Hubble atlas of galaxies.* Mt Wilson and Palomar Observatories, Carnegie Instn of Washington, Calif. Inst. of Technology. Publication 618. 32+50 pp. (1961).

156 **Rubin, V. C.,** The rotation of spiral galaxies. *Science* **220**:1329-1344 (1983)

157 See also David Malin’s colour photographs of NGC3628, 3623, and 1055 to be found on the Anglo-Australian Observatory (AAO) website <http://www.aao.gov.au/images/general/galaxies.html>

158 For a similar type of argument see also:- **Ghosh, A.. Rai, S. & Gupta, A.,**: A possible servomechanism for matter distribution yielding flat rotation curves in spiral galaxies. *Astrophysics & Space Science* **141**, 1-7 (1988); **Ghosh, A.,** *In* Arp, Keys &

the transition, further out, to the similar dynamics provided by the G-E driven wind on its own will be hard to discern. If we are talking about a ring of material its diameter will increase and gaps or cooler lanes in the ring at weakly cohering places, to accomodate this, are likely to appear, conccntrating star formation within the segments. The same should apply to the more-circular inner parts of spiral arms.

Indeed, an almost ubiquitous feature of luminous spiral arms, is that they are cut, usually obliquely, into numerous very short segments by quasi-linear dust lanes, cooler and lacking stars, but the concept of gravitational *contraction* as the basis for galactic evolution has tended to discourage emptiness being entertained as a serious possibility within the confines of the overall image. Seen here as evidence of stretching, this interpretation of such a widespread feature places the dynamics of galactic evolution firmly in the CT range of effects involving outward motion of their materials. It means that, overall, the spiral arms should be seen as moving outward, and unwrapping with time, not the reverse, although their outer ends nevertheless have a 'trailing' geometrical relationship to the direction of rotation of the galaxy. Whether the gaps/lanes cutting the arms are 'empty' or are filled with dust drawn from the dense dust lane that commonly lies along the inside of arms (NGC3627/M66, 5248, 23) may be a variable option.

At the 'input end' of our galactic dynamical system, globular clusters in the Galaxy halo are seen to be approaching the centre of it from 'above' and 'below', but some of these are abnormally old, based on their high metallicity, and may be recycled from the disc or arms outflow. In that case the high metallicity could be inherited from the source dust and not be a direct measure of the cluster age. To convert an Irregular galaxy progressively into a spiral, along the morphological sequence Irr, Sc, Sb, Sa, seems to require the systematizing influence of polar input streams, ideally with a steady angular momentum vector.

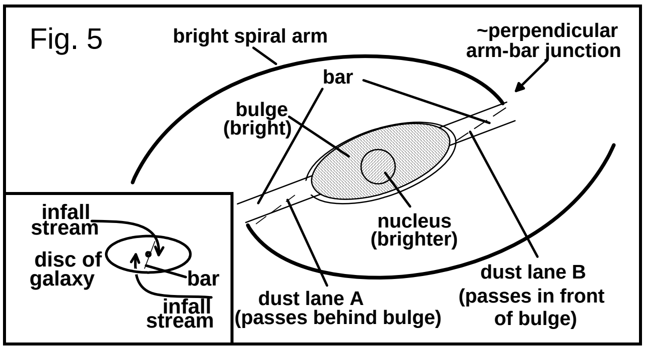


Fig. 5 Formation and structural elements of a barred spiral galaxy (e.g. Type Sbb). Based principally on NGC 1300, 5383, 1097, 5236 and 6951**.**

Notes

1. Rotation of the arms is clockwise about the galactic centre but the orientation of the bar axis is fixed in space by the relative positions of neighbouring galaxies (see note 6). Most theoretical treatments of bars have failed to recognize this possibility.

2. Dust lanes A & B on the bar link up with dust lanes (not shown) that follow the insides of the spiral arms.

3. The angular extent of the arms can vary widely.

4. The bar is always diametral to the bulge and nucleus, and it may extend inwards nearly to the nucleus.

4. The space inside a notional ring through the ends of the bar may be faintly luminous (as a continuation of the bulge) but is devoid of visible structure.

5. Occasionally the ring is not notional but is luminous and the arms leave it at points that do not coincide with the bar ends.

6. The inset shows how the polar infall streams can provide a couple to set up rotation with a bar axis in the galactic plane, but whose orientation is fixed by dynamics external to the galaxy, so does not rotate with it.

Figure after Osmaston (2002)

9C.(ii) ***Barred spirals - a vital route to ellipticals.***

We turn now to **barred spirals**, the essential morphological elements of which are sketched in Fig. 5. The recent high-redshift studies have shown that the incidence of barred spirals is rare beyond $\boldsymbol{z} = 0.6$. It is proposed here that 'barring' is a metamorphic process imposed upon already-formed spirals at any stage of their development by a change in the polar infall conditions. The evidence suggests that in a CT (mass-increasing) Universe clusters have grown sufficiently, by the $\boldsymbol{z} = 0.6$ look-back time, that the relative motions of other galaxies in the neighbourhood may modify the direction, density and a.m. of the infall streams to the galaxy under consideration. The view to be developed here places emphasis upon the limited evidence (Fig. 5) that bars are structures with self-rotation about an axis that lies in the main plane of the spiral and therefore that the straightness and diametral disposition of bars is due to this and not to a resonance in which the material is moving through it with a radially varying pattern of angular velocity in that part of the disc, such as is believed to be the case in normal spirals.

