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An interim outline of some research under the heading: Some aspects of a continuum theory of physical nature.

by
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Summary statement. A continuum theory, in which particles are special forms of disturbance of the continuum, whose consequent random motion thus affects the propagation of TEM waves by it, appears to be of potentially wide relevance. Gravity and the strong nuclear force have causes, relativity (arguably invalid in two well-observed respects) becomes redundant, and the cosmological redshift is among numerous TEM-wave transmission effects apparently observed astrophysically. Various terrestrial tests are available; two have given supportive results already. Much theoretical consolidation remains to be done.

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1. Basic concepts.

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The central proposal explored herein is that the universe is pervaded by and consists entirely of a continuum of electric charge. Transverse vibrations of this continuum are to be recognizable as transverse electromagnetic waves, longitudinal vibrations as gravity waves and particles are envisaged as predominantly rotational[2], rather concentrated disturbances of the continuum. The name "aether" is resuscitated to apply to this continuum, despite the fact that the aether of a century ago (the "elastic polarizable aether" of Maxwell's equations and the "aether drift" sought in the Michelson-Morley experiment) was regarded as completely different from particles. Thus, under the present proposal, particles are "made of" aether and the Michelson-Morley experiment was doomed to failure from the start.

Aether is seen as a compressible superfluid whose compressibility derives from the mutual repulsion of its constituent charge. Thus spatial differences in aether density (however caused), represent spatial differences in electric charge density, and set up aether pressure differences that always attempt to smooth them out. This form of elasticity will permit the transmission of compressional waves.

[It is noted here that the requirement for this "aether pressure" to be present throughout the observable universe carries the implication that the universe is either infinite and everywhere "filled" with aether or is bounded in some way that "keeps the aether in ". Neither is a topic upon which progress can usefully be made.]

To transmit transverse, or shear, waves appeal is made to the electromagnetic field induced in the surrounding aether by the transverse displacement of aether, i.e. electric charge, associated with the E-vector of the wave. This electromagnetic field stores the energy with which to restore the displaced aether as the E-vector falls, thus providing by dynamic means the required elasticity in shear despite the superfluid nature of aether. The aether provides a vehicle for the "dielectric displacement current" of Maxwell, which has hitherto been lacking.

It is proposed that, in common with all substances that transmit waves, the velocity of wave propagation depends on the density of the transmitting medium and it is inferred from the evidence of gravitational lensing - see later - that in this case the velocity goes down as the aether density, i.e. the spatial charge density, goes down. It should be noted, however, that the comparability is not a true one because in "normal" substances that transmit waves the dependence is upon the mass-density whereas here it is upon the charge-density and aether has no intrinsic mass-density. More accurately, the aether density affects the quantity sometimes known as "the dielectric constant of free space", a rise in which reduces *c* in Maxwell's equations.

Initially, the question of whether the aether is a continuum of positive charge or of negative charge is not constrained by postulate but is a matter to be determined by observation. However, for the purpose of the present outline I will simplify descriptions from here onward by stating that the solar data, discussed later, lead me to conclude that the continuum has to be one of negative charge (under existing conventions). Thus regions of lower-than-normal aether density constitute regions of positive charge, and *vice versa.*

Stable particles come in nature with (or without) two principal attributes, charge and mass. For a concentrated (but not centrally infinite in any respect) rotational disturbance of aether to have charge it is simply necessary for the disturbance to provide a local increase (-ve charge) or decrease (+ve charge) in aether density within the disturbance. The highest determined charge density concentration, relative to its surroundings, is that of the electron and, by similarity, of the positron also. Thus the "normal" charge density represented by the aether

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[2] I find this is an unwitting revival, in a modified form, of a proposal by Larmor(1894), but never pursued in the face of Lorenz's (1892) insistence on an inexplicable dichotomy between aether and ordinary matter.

must at least be sufficient to provide an aether density which a positron causes to just drop to zero in its core, or which is consequently doubled in the core of an electron. It is impossible to conceive of a rotational disturbance, in a spatial volume, that involves only a part of the aether fluid at the point concerned. In fact, the apparent invariability of the electron and positron charge (and the stability of the electron?) could be due to the positron representing the local zeroing of aether density in its core. On this basis the charge density of "normal" aether is calculated to be at least 3.8×10^{28} coulombs/cm^3 of negative charge.

It is clear from this figure that the electric gradients, i.e. aether density gradients, producible by man, as with a charged capacitor with vacuum dielectric, represent an almost negligible modulation of the mean aether density. It also means that huge forces can be brought into existence if only the aether density can be modulated sufficiently or, more precisely, if high enough aether density gradients can be produced. This is the basis of my proposals regarding gravitation.

2. Mass, gravitation, inertia, the strong nuclear force, $E = mc^2$ and QED.

The proposal that particles are rotational dynamic configurations of aether means that particles are polar entities. I propose that the property of mass is conferred if the dynamical configuration has, in addition to its self-contained rotations about its axis, a motion component that passes ("pumps") some aether along its axis, in at one end and out at the other. A smoke-ring might be a partial analogy to aid visualization.

Thus aether does not possess the mass property *per se*, so its motions do not suffer from inertial effects, such as centrifugal forces, which would make the rotational configurations fly apart. Further, being a superfluid, its motions are lossless and capable of being perpetual.

Particles that possess some mass, thus defined, and are in random motion will tend to clot together (much as a collection of ordinary magnetized macro-particles do - to help in short-circuiting their external field lines) to help in short-circuiting the external aether flows produced by their internal pumping actions. To optimize this the particles will optimize their relative orientations.

At short range, this clotting action is suggested as the origin of the strong nuclear force, and the reason why 3 quarks are preferred to 2 - see Appendix H.

At longer range, when particles are already grouped within nuclei or within atoms, themselves with random motions and orientations, for mutual attraction to occur there has to be a stimulated mutual response if gravitational attraction is to occur. Because of their aether pumping action, all mass-possessing particles are extremely sensitive to any externally occurring aether density gradient and will try to orient themselves, even while constrained within atoms, so as to align their internal in-to-out (pumping) aether density gradient with the external one. This will cause them to "suck" themselves down that external gradient. This is regarded as the mechanism of gravitation.

On this basis, particles which are bound together into a body by gravitation are continually pumping aether out of its interior. This means that a radial aether density gradient, i.e. an electric gradient, is produced, giving the body a positive charge with respect to its distant surroundings. Ionized particles within and at the outside of the body will respond to this in a manner that may easily override their gravitational response (hence the solar wind, CME's, stellar mass loss and cosmic rays - see later). Under the present proposals gravitational and electric force are identical in nature, both being due to spatial gradients in aether density, but it is the way they are generated and sensed by particles that makes them different. So the

susceptibility of a particle to the gravitational electric gradient will depend on its ratio of charge to mass.