Unfortunately, observations purporting, on the latter assumption, to measure the degree to which the 'bar pattern' is rotating with other parts of the galaxy (e.g. Ryder *et al* 1996[159] and references therein) appear actually to have compared the rotation of the inner and outer rings between which the bars lie and assumed that they and the bar form a single dynamical feature.

On our new hypothesis of the nature of bars, to achieve a bar and to keep it straight the accretion streams must set up a rotation with an axis lying in the plane of the galaxy. The inset to Fig. 5 shows an appropriate geometry. The orientation of the bar axis then depends on the dynamics of the infall streams, which will owe much to the spatial distribution of neighbouring galaxies, so the axis does not rotate with the galaxy concerned. Because the rotation of the bar about its axis is being driven mainly by infall near its midpoint, the gravitational centre of the galaxy, torsion of the bar is to be expected and is expressed by the observed dust lanes A and B. NGC 1365 (see the AAO website) appears to be a similar case. Although in flattened spirals the central bulge is often lenticular in form, the available images of barred galaxies (not detectable as such when seen edge-on) appear to permit it to have (acquired) the form of an ellipsoid of revolution coaxial with the bar. The

Rudnicki, eds., *Progress in New Cosmologies: beyond the big bang,* Plenum. 305-326, (1993).

159 **Ryder, S. D., R. J. Buta, H. Toledo & H. Shukla.** Neutral hydrogen in the ringed barred galaxies NGC 1433 and NGC 6300. *Astrophys. J.,* **460**:665-685 (1996).

image of NGC 2685 in the Hubble Atlas illustrates the rotational nature of this bar process beautifully; the bar is surrounded by circular dust lane arcs silhouetted against it and the ends of the bar show vestiges of spiral arms from it. The latter would be expected to show up better with a longer exposure but this would bleach out the arcs.

Both the establishment of the bar's self-rotation and the constancy of the infall streams that drive it necessarily mean that the material incorporated within the bar loses any original rotation it may have had about the galactic centre. It therefore will gravitate **along the bar** towards the nucleus and may be important in the growth of the bulge. The continuity of the lanes A and B with the dust lanes along the arms (Fig. 5, note 1) means that arm material is being drawn into ('consumed by') the ends of the bar. Remember that the material forming the arms has not yet been affected by the metamorphosis, so it will still be orbiting/spiralling about the galactic centre and this will feed it into the ends of the bar, the orientation of whose axis may be spatially quite stable and controlled by the infall streams. In this way it appears that the bar will lengthen over time, consuming the arm material at increasing radius from the galactic centre as it orbits past. If the dynamic drive by the infall streams is insufficiently coupled along the bar to achieve this lengthening (in the presence of the conflicting a.m. of the consumed arm material) the ends of the bar may scribe the occasionally observed circle (Fig. 5, note 5; NGC 2523) or arcs, as the disc and arms rotate past them.

If the infall streams fade (e.g. as a result of relative motions of the galaxies in the cluster) and cease to provide the bar-maintaining input of a.m., differential rotation in the galactic plane will set in again, winding the bar into a 'spiral within a spiral' (NGC 5364). As mentioned above, the polar infall a.m. driving the bar would have caused the material in the bar to lose its orbital motion about the galactic centre. So we need to be clear as to how this material can regain its differential orbital motion and get 'wound up'. At this stage the bar is still being 'fed' at its ends by capturing material from the inner ends of the spiral arms as they orbit past. This material still has its orbital a.m. about the galactic axis and, in the absence of the drive upon the bar, will, as the bar shrinks axially, cause the bar to wind into a spiral form.

This synthesis of the evolutionary process means that the bar-forming metamorphosis is externally imposed by a change in the infall conditions brought about by the motions of its neighbours and could befall any galaxy in any stage of its 'normal' spiral development and mass-growth but the necessary deviance of infall streams does require that it have cluster companions, so are increasingly rare at large look-back times, as observed. In this sense, barred galaxies do not comprise a separate sequence but a number of diversions/branches from the normal course of events. In this light, ellipticals can ensue from either or both of two situations, each permitting the bar to contract axially. Either the bar may have consumed all the spiral arm material or the dynamically important infall streams of star-forming material be 'switched off' by a change in the environment. It has long been recognized that ellipticals have used up their (internally held) supply of this gaseous material but I suggest that the timescale for such consumption is relatively short in cosmological look-back time terms unless it is continually replenished by the infall streams. This short timescale would explain the presence of ellipticals at high redshifts.

Triaxial ellipticals lack the slender dimension symptomatic of a spiral past history so seem to confirm a descent though the axial collapse of a bar. Morphologically, the problem of getting from a very flat spiral to a fat elliptical presents severe difficulty and has seemed to cast doubt on the truth of the morphological sequence at this stage. I now suggest, therefore, that the route to true 3-dimensional ellipticals with old stellar content is via the barred spiral route in which the polar infall has ceased. The rotation of the bar about its axis would provide the morphological thickening inherited by such ellipticals.

9C.(iii) ***Irregulars, the start-up conundrum.***

So much for the later stages of galaxy evolution; but what about the initiation of the entire process if, as suggested above, irregulars are to be our source of clues? We note that the best we can do in this way is to infer how irregulars have come (and are coming?) into being at the comparatively late moments of Universe history that are observable to us. How the very first ones were initiated is a matter that should be postponed. The Jeans mass requirements for gravitational condensation seem hard to achieve in this situation unless heirarchical condensation can be considered[160] but that requires the presence of dust, so presupposes that the material involved is not of young cosmogonic origin. It seems that the wispy, clotted, character of irregulars favours that star or globular(?) cluster formation has in some places occurred at shock-front-like zones of interaction between differentially moving streams of matter. This would be consistent with the importance of such streams that we have inferred for the subsequent morphological evolution and metamorphosis of spirals, once we have a cluster of galaxies, but it leaves us with a major build-up gap still to fill before an irregular has enough mass to attract its own systematizing infall streams to set it upon that evolutionary path.

9C.(iv) ***Review.***

The outstanding result of this discussion is that galaxies, far from being surrounded by an intergalactic space that has been virtually empty since they were formed, are actually surrounded by huge amounts of gas and dust that play an essential role in their morphological evolution and growth. Support for this has been adduced from the deep optical images of galaxies already discussed. The extent to which all this material is recycled from galaxy edge back to infall, as already suggested, will need much study but it seems inescapable that much of it cannot be second-hand and may be

[160] **Hoyle, F.,** On the fragmentation of gas clouds into galaxies and stars. *Astrophys. J.,* **118**: 513-528. (1953)
[Hoyle argued that the gravitational contraction of a dusty nebula would be more nearly isothermal because of the radiative property of the dust; and this would enable the Jeans criterion, for the possibility of gravitational contraction of a gaseous mass, to be met at successively higher densities and smaller masses, so that the original mass would fragment into smaller, separately contracting ones.]

cosmogonically young. In CT the potential for ongoing particle creation is, as mentioned earlier, and seen in man-made particle colliders, likely to be enhanced by an increased energy level of the environment, such as a cluster provides, both within and between the galaxies. So here we have a feedback mechanism that is a potential explanation of how some clusters have become so rich and why huge volumes of the cosmos elsewhere seem to be altogether empty. It may be speculated that the faint 'ripples' on the CMB, widely hailed as inherited from the Big-Bang, may actually derive from the spatially non-uniform aether-motion energy levels related to that non-uniform cosmogony.

10. Quantum physics, random aether motion and SED.

Maddox (1999)[161] saw the incompatibility of quantum mechanics with GR gravitation as "the central problem in fundamental physics". With the discrediting of Relativity set out in this paper the question of whether CT offers to provide an adequate new foundation for the undoubted benefits of quantum theory becomes an urgent one.

A characteristic of quantum mechanics is that it has only been needed in connection with phenomena at the smallest of scales. That is precisely the domain in which the effects of a randomly moving aether, as defined overall within this paper, may be expected to impinge. To this author it therefore seems unsurprising that it has widely been reported that an apparently quantum physical problem could equally well be resolved by classical means if combined with a hypothetical 'random energy of the physical vacuum', as recognized under the name of Stochastic Electrodynamics (SED). So the nature and source of this energy is currently an active topic, as are references to 'zero point energy' and 'zero point field'. In his review of aether theories, Duffy (1998)[162] emphasized that these perspectives had already become a growing concern, but that all, not surprisingly, had done so in the frame of an expanding Universe and GR. This still seems to be the case. As we have shown, neither is applicable in CT, so straightforward linkage is impossible.

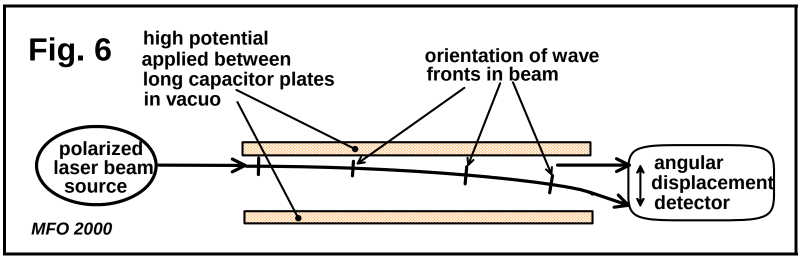
In this paper, although beginning with visualizations at sub-particle sizes, the thrust has been to develop from it a picture of the large-scale observables. So it is speculated that the randomly moving aether, as characterized herein, should be considered as the site and source of this random energy.

Recognition of this energy resource suggests that the principle of the conservation of energy, one of the icons of physics, may require yet further stretching to allow for unobserved energy, a process already begun in order to accommodate neutrinos.