This conceptual formulation of gravitation means that gravitational fields are communicated responses between bodies with the the velocity of communication being *c* or a simple function of *c*. A Mach's Principle formulation of the origin of inertial force, as the retarded field action of the gravitation of the rest of the universe, fits this situation very nicely, provided that the gravitational effect of the rest of the universe is finite and defined by the ratio of gravitational to inertial force - the "universal" gravitational constant (G).

This requirement is most simply met by the extent of the mass-containing part of the universe being finite. This would seem to fit well with a continuous-creation universe, clearly one of the options in a continuum theory of the proposed kind, but this raises the spectre of Dirac's secular decrease in G, which is probably untenable unless the age of the universe is much longer than the 10-15Ga currently discussed - see later. An alternative might be that the effective extent of the mass-containing universe is limited by communication effects of some kind. This too, however, will probably not escape a dependence on mean density.

A cautionary thought occurs here. If the effective extent of the region involved in defining the value of G observed by us is only a small part of the Universe then the value of G in other parts of the Universe will vary according to the density of the region involved. Consequently the inertial mass of electrons will vary accordingly, and the associated atomic spectra likewise.

Einstein's famous equivalence of mass and energy, $E = mc^2$, is in principle incorporated into the present proposals but in a restricted form. The idea that aether pumping, clearly a form of energy in the form of aether motion, is a measure of the mass of the particle directly implies that equivalence. The notion that all forms of energy, however, and notably transverse electromagnetic (TEM) wave energy, can be expressed as, and can behave as, a mass is expressly excluded here. TEM waves no longer have a wave/particle duality, so it is proposed that the quantized results of their interaction with matter are to be seen as dictated entirely by the operation of dynamic (e.g. orbital) stability criteria in source or receiver which inhibit either from existing in an intermediate energy state. This, if successful, will remove from the slate the need for the unphysical (and unethical?) charge renormalization procedures that have long dogged the consciences of many involved in quantum electrodynamics (QED), e.g. Roger Penrose in a Royal Society lecture a couple of years ago.

The phenomenon of "light pressure", sometimes cited as demonstrating that TEM waves possess mass, was shown by Born in the 1930's to result equally from treating TEM waves as waves.

A further consequence of excluding the interchangeability of TEM wave energy and mass is that the relativistic increase in the mass of a particle that is thought to occur during its acceleration by TEM wave energy becomes impossible. This is discussed below.

3. Relativity.

The presence of an aether capable of behaviour that is independent of both source and receiver, and responsible for transmission of electromagnetic waves between them, completely queers the pitch upon which Special Relativity was founded. All transmission effects were expressly excluded by Einstein on the hypothesis that TEM waves, despite their formulation by Maxwell (which has never been substituted) requiring a transmitting medium, could be propagated through a space containing nothing, because Michelson and Morley had failed to find an aether (of the kind they were looking for).

That was, with hindsight perhaps, not a good start. But there is worse to come, as I will now outline.

(a) Stellar aberration. The classical velocity triangle treatment of Bradley leads to an aberration angle $\sin^{-1}v/c$, and the relativistic treatment gives $\tan^{-1}v/c$, where v is the transverse velocity of the observer relative to the source. At the small angle produced by the Earth's 30km/s orbital velocity it is not practical to distinguish between these formulations. However the relativistic treatment also predicts, since it is only concerned with the relative velocity of source and observer, an appropriate aberration for, say, a spectroscopic binary component moving transverse to the line of sight. This is not observed; if it were, such binaries would appear to scoot to and fro across the sky, a behaviour which would long ago have been used to detect them without a spectrograph.

Appeal to a transmitting medium (aether) resolves this at once. In the case of the Earth's orbital velocity the gradient of transverse velocity, between transmitting medium and receiver, is clearly concentrated relatively near the receiver and a classical triangle of velocities yields the aberration angle. For a binary star component, on the other hand, the gradient of transverse velocity, relating to the orbital velocity of the source, is somewhere near the far end of the transmission path and the aberration angle produced there merely results in the observer receiving rays from the star that were not those originally emitted directly towards him, so no visible aberration is to be expected.

(b) Ives and Stillwell (1941). For relativists this citation signifies I&S's canal rays experiment in which they claimed to have demonstrated the transverse doppler effect (a redshift) of relativity, a theory which they therefore espoused. What I&S did not mention, nor has anyone else that I can trace, is that only 10 months earlier, also in JOSA, 1941, they had published beautiful results and rigorous calculations relating to interference patterns they had produced in gravity waves on a pool of mercury. This paper was cited in MFO (1960)[3]. In it they showed all the "relativistic" adjustments - the Fitzgerald contraction, the Larmor-Lorenz change of clock rate and the Fresnel convection coefficient - were both expected and observed BUT *with c in this experiment being, not the velocity of light, but the velocity of gravity waves on mercury.* In other words, though they didn't say so, there is nothing special about the velocity of light in these formulations so long as there is a transmitting medium (e.g. mercury) for the waves. [The relativistic adjustments arise **only** if one chooses to deny that the waves can, along part of their path, travel faster than *c* relative to the observer - that is like saying that a 30km/h fly in a moving railway train can go no faster than that relative to a man on the station platform.] I conclude that by restoring the local aether as the reference frame for the propagation of change all the phenomena currently attributed to Special Relativity effects become equally explicable.

(c) The "transverse Doppler effect". The velocity triangle treatment of aberration discussed in (a) above leads also to an expected stretching of the wave train to a degree represented by the hypotenuse of the triangle and is in practice (i.e. to the first order of small quantities) indistinguishable from the relativistic value. The vector summation of the velocities results, in effect, in the wave velocity relative to the observer being slightly increased. Under the present proposals such vector summation, and resulting velocities higher than *c*, relative to an observer (though not relative to the currently transmitting aether), are regarded as normal, whereas in relativity this is specifically denied by Einstein's second postulate. The mechanism of this redshift is an embryo form of that to be discussed later for the cosmic redshift.

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[3] M.F.Osmaston, *A medium theory of physical nature. (Preliminary synopsis of the proposed paper.)* June 1960. 16 pp. Unpublished.

(d) Relativistic increase in mass. An increasingly large amount of electromagnetic effort has to be put into accelerating particles by small amounts as velocity c is approached. Under relativity this effort is regarded as having increased the particle mass on the $E = mc^2$ basis, though the apparatus is always so inefficient that no-one has ever shown that the apparatus actually lost that amount of energy to the particle. Conversely, particles travelling at such velocities have the ability to penetrate much further into other particles or structures of particles than would be the case if their kinetic energy were a normal square-law function of their velocity.

The phenomenon of Cerenkov radiation, much used for measuring particle speeds, is the shockwave-like generation of a cone of radiation whose included angle is a direct measure of $v\mu/c$ when a charged particle having velocity v ($> c/\mu$) is fired into a medium of refractive index μ. This shows that the electric field of the particle can only be superimposed on the field structure of the medium at velocity c/μ and implies that the refractive index affects the speed of TEM waves and longitudinal aether waves equally.

Because of this limitation on the speed of interaction between a moving particle and its environment, efforts to accelerate or decelerate it must be greatly weakened as the particle speed approaches c. This consideration probably applies in all theories that accept that electromagnetic fields are propagated with finite speed. It follows that if a relativistic increase in mass were to occur too the difficulties in affecting the speed or path of a high-speed particle would be doubled - which they are not. I wrote to Herbert Dingle about this in 1960 but got no reply.

I conclude that what has been attributed to mass increase is in fact merely the result of a finite field superposition rate. This result is important for the present continuum theory. I propose that stable, mass-possessing particles are particular aether dynamical configurations that happen to confer stability and there can be no place for a continuous variation of mass. Under existing theory, of course, there is no place for a continuous variation of mass either but the microwave-frequency quanta regarded as being added by the accelerating equipment are so small that the lack of continuity is never expected to be apparent.

(e) Gravitational redshift and light deflection. The relativistic reasoning involved here is that TEM wave quanta possess mass and that consequently their energy content and their ballistic paths ought to be affected by environmental changes in the gravitational potential. That is clearly untenable in the new framework proposed here. However both effects are reported to have been observed. The requirement, therefore, is to link the effects to gravity in another way (or ways). In this I have had partial success but more is required. The main points are now summarized.

(i) Redshift. Current atomic theory makes no provision for the support of the nucleus within the electron shell structure when the atom is supported in the presence of a gravity field, so the inevitable eccentricity of the nucleus has apparently never been considered. TEM wave energy emitted from the nucleus may well be governed as to wavelength by cavity resonance effects which depend upon the nucleus-to-K-shell distance **in the direction of emission.** The Mössbauer effect in iron-group elements, used in several laboratory measurements of the gravitational redshift, involves a wavelength commensurate with the K-shell radius, so could be affected in this way, though why the result should match the relativistic prediction in magnitude is unclear. The resonant cavity picture might also explain the very narrow bandwidth of the Mössbauer process, which is what made it so suitable for the experiments.

One of the Mössbauer experiments further demonstrated that the same result was achieved if centripetal acceleration in a rotating system was substituted for gravitational acceleration, thus

confirming Einstein's Principle of Equivalence of inertial and gravitational mass: a principle that is entirely acceptable (for acceleration purposes but not in terms of physical origin) in the present context also.

The possibility under the present theory - see later - for producing redshifts that are transmission effects in stellar atmospheres is so good, and the linkage of observed stellar redshifts to the relevant stellar mass so ill-constrained that this may well prove a satisfactory explanation of these observed redshifts. The limbward rise of the solar redshift, in particular, gives strong grounds for such an explanation - see later.

(ii) Light deflection. Within the Sun's planetary system the light deflection has been verified with good precision for the purposes of space vehicle navigation. The light deflection within 15 solar radii of the Sun's limb has not. The relativity prediction is a radial deflection of $\alpha = 4GM/c^2r = 1.75"$ at the limb, decreasing with distance from the Sun's centre. The eclipse observations yield results that have commonly been around 2.2" but Van Biesbroeck (1959) concluded there was better evidence for a westward deflection both sides of the disc than for a radial one. On the new theory, passage through the rotating corona is expected to produce a westward deflection of 2.74" at both the equatorial limbs (see Sect. 6.b). This would be superimposed on any radial shift. In the eclipse observations, the inclusion of more stars to the west of the Sun could thus have produced the increased result when analysed for radial deflection alone. Another form of this effect may be present in the near-solar passage observations of the frequency of the 21-cm absorption line of Taurus A.

Gravitational lensing by quasars has been widely inferred in several instances.

My proposal (Sect.2) as to the nature of gravitation implies that massive bodies create major depressions in the regional aether density. These fade outwards with distance from the body. Under my proposal (Sect.1) that the velocity *c* of TEM waves is not an absolute constant, but decreases as aether density decreases, the inward decrease in aether density will result in slower transmission at small distances from the limb of the body, and a corresponding lensing action. Thus the lensing action is directly linked to the gravity field strength, as required, but a replacement for the relativistic prediction of its magnitude has not been worked out.

(f) Perihelion advance of Mercury. This orbital phenomenon is dealt with under the next section.

4. Orbital phenomena.

The present proposal that the gravitational interaction between two bodies is a stimulated response of the mass-exhibiting particles in each to the aether density gradient produced by the other means that interaction is governed by a communication time-lag measured by the velocity of aether longitudinal, or compressional, waves. It was argued earlier that the phenomenon of Cerenkov radiation indicates that these are propagated at the same velocity as TEM waves, namely *c*.

Further, since gravitational force is herein identified with electric force, it justifies the unified treatment of orbital phenomena at all scales, from electrons in atoms to stars in galaxies, and beyond.

Under the present proposals three kinds of effect are to be expected:

A. a time-lag in the **magnitude** of the interaction force if the orbit is elliptical;

B. an **aberration** of the interaction vector, due to the different angular velocity of the intervening aether;

C. a **misdirection** of the interaction vector from each of the bodies, due to the rotation of each during the time-lag. This effect will presumably be absent in the case of an orbiting elementary particle, whose pumping (= spin?) axis would be locked onto the interaction vector.

The effect of A alone is to give an attractive force during the receding leg of the orbit that relates to a slightly nearer position of the orbiting body, so is more than what is statically appropriate for the actual distance, and a force that is correspondingly lessened during the approach leg, thus causing the orbit to rotate. Burniston-Brown states that Gerber in 1898 showed that this, using *c* as the communication velocity, would account for the excess perihelion advance of Mercury. I have been unable to check this.

The effect of B is especially important when the intervening aether includes matter that is in Keplerian orbits, i.e. is orbiting faster, the smaller the orbit. The interaction vector transmitted through that aether then arrives at the orbiting body from a direction slightly ahead of the geometrical instantaneous radius vector (GIRV). Thus the orbit is not stable but is an outward spiral. When the motion of the intervening aether is no longer Keplerian orbital, but is diluted by other influences (e.g. the solar wind), this effect may largely disappear.

If, on the other hand, because of these other influences, the intervening material effectively orbits at a slower angular velocity than the body the body's orbit will contract, an effect that may be pertinent at the atomic level - see below.

The effects of C, the rotations of the interacting bodies, may be quite complex. The particles in each body respond to the instantaneous interaction vector at their site by adjusting their pump-axis orientations slightly so as to produce some resultant pumping along the vector. Rotation of the body will continuously carry this response forward of the GIRV, producing a retarding torque on the body analogous to a tidal one if, and only if, the interaction vector was not exactly radial to the body considered. Details will not be pursued here.

The effects of A, B, and C are conveniently combined under the name Orbital Stability Criterion (OSC). At the atomic level it offers insight into how intrusive particles may disrupt the stable atomic orbital structure by altering the angular velocity of the orbiting aether within the atom. At the solar system level - see the extensive discussion in Appendix E - it is inferred to have played a major part in the early attainment of large orbital radii and in the expulsion of redundant nebular matter from the system. At the galaxy level - see later - the effect B in particular offers insight into the evolution of spirals by repeated metamorphosis and their eventual stabilization as ellipticals.