12. Magnetic fields and 'lines of force'

Michael Faraday, as recounted recently in some detail by Kelly (2006)[163], persistently adhered to the view that magnetic fields are best described in terms of lines of force. Kelly, himself a skilled experimentalist, has repeated in an especially exhaustive manner the critical experiment to determine whether or not, if a magnet is rotated upon its north-south axis, the field rotates with it. The matter has been repeatedly argued experimentally ever since Faraday but he concludes that it does. The significance of this conclusion for the matters covered in the present paper is that it is consistent with our assumption that solar rotation was strongly coupled to the Protoplanetary Disc Wind when the planets were being formed. That it is magnetically coupled to the solar wind at present is suggested anyway by observations that it performs an Archimedian spiral as it leaves the Sun. Theoretically, the significance is that, in this case at least, magnetism is not adequately treated by a field theory, a conclusion similar to the one we reached in Section 5C in respect of gravitation. At the most fundamental level of all it is to be hoped that this insight into the structure of magnetic fields might lead us to an insight on how moving charge produces magnetic fields. That would have pleased Faraday.

Fig. 6



12. Six experimental checks.

1. Central to the whole basis of CT is the charge density and polarity of the aether. A possible experimental method to determine the polarity and charge density of the aether is sketched in Fig. 6 but careful assessment is required as to whether enough experimental sensitivity can be achieved. The CT view of Maxwell's dielectric displacement current is that the charging of a capacitor involves the displacement of aether away from one plate and towards the other. In Maxwell's equations the velocity of TEM-wave propagation rises with increasing elastic modulus of the medium, which relates to the charge density of the aether. So a charge density (i.e. aether density) gradient, set up in the aether between

161 **Maddox, J.** The unexpected science to come. *Scientific American* **281,** 62-67 (1999) (the final issue of the 20th century)

162 **Duffy, M.C.,** Ether, cosmology & general relativity, In: *Phys. Interpr. Relativity Theory VI;* Brit. Soc. Philos. Sci., London:11-14 Sept 1998; *Supplementary Papers*, M.C. Duffy (ed.), pp. 16-35, ISBN 1 873 757 581 (1998).

163 **Kelly, A.** *Challenging modern physics: questioning Einstein's relativity theories. Chapter 9.* pp. 181-212. BrownWalker Press, Boca Raton, Florida (2005): see also:-
Kelly, A.G. Experiments on the relative motion of magnets and conductors. *Inst. Engrs. Irel.*, Monogr. No5 (1998).
Kelly, A.G. Experiments on unipolar induction. *Physics Essays* **12** (2) 372-382 (1999)
Kelly, A.G. Experiments on unipolar induction. *Ann. de la Fondation Louis de Broglie* **29** (1-2) 119-148 (1999).

the plates of a charged capacitor, will progressively tilt the wave fronts and deflect the beam. Rotation of the polarized source would modulate the deflection. If the aether is a continuum of negative charge the beam deflection will be towards the negative plate. This experiment would also check the proposed mechanism of the 'gravitational light deflection' and of the transverse displacements involved in the RTV redshift process, and thereby provide another check upon the intensity of the G-E field in given gravitational circumstances.

2. As recommended in Section 4B the Sadeh *et al* (1968) experiment using caesium clocks over a ground-level path should be repeated, with appropriate controls, to confirm the redshift-distance relation that they found. It would not be expensive. Attempts should be made to discriminate the diagnostic effects of path temperature and ionization.

3. The Pioneer 6 carrier-wave redshift observation during superior conjunction, as discussed in Section 4B.(iv), should be repeated on the carrier wave from another space vehicle to confirm it and secure it as an example of coronal RTV redshift. With so many vehicles currently orbiting the Sun this should be quite easy to arrange.

4. An attempt should be made to measure the G-E field of the Earth, at ground level. Ionospheric observations suggest a potential gradient of a few hundred mV/m. The all-pervasive nature of the gradient raises problems. Some sort of ionic drift method might be worth consideration. One in which the chamber was rotated in a vertical plane, thus reversing the anticipated drift and giving an oscillatory signal, would remove zero-point error, but to avoid the signal being swamped by emfs from currents induced by the motion would require extemely efficient magnetic screening and demagnetization of the equipment.

5. Attempts should be made to check various diagnostics of motions in galactic bars, suggested by Figure 5.

6. Gravitational lensing, as viewed in GR, is independent of the polarization of the TEM-wave; in CT the deflection would appear to maximize for waves whose E-vector lies radial to the gravitational centre. An attempt should be made to check this diagnostic by observation. It might also relate to the polarization of radio sources.

13. Summary of the main results.

13A. Four outstanding conclusions

Four fundamental physical conclusions stand out above the rest.

(a) There is indeed an aether and the various effects of its random motion (Table 1) are both important and widely evident, the Hubble redshift being one of them, though its particle-linked behaviour in systematic matter-motion situations requires further study (Section 2B.(iv)).

(b) Electric charge has now to be regarded as occurring in two modes, continuum and particulate (when that continuum is constituted as charge-bearing fundamental particles).

(c) A deeper insight into the mechanism of gravitational interaction yields recognition of the associated G-E field, for which there is ubiquitous evidence also.

(d) A door has been opened for the study of the dynamic structure and aether motions of fundamental particle interiors, hitherto a topic rigorously excluded on theoretical grounds, which had left us with no opportunity to understand how their external properties arise and had added many 'constants' to our list.