Overall, the OSC provides a more extensive departure from Newtonian gravity law than that provided by relativity. Truly stable orbits become very special, not the normal expectation. Conceivably, the stability of particular electron orbits in atoms arises as a result of the aether motion in the "interaction space" being dominated(?) by the outer fringes of the aether motions intrinsic to the particles themselves, thus eliminating effect B and leaving a virtually relativistic situation at this level, where relativity is known to have been fruitful.

Under General Relativity gravitational waves are shown theoretically to arise from the oscillatory displacement of the centre of gravity of rapidly orbiting, but disparate, binary stars. These waves are expected to be transverse in character and travel at velocity c, but it seems that longitudinal waves are not expected. Under my present proposals, by contrast, it appears that gravity waves (i.e. aether waves) of ***both*** *kinds will be emitted in the general direction of the plane of the orbit. The transverse ones will presumably be observable as very low frequency TEM waves. I have pointed out in Sect.3.d that the Cerenkov phenomenon seems to imply that longitudinal, i.e. compressional, aether waves (involved in the*

superposition of fields) also propagate at velocity c, in that their velocity is affected by the refractive index of the medium in the same way as that of TEM waves.

5. Generation of cosmic, stellar, solar and terrestrial magnetic fields.

This has long presented a problem in the cosmic environment because the apparently necessary large-scale electric current flow demands the large-scale separation of electric charge, for which no mechanism has seemed to exist. The concept of gravity as a stimulated response means that the solar force field acting upon Jupiter, say, does not exist until Jupiter is put there. Interaction between them then causes the aether density in the intervening space to be reduced. This volume with reduced aether density moves round the Sun as Jupiter does, constituting a circulating positive charge and generating a corresponding magnetic field. There have been widespread inferences of the presence of synchrotron-type radiation (namely the radiation emitted by charged particles when they spiral around magnetic field lines) mainly, I think, in relation to the centre of the Galaxy. This centre has lately been inferred to contain a bar and I shall argue later (Sect. 9) that galaxy bars consist of material rotating relatively rapidly about the long axis of the bar. So this might be the source of the magnetic field necessary for the synchrotron radiation.

Another site for which magnetic fields have been inferred is the spiral arms of the Galaxy, in attempts to explain the interstellar polarization of starlight. Except when looking in the direction of the galactic centre this polarization is in the sense that the E-vector shows a rather consistent preference for the galactic plane. The argument has been that a magnetic field caused the alignment of the long axes of dust particles. In Section 9, however, I shall argue that these arms are devoid of self-rotation. The appropriate alignment of dust particles seems likely to be readily achieved by the radial electric gradient, within the galactic plane, that is associated with the overall gravitational field of the Galaxy under the present proposals.

Within condensed bodies the magnetic fields present have either been attributed to concentration by contraction in a cosmic magnetic field or to MHD dynamo action. I regard the latter as an increasingly doubtful straw to clutch at. No convincing unipolarity model of such a dynamo has been demonstrated, let alone one that reverses either with rather stable periodicity (solar case, and many stars) or in an irregular fashion with occasional long periods without reversals (terrestrial case). For pulsars the highly-oblique rotator model appears successful where the pulses, from alternate poles, are of alternating form. Extension of this model to many other cases where the pulse rate is slowly decreasing (the commonest situation) or increasing carries the requirement that the star's rotation rate is changing, implying either that the star is expanding or contracting or that it has major tidal torque exerted upon it by a companion. These are exacting requirements to meet. *Consequently, in the cases that the pulse rate is decreasing, many workers have inferred a close binary model , involving energy loss by gravity radiation. On the lines of the Sun-Jupiter effect outlined above, this configuration would also provide the pulses. Gravity radiation won't work where the pulse rate is increasing, however. In that case the changing pulse rate would have to be attributed to changing orbital radius and period brought about by the operation of the OSC as described in the previous Section.*

For the terrestrial case I am currently playing with a model depending upon thermoelectric currents across the core-mantle boundary, which evidently has the necessary reversal properties.

In the solar case, the reversals (a few gauss) match the sunspot cycle. In Section 8 I argue that the Sun (and other stars too) has a positive electric charge associated with its gravitational field and that the output of the solar wind affects the relative abundance of

negative and positive charged particles near the solar surface. This, combined with the solar rotation, will generate a quasi-axial magnetic field; it is only necessary for the charge preponderances to exchange their levels in the atmosphere for the resulting field to reverse. This completely escapes the short-period reversal problem, acute in most such stars, presented by the high electrical conductivity of stellar interiors. (In some cases the decay constant for such currents is of the same order, or greater than, the age of the star. This gives a secure base to the argument that some strongly magnetic stars incorporate the much-enhanced field of the interstellar medium from which they condensed.) There does not seem to be a problem, in principle, in explaining sunspots as convective-plus-coriolis intensifications of the polar field. The problem is to explain the agency and timing of the reversal cycle.

It has been shown that integrated planetary jerk (that is, the rate of change of planetary gravitational pull upon the Sun, which moves the instantaneous centre of the whole system) has a fundamental that closely matches the sunspot cycle over the past 250 (I think) years. Through the linkage provided by the present proposals between gravitation and the position of electric charge it thus seems possible that a good account of the solar cycle may emerge.

Other magnetically reversing stars, with much higher field strengths (e.g. +7000 to -6000 gauss for Babcock's star - HD 125248), shorter reversal periods (e.g. 9½ days) and much faster rotations, exhibit synchronous other forms of variability, notably a variation in radial velocity deduced from spectral lines, the integrated magnitude and duration of which would in some cases take the source material well beyond the confines of the star. I suggest that some of this "velocity" variation may be RTV redshift (see Sections 6.c.i and 7.a) variation in the stellar atmosphere, due to its varying temperature and depth associated with the star's variability. That variation may also transpose the respective atmospheric levels at which ions and electrons dominate, to give the field reversal. Such mass transposition would bring about angular velocity changes which might explain observed asymmetries in the variation waveforms.

6. Transmission effects upon TEM waves.

Under the new proposals, transmission effects upon TEM waves arise from three sources:
variations in the density of the aether, both regional and local random;
systematic aether velocities, both transverse to and along the direction of propagation;
random aether velocities, both transverse to and along the propagation direction.

(a) Aether density.

(b) Systematic velocities. Transverse velocity of the source, discussed in Sect. 3.a, involves a systematic transverse velocity gradient along some part of the transmission path, which causes aberration that, although physically invariant with respect to location along the sightline, differs in perceived amount according to whether the gradient is near the observer (the full amount) or the source (zero). Transverse velocity that does not involve the source/observer relationship will transport a collimated beam 'downstream' but the two lots of aberration, at entry to and exit from the stream, will cancel, so no net aberration will arise.

Systematic along-path aether velocities modify the transmission time, giving that part of the path an effective refractive index equal to $(1 \pm v/c)$. When such velocities are introduced by the passage of the TEM waves through the rotating atmosphere of a star (e.g. the Sun or the near member of an eclipsing binary) there will be a unidirectional apparent refraction of the waves. This can be understood as follows. The grazing light-path can be regarded as passing through an extremely wide-angle, low refractive index prism, represented by the stellar atmosphere. On the side that is approaching the source the waves entering the

atmosphere experience an extra drop in velocity (relative to propagation conditions before reaching the stellar environment) and more refraction occurs; on the other side, the waves experience a smaller drop and less refraction occurs. The result, a difference between the two, is independent of what normal refraction the stellar atmosphere actually does. In the case of the Sun this is the basis of an expected $2R_s\Omega_s/c =$

(c) Random aether motion. Under the new proposals four effects stem from long-distance transmission in a randomly moving (e.g. Maxwell-Boltzmann gaseous) environment. These are:- redshift, directional scattering, spectral dispersion (e.g. line broadening) and thermal noise generation. The basic concept applicable to all these is that the motion of the aether that is transmitting the wave is representative of the particle motions in that space but at reduced velocity amplitude, due to averaging associated with the overlapping of the influences of numerous particles in the neighbourhood. It might be thought that this averaging, or smoothing, will decrease as the particle separations increase at very low, e.g. intergalactic, pressure. It is shown in Appendix A, however, that this will not be so, provided that the law of individual particle influence, with distance (inverse square or any other), does not change.

The influence of neutral particles or atoms beyond a few particle-radii distance will be confined to their aether-pumping (mass) property, but at close quarters local and rapidly moving internal imperfections of internal neutrality of the atom might "show through", to give an effective change in the influence law and a rise in effective random motion of the transmitting aether at very high pressures. An alternative, and perhaps more realistic, view in this respect is that particles and atoms, being made of aether in any case, would be transparent for the purpose of TEM wave transmission; thus the aether disturbances which they 'contain' would always be part of the transmission volume but only affect the transmission process significantly when, at high pressures, their volume became a substantial proportion of the transmission volume, as may be the case only in extreme stellar interiors.

The influence upon aether random motion exerted by charged particles and ions will be greater by many orders of magnitude, measured by the ratio of electrostatic force to gravitational force between two identical particles. This ratio is 4.17×10^{42} *All four of the effects will increase with the gas temperature along the path, in a manner dependent upon the velocity statistics of the particular gas. For Maxwell-Boltzmann statistics the effects will vary with* $T^{½}$.

Three of the effects (but not the noise generation) will be completely independent of the wavelength being transmitted.

(i) Random transverse velocity (RTV) redshift. (See also Appendix A.) This is an elaboration of the "transverse doppler effect" redshift associated with aberration discussed earlier. In this case the wave-train is subject to random transverse displacement at different points along its length. These always stretch the wave-train; there is no balancing process to shorten it. The process is proportional to distance for small proportions of stretching but its proportional incremental nature becomes apparent as an exponential buildup as the amount of redshift rises. Thus

$$\lambda_D = \lambda_0 . e^{RD}$$

where λ_0 *and* λ_D *are the wavelengths at emission and after travelling a distance D, and R is the redshift proportion per unit distance.*

Analytical treatment of this process (Appendix A) for transmission by a Maxwell-Boltzmann gas of neutral particles, shows that the redshift (R) per unit distance will be given by

$$R \propto T.n^{1/3}.m^{-1}$$

where T is absolute temperature, n is particle number density and m is particle mass.

This redshift appears to have been observed by Sadeh et al. (1968)[4] using caesium clocks in a horizontal ground-level experiment over distances up to 1500 km, but curiously not recognized as such by them or by their readers. Their results (see Appendix A)yield a redshift rate of about 1.75 x 10^{-20} per cm in air at around 290K (temperature not recorded).

In that redshift is a stretching of the wave energy into a longer spatial volume, the amplitude of the wave must necessarily fall. The received intensity will therefore vary inversely as the square of the redshift ratio. This is standard wave theory. This attenuation is in addition to that due to the scattering associated with TEM wave transmission - see the next subsection.

In a quantum theory context, the continuous variation of quantum energy during transmission, 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. Under relativity-plus-quantum theory the emitted quantum is regarded as undergoing a relativistic transformation on entering the reference frame of the observer. Such transformation has never been elucidated in physical[5] terms.

(ii) Directional scattering ("Deflection scattering"). (See also Appendix B.) The random transverse displacements involved in RTV redshifting produce random changes in the propagation direction. [The occurrence of stellar aberration proves that transverse displacement of TEM waves does indeed alter the effective propagation direction and not just displace them sideways.] Light from a (impossible!) point source consequently reaches an observer from an ever-increasing angular range (2θ), the further the light has been transmitted. As θ approaches 2π, however, all the 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, 6πDeflection 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 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 that both the redshift goes up and the intensity down with distance faster than 'normal', thus (in the case of the cosmological redshift) adding to the impression of a linear Hubble law.

If the propagation space has large-scale heterogeneity the virtual image in the antisource direction may appear smeared out, so that light which has been scattered in (say) from the right or left of the observer does not concentrate in quite the same place as that which has been scattered in from above or below. In general this will make the virtual image unrecognisable as derived from its 'parent'; only the close opposition will do that. If, as seems likely, deflection scattering of the proposed kind operates wholly upon the E-vector of the wave, because aether motion is charge motion, any such smeared-out image may be polarized differently in different places. In addition, the virtual image may exhibit scintillation-like variability, both in intensity and in position, on relatively short timescales, giving the erroneous impression of very rapid (superluminal?) motions in the source.

(iii) Random longitudinal velocity (RLV) line broadening and spectral dispersion.The shape of the line-broadening produced will depend on the velocity statistics of the gas along

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[4] D.Sadeh, S.Knowles & B.Au. *The effect of mass on frequency*. Science, 161 (3481) 567-569.

[5] I use the word in its older sense, not the present-day sense in which mathematics is regarded as an adequate substitute for physics.

the path but may prove impossible or difficult to distinguish from emission temperature of the source except on grounds of physical reasonability. The line-broadening will be progressive along the transmission path and the shape will therefore grow in a manner analogous to that in which normal absorption profiles grow according to the kinetic temperatures along the route. On the other hand, the RLV effect on absorption lines is distinct and may be the origin of the 'pinched' lineform tips seen in the "Lyman α forest" typical of high redshift quasars. [It may be noted that awkwardly high temperatures are neverthless inferred for many of the intergalactic clouds thought to be responsible for these absorption lines, a problem that may be reduced or resolved by allowing for subsequent RLV line-broadening en route.] Where the absorption lines are sufficiently isolated, however, as in some stellar spectra, the widening of the skirts will be obvious.