Listed in more detail, the main results of this paper are a highly interlinked set of understandings, tied to observation and constituting the proposed new 'ground floor' to which the title refers. This interlinking inhibits the presentation of any one of them as a standalone argument and is responsible for the length of this paper. These understandings, in summary and by no means an exhaustive inventory, are divisible into 6 groups:- the aether and its derivatives, gravitation, TEM-wave propagation effects, Relativity, cosmology, and 'other matters'.

13B. The aether, its polarity and the nature of mass.

1. The Universe is pervaded by an aether which is a perfect fluid continuum of electric charge, the density being at least 3.1×10^{29} coulombs/cm^3 everywhere except in stellar interiors. This is based upon, and equal to, the experimentally determined charge densities within electrons and positrons (see Fig. 1).

2. Such an aether offers the most fertile implementation yet of that which is called for in Maxwell's equations for the propagation of TEM-waves, including the characterization of his 'dielectric displacement current *in vacuo*'.

3. The polarity of the aether charge is determined as being negative, in conventional terms, from observation of the solar repulsion of positive ions where gravitational action (see 13C below) is maintaining a lower aether charge density in the solar interior. Less aether is then equivalent to a positive charge.

4. The high charge density of the aether gives it, at large scale, a virtually irrotational property, providing the basis for the operation of directional devices that detect rotations relative to 'the fixed stars' - gyros, Foucault pendulum, etc. This suggests a link between the aether and the origin of inertia.

5. Mass-bearing fundamental particles are 'made of aether', taking the form of tight, but actually boundless, rotational configurations with vortical properties that 'pump' aether along their axes, thus 'sucking' themselves towards their neighbours and generating gravity. The corollary is that TEM-waves, being a purely wave phenomenon, are massless.

6. At a fundamental particle level, the same process is possibly the mechanism of the strong nuclear force. The associated changes in pumping flow pattern then offers a link between the energy content of such aether flows and the mass changes on nuclear fusion, giving a new meaning to $\boldsymbol{E = mc^2}$.

7. Large-scale uniformity of the aether's charge density (maintained by the self-repulsion of the aether's charge) defines unit charge, the charge of an electron, the basic building block of atomic species, throughout the Universe, so the products of creation/cosmogony are uniform without the need for proximity.

13C. Gravitation and the gravity-electric (G-E) field.

1. Gravitationally retained assemblages are held together by the 'suction' of the aether pumping mechanism (13B.5) which generates an aether density gradient, namely a gradient of electrical potential, the G-E field, which pervades the body. This also extends outside it, due to gravitational interaction with the rest of the Universe. Due to its direct relation to the gravitational process the intensity of the G-E field is directly proportional to the gravitational potential at the same place.

2. Inside stars, the G-E field causes the ionic material to provide an additional outward pressure, not previously recognized, so stellar interiors are cooler and stellar ages greater. This does not conflict with the age of the Big-Bang, because this hypothesis is abandoned (see 13D.4, D.10, F.2 and G.6 below), but it offers to explain aspects of the solar neutrino deficiency.

3. Outside stars, the G-E field is probably a major contributor to stellar mass loss generally and is evident both at the Earth and in many features of the heliosphere, including the particle energy gain responsible for the high ionization levels in the solar corona which have led to mistakenly high temperatures being inferred on an LTE assumption. Around distant clusters of galaxies it is probably the cause of their auras of x-ray emission, requiring that matter is present there.

4. In planetary formation, as seen in the solar system, the solar G-E field played a vital part in the new scenario dynamics (Section 6) of the (secondary) acquisition of the protoplanetary disc as an outward-moving flow, imparting its huge angular momentum content to the planetary material, a problem never previously resolved.

5. The G-E field is the probable source of cosmic ray acceleration. Extrapolation of the ~5 GeV maximum of solar cosmic rays to the gravity at the surface of a neutron star yields an energy of ~5 x 10^{20} MeV, which is the cut-off upper limit of the great majority of observed cosmic ray energies (Section 7).

6. The gravitational deflection of TEM-waves is not due to their possession of mass (which in CT they cannot, see 13A.5) but to the aether density gradient that is the G-E field, since Maxwell's equations imply that reduction of aether density lowers the value of ***c***. The deflection is therefore, in effect, dependent upon the gravitational potential, as in Relativity.

7. Gravitational interaction, being primarily a communication process involving the displacement of aether (i.e. electric charge), is therefore communicated at no more than the velocity ***c.***

8. Gravitation is no longer the 'odd man out' among the family of forces but is firmly intertwined with the electromagnetic ones, a long-sought result among physicists.

9. The strong nuclear force appears to have the nature of gravitation in miniature (Fig. 2), so could be a member of the same family.

10. The weak nuclear force, seen as the important player in the beta decay process, may perhaps, by contrast, rather be viewed as its inverse, as a measure of the susceptibility of the individual nuclear structure to the disruptive influence of random aether motion, from which it has been inadequately shielded. Diagnostically, if correct, this would render the relevant decay 'constants' slightly less than absolutely constant.

13D. Aether motion, TEM-wave transmission effects and cosmogony.