RLV line broadening and RTV redshift depend on exactly the same parameters of the random motion of the gas so their basic magnitudes are directly related in any given case. As stated above, however, the line broadening grows as the square root of distance whereas the redshift grows in direct proportion to distance. This seems likely to prevent lines becoming unrecognizably wide at very large redshifts. Moreover, given, say, a knowledge of how much of the observed redshift is RTV, the amount of RLV broadening present will be directly calculable, perhaps enabling source temperature to be estimated.

(iv) Thermal noise generation. The provision (earlier) that the velocity of TEM wave propagation varies with aether density may mean that the propagation process itself is not a physically linear one, so will automatically give rise to sidebands at the aether random motion frequencies. I haven't been able to decide about this yet. If this does happen the additional line broadening will be too slight to be detectable in the cosmological case with a propagation temperature of 2.75K. In a deep stellar atmosphere or a gassy galaxy the effect might be substantial.

An idea of the low depth of aether density modulation represented even by intense TEM waves is given by the fact that the energy density of an electron and therefore, as previously argued, the minimum energy density of aether (at normal density) is

$$Q_a \geq m_e c^2 / \tfrac{4}{3}\pi R_e^3 = 1.96 \times 10^{41}\ erg/cm^3$$

whereas the energy density (radiation energy flux ÷c) at the solar surface (Allen, 1963) is only 2.3 erg/cm³It does seem clear, however, that this same dependence of c upon aether density will cause aether random motions, due to the temperature of the propagation region, to generate TEM waves of its own at the corresponding frequencies. Such radiation will be isotropic. Turbulent motions of the gas would, in principle, have a similar effect but the radiation would not be isotropic unless the turbulence was.

It is tempting, but doubtful, to try to tie this effect to the origin of black-body radiation continua generally, thus evading the Planck argument for the particulate nature of TEM radiation.

By regarding this temperature as the actual effective temperature of the intergalactic medium,

7. Solar and stellar phenomena.

(a) Solar redshift.Continuum theory offers a preferable alternative. It is all

(b) Gravitation and a positive electric potential for the Sun and stars. The central proposal, given earlier, regarding the nature of gravitation implies that the Sun must have a major positive electric potential. The presence of a potential was proposed by V.A. Bailey in 1960 to explain the solar wind of predominantly positive ions but Oster & Philip[6] killed further discussion of this by stating that the Stark effect to be expected from the potential gradient is not present in the solar spectrum. If this is correct and there are no possibilities

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6 L.O.&K.W.P., *Existence of net electric charges on stars.* Nature, **189**, 43.

for the Stark effect to be masked in this case, then much of the edifice outlined herein (insofar as it relates to the cause of gravitational force) collapses.

(c) Solar flares, coronal temperature, coronal mass ejections (CME) and the solar wind. The energy support of the coronal temperature of apparently upwards of 106K when the photospheric temperature is only about 6000K has long been a puzzle, bearing in mind the second law of thermodynamics. The coronal emission spectrum shows the presence of ions stripped of more than 20 electrons but the particle velocities needed to achieve this need not be thermal; acceleration by the solar electric gradient would do. Likewise, some of the line breadth could be due to transmissional RLV line broadening. Thus the actual coronal temperature may not be so high but the basic problem remains.

Recent studies of solar flares show that they occur when an arcade loop bursts and releases ionized material previously magnetically confined to coursing within the loop. The presence of a radial electric gradient provides a nice way of keeping the loop upright and of causing the loop to burst when it has become so full of ions that the radial force developed upon them by the electric gradient overcomes the magnetic containment. The enhanced brightness of the loop footpoints may be due to energy released by the returning electrons. Observations of the resulting flare and CME show that the released particles accelerate outward through the corona. This too is consistent with the presence of an electric gradient. The high levels of ionization are then the result of impacts during this acceleration, and their progressive increase is, in part, the cause of that acceleration. Thus the high energy density in the corona is energy derived from the electric gradient and is not 'transported' from the chromosphere.

The solar wind contains a predominance of positive ions; the electrons it contains may have been produced by collisions with the interplanetary medium. Eclipse observations of the corona show radial striations of the luminescence suggesting that the solar wind is isotropic. Both are consistent with the Sun having a positive electric charge. The strength, in the Sun, of the spectrum due to the negative hydrogen ion seems to indicate that there is a large excess of electrons in the outer part of the Sun, that have fallen back in the electric field after being knocked off ions contributing to the solar wind. Although the Sun's (proposed) positive electric potential has a separate origin (e.g. gravitation, as proposed) the evident continuing loss of positive charge in the solar wind (it is entirely possible that the solar wind has, over time, more than halved the Sun's mass) would have been halted long ago by the build-up of a ***negative*** *So far as I am aware, this problem has not previously been discussed, authors having seemed to avoid it by assuming that, despite the evidence, the solar wind is, on the whole, an electrically neutral solar loss. One of the criticisms levelled at Bailey's proposal was that he lacked a means of generating and sustaining the positive electric potential. Under my proposals outlined here, the electric gradient associated with the gravitational process is different from that of a simply electrically charged body. In the latter the charge concentrates at the outer surface of the body and the interior is gradient-free. In the proposed case, the electric gradient persists, as does the gravity gradient, into the deep interior of the Sun. Consequently the excess electrons will flow towards the Sun's centre, where their abundance may have a marked effect upon the hydrogen-burning sequence of reactions. Presumably the excess electrons would be disposed of by electron-positron annihilation, the positrons for this being a by-product of the first reaction in the hydrogen-burning proton-proton (PP 1) chain, the deuterium-generating*

$$p(p, {}^{e}+ + ne)$$

In any case, even if electron-positron annihilation energy has already been included in the calculations, it seems to me likely that the surfeit of electrons (both from the surface loss of solar wind ions and from the general ionization within the Sun) brought towards the centre of the star by the electric gradient will modify the reaction probabilities in ways that I am not qualified to forsee.

It is tempting to suggest that herein may lie solutions to three other problems. One is the well-known observed shortage, by a factor of about three, of solar (electron) neutrinos compared to the number to be expected if the standard hydrogen-burning sequence is providing all the energy output. The second is my reasoning (later - Section 8) that when the solar planetary system was formed 4.6Ga ago the Sun needs to have been already in a fairly condensed and evolved state, so must have evolved more slowly since then than is expected under current theory. The third is the apparent discrepancy between the observed H/He ratio in stars and the much lower ratio that calculations indicate can be achieved by the standard H-burning reactions in stars before the CN reaction sequence takes over. I wonder whether the higher energy release and/or modified reaction probabilities which I now associate with hydrogen-burning and electron-positron annihilation combined may delay the CN takeover until a higher level of He is present[7]. This latter is a matter of great importance in the context of the proposal (later) that RTV redshift is the cause of the cosmological redshift, thus removing Big Bang nucleosynthesis as an explanation of the He abundance.