1. If particles are 'made out of aether' it follows from their random motions that that part of the aether which they entrain must be in correspondingly random motion, varying with the velocities and spacing of the particles. It follows at once that TEM-waves propagated by it will suffer various transmission effects and that these will vary in magnitude according to the applicable gas parameters, or according to primordial random motion to the extent that it may be present.

2. Three propagation affects are to be expected, each proportional to distance travelled; a redshift, a growth in line width variance and a scattering. All three have been observed, the first two sometimes in a diagnostically correlated manner, in a range of astronomical circumstances.

3. The solar redshift, widely cited as conforming to the GR prediction, is on close examination nothing of the kind (Section 4B) but its various features are consistent with the CT-predicted transmission effect (RTV redshift, see Section C2) in the solar atmosphere.

4. The RTV redshift appears to have been reliably observed over ground level paths, but not recognized as such. Simple extrapolation of the result to extragalactic parameters is apparently capable of yielding an acceptable value for the Hubble parameter $\boldsymbol{H_o}$ and explaining its suspected non-uniformity. Taken together with our conclusion regarding the CMB (13D.9 below) this demolishes two of the principal arguments for a Big-Bang, an hypothesis which accordingly is abandoned. But it leaves the problem of light-element nucleosynthesis. We have endeavoured to tackle that with a new model for quasars (13G.4 below and Section 8).

5. Operation of RLV line-broadening effect in stellar interiors must increase opacity, further adding to the impact of

CT upon the modelling of stellar evolution.

6. Aether motion of the inferred kind must inevitably include very small scale rotational components. Mass-bearing particles being rotational in character, this gives the motion a cosmogonical property, the implications of which we have explored at both ends of the scale-range.

7. The cosmogonical property of aether is manifest in the readiness with which particle-antiparticle (e.g. electron-positron) pair production occurs in high-energy situations, suggesting that some of the particles 'found' in high-energy particle research may in fact be on-the-spot constructs, not necessarily representative of Nature. In this respect the Higgs boson, if 'found', would not necessarily be the highest mass that can be built, albeit ephemerally.

8. At the grandest of scales the property is evidently significant for the creation of galaxies, for the provision of infall streams of young material to control their morphological evolution, and for the provision of material for the progeny-like formation of galaxy clusters. Such infall streams appear to bring about the metamorphosis of a spiral into a barred spiral, itself a key step along the evolutionary route to final triaxial elliptical. Morphological evolution rates along this route will vary accordingly and the presence of such ellipticals at quite high redshifts indicates that rates can have been be quite high.

9. Aether random motion also implies the acceleration of electric charge and the generation of TEM-waves, though extremely inefficiently. We have explored and conclude that this may be the origin of the CMB, the energy of which radiation in no way represents the energy content of the underlying aether motion. As noted in Section 2E and in 13B.6 above, the $\boldsymbol{E} = \boldsymbol{m}\boldsymbol{c}^2$ relation offers some indication of the latter.

10. The Universe 'began' an undefinable amount of time ago as nothing but aether in random motion. The energy content of that motion has been, and still is being, gradually converted by its cosmogonical action into the mass-containing Universe we see. Gravitational concentration of that mass, raising energy levels, must have shifted the locus of cosmogony progressively in that direction, by the resulting process of positive feedback, though to an uncertain extent.

11. It is speculated that quasars (see 13G.4 below) may represent the loci of an extreme degree of this feedback concentration of cosmogony, particularly but not exclusively apposite to the interpretation of AGN, providing also the ongoing injection of light elements into the Universe.

12. For cosmogony, as conceived here, to happen we need a mechanism by which the fundamental particles - notionally electrons, quarks and protons, with their antiparticle brethren - that emerge from the random motion of the aether can become fabricated into atoms of H. Quarks seem to be shy of an independent existence in the aether motion environment so might not have been a primary product. These are questions for the future.

13. Recognition of the latent energy of the random motion of the aether suggests that all physical calculations involving entropy or energy conservation should incorporate a corresponding term to avoid contravening the Second Law of Thermodynamics. This requirement is already implicit in the study of SED.

13E. Relativity.

1. In CT our observationally-based recognition of an aether, its random motion and its responsibility for TEM-wave transmission are in direct conflict with the postulates of Special Relativity. Had this observation base been available a century ago it seems doubtful if Relativity would ever have been proposed. So this paper has been much concerned to examine the validity, in a CT context, of what has been regarded as the exclusive empirical foundation of Relativity. My examination of eight of these in Sections 3, 4B and 5 has shown that either there are overlooked flaws (to put it kindly in some cases) or that CT can do the same or better in detail. The gravitational light deflection, the topic which really launched GR after the solar eclipse in 1919, has a probable CT replacement (13C.6). The rigidity with which Relativity is framed renders it fallible as a whole even if only one of those foundation items is conclusively shown to fail, so the neglect here of several other items of that foundation is justified on the grounds that in that case they could not prove decisive.

Three of the matters discussed in this paper merit special attention here.

2. The belief that the experimental evidence from particle accelerators demonstrates the predicted relativistic mass increase is, on sound electromagnetic principles, unavoidably mistaken. It fails to recognize the limitations of the acceleration process employed. This involves, in effect, pushing a charged particle with the front of an apparatus-based TEM-wave, requiring electromagnetic communication between the two fields. The terminal velocity for this is $\boldsymbol{c}$, so as $\boldsymbol{c}$ is approached it is the pushing efficiency that decreases, not the mass of the particle that increases. It is this finding that has made possible the entire progress listed in 13B above.