(d) Cosmic rays. These, by convention, are those positive ions with velocity energies above 1 GeV. Those from the Sun attain a maximum of 5-10 GeV. If this is taken as an empirical yardstick for particle acceleration by the electric gradient representing the gravitational field at the solar surface then the field at the surface of a neutron star should be capable of producing cosmic rays in the $^{1019\text{-}1020}$ eV bracket. This is, in fact, the upper limit of observed cosmic ray energies. Recent investigations discussed by Wolfendale have shown that heavy nuclei (Fe and beyond) tend to predominate at the high end of the energy range. This is to be expected if, as proposed here, mass loss from a star depends, in part, on the ratio of electric repulsion to gravitational attraction acting upon the nuclei, i.e. upon their ratio of ionic charge to mass. This ratio climbs through the elements rather steadily from 2.0 at 4He to 2.2 at the iron group and 2.5 at Th, so the heavy nuclei will tend to get expelled last.

A possible example of the converse of this is seen in the solar wind. For 3He nuclei the ratio is only 1.5 so, relative to 4He, they will be strongly preferentially selected from the solar plasma and accelerated into the solar wind. Lin has described[8] *solar wind events that are much more frequent than those associated with solar flares and CMEs and which he calls "non-relativistic electron-3He-rich" events. These, in contrast to CME-related events, are characterized by an up to >1000-fold enhancement of the 3He/4He ratio relative to the 'normal' solar value and by enhanced abundances of highly stripped (e.g.* ^{Fe}

(e) Stellar K-effect. This is a long-recognized spectral-class-related redshift, distinguished from a velocity (doppler) shift by comparisons with other stars of different spectral class within a compact group, or by comparison with interstellar absorption lines from the cloud in which the star is immersed. The names of Trumpler, Weaver and Feast figure in these studies. The effect gives the impression of a class-related recession from the Sun, independent of direction, and was one of Finlay-Freundlich's items. According to Allen (1963) it is equivalent to 5.3km/s for B0 stars, falls to zero by F0 and later, rising again to 0.4km/s for M0. Feast reported substantially higher figures for O-stars, in which the relativity prediction would have amounted to no more than a few km/s. It is seen at once that the term relates to stars with deep atmospheres and/or high atmospheric temperatures, which

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[7] A further possible contribution to this discrepancy is the likelihood that a disproportionate amount of He gets left behind on stellar surfaces because its uniquely high first ionization potential will mean there are fewer ions to take part in the electrically driven mass loss process. This point will be taken up again in Section 10.d.

[8] R.P.Lin, *Exploring the enigma of solar energetic particles.* EOS, Trans.Am.Geophys. Union. **75,** No. 40, October 4, 1994.

is consistent with an RTV redshift interpretation. Moreover, the K-term varies strongly with the star brightness, being much reduced for faint (= small) stars of the same class.

In short, the stellar K-effect appears merely to be the integrated form of the solar redshift discussed in subsection (a) above. The way, therefore, to distinguish it from the relativity prediction is that degenerate stars with thin atmospheres will not exhibit a large redshift unless that atmosphere consists primarily of electrons left behind by the expelled ions. In this context note that the white dwarf L886-6 exhibits no detectable redshift relative to its binary companion, whereas the relativity prediction for this star is ~250 km/s. A similar situation occurs with the white dwarf R 627. On the other hand, the white dwarf Sirius B has a 19 km/s redshift superimposed on its orbital parameters relative to its large class-A1 binary companion, Sirius A, a fact which has been widely acclaimed as fitting a relativity interpretation not uncomfortably.

(f) Interpretations of stellar line widths.RTV spectral dispersion may be the cause of temperature estimates for the absorber in some giant and supergiant stars that are ridiculously high when compared with their black-body colour temperature; examples include Aurigae (2 x 106 K) and 17 Leporis (30 x 106 K) (Aller, 1951), interstellar reddening having been discounted in these cases. Previous interpretations have invoked extreme turbulence in the stellar atmosphere. Significantly, perhaps, two stars reported in this group also have substantial (K-effect?) redshifts, whereas the relativity prediction here would be only a few km/s :- δ Can Ma (Type F8; Mv = -7.0; vr = +34.3 km/s) ; ε Can Ma (Type B2; Mv = -5.0; vr = +27.4 km/s).

(g) Stellar mass and mass loss. Many phenomena are known, indicative of stellar mass loss. Early-type (WR, O, B) stars are typically much more massive than their evolved F and G sequels. Of these, a recent report by Crowther[9] shows that a major group of Wolf-Rayet stars, in particular, exhibit spectra indicating chemically evolved stellar cores from which stellar winds giving very high rates of mass loss (typically 10MSun/Ma) have removed the outer hydrogen-rich layers. Crowther stresses that such rates of mass loss lie beyond what radiation pressure can do. T-Tauri phases, P-Cygni stars, Beta Lyrae stars, planetary nebulae with outward-moving gaseous shells, and novae too, are further evidence. While the present proposals offer a much more effective mechanism for mass loss than was previously available, careful thought will have to be given to the questions then raised - How did the mass build-up of the star occur in the first place? - Is this gravitationally/electrically-driven mass loss mechanism an important factor limiting the initial mass achieved by a star?

(h) Stellar interiors, nucleosynthesis, the question of energy resources and black holes. The remarkably successful theory of stellar evolution by nucleosynthetic reactions has assumed that the participating nuclei and particles are themselves completely unchanged by pressure, the reactions being influenced only by proximity and velocity. A keystone of the theory has been the balance or imbalance between energy production and external loss by radiation and neutrinos. I have already outlined (subsection (c) above) some modifications that may be necessary in the light of the electrons left behind by stellar winds.

The present proposals also imply a reduced aether density in stellar interiors and this might make quite a difference under sufficiently extreme conditions. It is not clear whether the aether content, and the mass (aether-pumping capability) too, of particles will remain unchanged or will be adjusted downward but if, as suggested, the core of a positron represents a local 'bottoming-out' of the aether the charge content of positrons will necessarily fall. If

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[9] P.A.Crowther, *The chemistry and evolution of Wolf-rayet stars.* RAS meeting of 1993 December, The Observatory, **114,** 142-144, (1994).

the other fundamental particles undergo similar falls in charge content the reaction sequences might remain similar apart from a reduction in intrinsic energy output. If the gravitational mass, and with it the inertial mass, of individual particles falls, higher temperatures will be required to induce the same particle kinetic energies and reactions. In addition, the mass of the star will have diminished, a form of mass loss without corresponding radiation or particle loss.

These comments serve to suggest that the extreme conditions of stellar interiors could provide important controls on the development of the proposed continuum theory. They also indicate that one of the keystones of physics, the conservation of mass/energy, may require abandonment under less extreme conditions than within black holes.