3. The recognition of transmission effects if the transmitting medium (the aether in our case) is in random motion invalidates the relativistic use of light waves as a perfect messenger between frames. Denial of that motion would mean rejecting all the evidence for it adduced in this paper.

4. The continuity of the aether at all scales ensures that there can be no discontinuity between logical frames, the propagation of TEM-waves depending at every point upon the aether at that point alone.

4. The acceptance of a propagating medium and the composition of velocities between frames was shown rigorously by Ives & Stillwell (1941a)(footnote 64) to render inapplicable the use of the Lorentz transformations (Section 3E). In the case of the lack of stellar aberration related to the transverse velocity of a distant binary star (a matter not, I think, satisfactorily resolved in Relativity) the acceptance of an intermediate reference frame (the aether) near the binary provides a simple reason (Section 3D and Figure 3).

13F. Cosmology in CT.

1. Removal of Relativity from our slate removes any consideration of space-time curvature, with its potential for a closed but unbounded Universe.

2. RTV redshift, associated with random aether motion, is inferred to be the prime cause of the Hubble redshift, so there was no Big-Bang and there is no indication that the Universe is systematically expanding or shrinking.

3. In these circumstances there is no need to have anywhere for the Universe to expand into, so the Universe is to be regarded as unbounded and infinite. This evades the need for a bounding wall to 'hold together' the high charge density of the aether. On the other hand it is this very pressure, operative because of the 'local' reduction of aether density in stellar interiors, that holds them together and constitutes the force of gravitation.

4. Because of its infinite extent the gravitational contraction of the entire Universe is an inappropriate concept, the possibility of gravitational contraction being confined to comparatively 'local' volumes of it.

5. The low mass content and density of the early Universe meant that the volume of a primary condensation (Jeans mass) must have been exceedingly large, but has fallen as cosmogony has raised the density and the locus of cosmogony has shifted towards these concentrations. In this respect the Universe will have presented a much more evolutionary character, and over a much longer time, than in any other cosmology so far considered.

6. The CT view that cosmogony/creation is ongoing today opens the door to the study of that evolution and what controls it, a philosophically valuable facility previously only available in the early form of Steady State Cosmology.

7. A potential destination of that evolution would be that the energy level of the aether's random motion became too low for further cosmogony/creation outside galaxies, or for quasar/AGN activity to do the same within them, allowing all galaxies to degenerate into ellipticals, concentrating more and more of the (indestructible) energy of the Universe into the mass-energy of high-metallicity materials.

13G. Other matters - black holes, inertia, quasars, GRBs, CDM etc..

1. **Black holes** envisage the unrestricted packing of mass into a very small space. In CT, particles are not singularities but have finite size, so this is impossible; such packing would result in mass annihilation with related release of energy.

2. The origin of **inertia** is still an active topic. CT is well adapted to formulations based on Mach's Principle, in that gravitational communication is at finite velocity. The ultra-high charge density of the aether may have the effect of making 'the rest of the Universe' have a much more restricted volume and therefore explain the lack of significant delay (has anyone done a refined check on this?) in its occurrence.

3. Dependence of **inertia** upon communication limited to velocity ***c*** implies that inertial force must be velocity-dependent, reducing as ***c***, relative to 'the rest of the Universe', is approached.

4. The CT model for **quasars** offered in Section 8 is based on an assumption of velocity-dependent inertia (such as a Mach's Principle approach would imply; G3 above), leading directly to the possible presence of superluminal orbital velocities around it. Such orbital velocities result in major Aberration-Related (A-R) redshift so that much of its redshift can be intrinsic, not cosmic, in nature. Therefore it no longer defines the distance of any galaxy in which it occurs. The model offers a full range of observationally supported features and provides for the *local* formation of the Lyman α forest of absorption lines. The central body is the CT equivalent of a black hole, but without the implication of enormous mass. A further difference is that the intense compression may raise temperature enough for light element nucleosynthesis, because CT admits of mass annihilation if the space gets too small (13D.1 above), so much more energy release is possible than in a classical black hole (which retains most of its mass, in degenerate form). A close relation to **AGN** is favoured and a possible relevance to the origin of **GRB**s is envisaged.

5. To the extent that the CT quasar model may be seen as successful it strengthens our insight into the nature of **inertia** and suggests that the **Universal Constant of Gravitation** (***G***) must also be velocity-dependent - not so constant after all, even on a relatively 'local' timescale, though its variation during the life of the Universe has long been a topic of debate.

6. Removal of the Big-Bang from the CT menu removes 90% of the demand for **CDM** (cold dark matter). Considerations of the internal dynamics of galaxies, their intrinsic RTV redshifts and of the evidence for cosmogonically young material around clusters of galaxies may remove the rest of it (Section 9B).

14. <u>Concluding remarks.</u>

A retrospect of this paper reflects a feeling that perhaps nothing in Nature is absolute - crudely, everything is affected by something else. To take just one example from among many suggestions of this in the paper, even the velocity of light depends on the aether charge density and this is subject to variation both at the particle scale and as the result of gravitational action. Such a perspective conflicts with a natural world seen as littered with and determined by 'physical constants', of which ***c*** has been treated as the very epitome; it is the qualitatative interdependence, however slight, that can be so philosophically illuminating. Theoretical treatments and quantification in CT have thus become much more complex matters if they are to recognize the network of new linkages, of which we have here been able to set out only a few. So formulations are deliberately almost lacking in this paper, for fear that they, not the logic behind them, should come to be regarded as defining CT. Much better at this stage that the basis of CT be seen as a web of reasoning, ultimately unlimited in its embrace but subject to remorseless amendment in the light of observation. Mathematical treatment and refinement then can follow, confident in the knowledge of what must be incorporated therein in order to avoid 'throwing out the baby with the bathwater' in the cause of tractability.

My pursuit of the CT idea was not conceived as an attack upon Relativity but as an open-minded attempt to explain observation, much as the formulation of Relativity was in large part motivated to explain the Michelson-Morley result, but differing only in that the former observation was of immediate practical importance, whereas the latter was a rather more philosophical question. The course which has emerged, driven by a strong preference for the inductive approach and a desire to understand causal links in simple physical terms, has taken the discussion into tangible first-order territories far from those upon which Relativity has seemed to bear. It is suggested that the most significant item in that category is our recognition of the G-E field as an inescapable and universal component of gravitational interaction. The supporting and refining observations for that are relatively modern but the fundamental basis has been in place (e.g. Newton, Faraday, W. Thompson (Kelvin), Maxwell and their contemporaries) since the 1860s and was already proving very fruitful in the latter part of that century, notably with H.Hertz' work on radio waves and J.J.Thomson's discovery of the electron. Perhaps that should properly be considered as the 'basement'. If CT is to frame a ground floor worthy of that basement its achievement will require both extension and much detailed consolidation beyond the scope of this paper, taking studies down exciting but unfamiliar paths**.**

CT, as presented here, prompts some intriguing questions. The material Universe has been wholly built, over a huge and undefinable time, from the original random motion energy of the aether and there is no reason to suspect that this process has ceased. That resource, though diminished thereby, continues to exist. By harnessing the energy of nuclear fission we are benefitting from the concentration of that energy previously wrought by Nature by the process of nuclear fusion. Could we ever succeed in tapping into it directly from the aether, emulating Nature? Would we want to, except out of curiosity? The 19th century saw the dawn of a realization that electricity could be useful. Is a similar road before us now?

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Table 1. Particle-tied aether - TEM-wave transmission and other effects

conttheo\talkslid\AetheffTable1.lwp

Effects to be seen as:-

SYSTEMATIC	**transverse to propagation (shear velocity gradient in aether between source and observer)**	1. **stellar aberration** due to Earth orbit velocity; but additional aberration reduced, for binaries and proper-motion stars, by distance ratio: shear site-to-source/shear site-to-observer.
		2. **aberration-related (AR) redshift** (ex-"Transverse Doppler Effect)
aether		3. **quasar intrinsic AR redshifts** up to z > 5..
	longitudinal to	1. Michelson-Morley result (in principle, but see text).
		2. Fizeau-Fresnel aether-dragging.
velocities	**propagation**	3. (**only** if aether is NOT irrotational) aether rotation with the Sun would cause refraction at solar limbs (predicted stellar 2.74 arcsec W deflection at both E&W solar limbs).
RANDOM	**'transverse'** (but see text)	**RTV redshift** (expressed as Doppler-equivalent velocities)
		1. cosmic redshift (say 60±30 km/s/Mpc).
		2. intrinsic redshifts of galaxies (variation with galactic type/gassiness - >800km/s for big Sc types).
		3. stellar K-effect (varies with spectral class/atmospheric optical depth - up to >60km/s for class O).
		4. excess redshift of the more gassy member of a binary (e.g. Plaskett's star (O supergiant) - +100km/s; WR-B1 binaries - +150km/s for WR component).
		5. solar redshift (steep line-to-line variation; to >1km/s at limb, but GR predicts 0.63km/s) & through the $3R_O$ corona (11m/s).
aether		6. ground-level redshift in air(~5 x 10^{-7}km/s/1000km)(Sadeh *et al*. 1968).
		RTV deflection scattering
		1. high-altitude daylight sky brightness distribution
		. 2. astronomical imagery to near ~10^{-13} arcsec (predicted limit)
	longitudinal	**RLV line broadening**, etc.
		1. broad lines in early-type (O/B/A/F3) stars, (deep stellar atmospheres), inconsistent with colour/excitation temp. - NOT now due to rotational broadening; spin-down problem at F5 resolved.
velocities		2. erroneously-inferred high (5MK) temperatures attained (but no thermal neutrons) in early nuclear fusion experiments (ZETA, SCEPTRE III).
		3. Low determinations of ***c*** when using pulse-extinction method.*vis-a-vis* microwave superposition method
	all components	**TEM-wave generation** due to acceleration components of motion (both particle-tied and primordial) at intergalactic path temperatures - mainly 2.73 K.
		1. cosmic microwave background (CMB)