The comments also suggest that black holes, in the sense of being sites for the irretrievable loss of mass/energy, could be a possibility within the proposed theory. (This contrasts with the general current view that the mass inside a black hole is not lost but continues to exert its gravitational pull on the rest of the Universe.) In the interior of a sufficiently massive object the aether density might become so low that aether dynamical structures with the characteristics of particles could no longer exist, and the velocity of TEM wave propagation become so low that radiation pressure became insignificant. Matter would be endlessly attracted to such a body, causing its outside to radiate intensely (a phenomenon hereinafter dubbed a "**white** hole") as also proposed for Schwarzschild relativistic black holes. The chief difference between the two versions would be that the no-escape characteristic no longer has to be provided by extreme actual velocities but by lowering *c*. The continuum theory version would provide the further satisfaction of offering some explanation of how the mass dissappears, which the relativistic version cannot, so has to conclude that mass can be concentrated without limit - not a very palatable idea but one which has gained currency in the Big Bang context *and one of the main motivations for the devlopment of cosmic string theory.*
It is not yet clear that black holes do exist, however, although many would dispute this.

The other side of this particular coin is that if mass-bearing particles are made of aether the energy content which they represent may quite reasonably have originally been drawn from the energy pool of aether random motion when the particles were formed/created - see "Cosmology". That would imply that aether random motion still may constitute a virtually limitless distributed energy resource that is currently always left out of the energy conservation equation because we do not understand how to observe it. It is suggested that some physical phenomena, e.g. the photoelectric effect, may have acquired their quantum behaviour reputation because of ignorance of this energy resource.

8. Formation of the solar system.

This is dealt with at some length in Appendix E. Essential aspects of the proposals are as follows.

At about 4.65Ga the Sun was already a fairly evolved star, not in the nebular state usually envisaged. I am not clear whether this is tolerable within the existing constraints of stellar evolution theory or whether appeal is required to the slower (subsequent) evolutionary rate suggested in a preceding subsection (Sect. 7.c) as a possible consequence of the electrons left behind during mass loss by the solar wind.

The Sun then ran into a cloud of young products of stellar mass loss, nova and/or supernova explosions, possibly with new novae still occurring. These cloud materials were attracted to the Sun, reaching it predominantly from axial directions, due to the disc-forming actions of a combination of magnetic coupling to the solar magnetic field and the Orbital Stability

Criterion (OSC) that arises under the present proposals - see Section 4. This process promises to resolve the problems of the large planetary angular momentum and orbital radii.

The resulting outward-spiralling disc of nebular material was much denser than hitherto envisaged, giving rise to several advantageous processes for planetary growth, the formation of iron cores and the transport of silicates to the outer parts of the system. When the Sun passed out of the cloud operation of the OSC caused all the uncondensed material to be expelled from the system, producing a sudden cooling of the exteriors of bodies, and a cessation of iron core formation, at 4.56Ga.

As has been remarked by others, a solution to the origin of the solar system may also bear on the origin of close binary stars, now known in various forms to be remarkably abundant in the Galaxy; probably too abundant in fact to be explained by orbital captures resulting from chance encounters. The concept developed here that, when an already fairly condensed star moves into a cloud of dust and gas, accretion to the star may not ensue but rather the material may be thrown into orbit around it could indeed be relevant to the formation of close binaries. In particular, the very disparate stages of evolution seen in the members of many binaries could be explained by this scenario, although mass transfer between members could in part be responsible for that. On this basis the fact that the Sun has a planetary system and not a companion star would boil down to the Sun not having stayed in the source cloud for long enough.

9. Formation and evolution of galaxies.

Two essentially different lines of argument are available. Either galaxies are formed as the primary gravitational condensations of the universe, and all further evolution within each is (except for intergalaxy collisions) in line-of-descent from that original stage, or else galaxies have grown, over a significant part of their lives, by accretion of much smaller primary condensations (globular clusters?). I shall pursue the first of these because the second encounters the evident difficulty (on the basis of the Jeans wavelength criterion) of achieving primary gravitational condensations of much-less-than-galactic mass in a low-density universe. That topic will be returned to under "Cosmology" (Sect. 10).

Under big-bang cosmology, of course, no such problem arises because, between its superdense initial state and its present one, there was always a stage when the density of the universe was high enough to permit small gravitational condensations to form.

The following discussion is based, in part, upon the galaxy forms illustrated in "The Hubble Atlas of Galaxies" (Sandage, 1961).

A starting-point for my proposals in this context is the recognition that irregular galaxies clearly lack a dynamic coherence that must have been important for the evolution of spirals through their various forms, including barred spirals and double spirals (one inside the other), with generally decreasing gas content, to ellipticals lacking spiral structure but exhibiting a well-defined symmetrical shape. Irregular galaxies, at least on the GMC and LMC evidence, appear to be of relatively low mass, suggesting one or more of three things:- either the process of mass acquisition is responsible for the dynamic shaping of galaxies or the dynamic shaping and systematic internal motions (however acquired) make them better at accreting more mass or, thirdly, a larger initial mass results in systematic internal dynamics.

Discussions of gravitational condensation, to form galaxies, have commonly envisaged a homogeneous, isotropic source region, devoid of major initial systematic motion. Much recent evidence, however, shows that the currently visible (extending back for many Ga) spatial distribution of galaxies is far from isotropic, with major voids and intervening thick

'walls' containing the clusters of galaxies. This suggests that the voids may never have contained much material, a proposition resisted by proponents of big-bang cosmologies because of the difficulty of explaining their existence. On a somewhat less vast scale a similar proposition of a galaxy source volume that is neither uniform in density nor devoid of large-scale flow velocities leads one to expect that gravitational convergences will rapidly acquire systematic rotation.

Following the same argument as I used earlier, in relation to the formation of the solar system (Sect.8), the operation of part B of the orbital stability criterion (OSC - see Sect.4), will cause the orbiting material to bulge and spiral outwards from the middle. [Note the physical difference between this and the present standard physical result that the rotation merely reduces the rate of contraction in the radial direction.] The rate of outward movement will be greatest near the centre of the system, where the orbital shear velocity gradient is greatest. Support for this proposed generality comes from the observation, initially by Oort and co-workers on the 21cm hydrogen line, that the middle of the Galaxy appears to be expanding towards the position of the Sun.

This disc growth, just as was proposed for the solar system, will result in the accretion streams being mainly axially-directed - but not quite, because of any inherited systematic momenta as independently moving material. These accretion streams, therefore, will cause the initiation of a second axis of rotation, within the plane of the forming disc[10]. This will start at the centre, towards which the accretion streams are approximately aimed, and the new axis will propagate axially outwards, both ways, in the plane of the disc. The result will be a lengthening cigar-shaped mass concentration, self rotating about an axis in the plane of the original disc. Differential rotation within the disc plane, about the original axis, will try to cause the axis of this cigar to become wound into a spiral, but this will be resisted, especially near its middle (where the cigar's rotation is directly driven by the accretion streams), by the self-straightening effect of the cigar's rotation about its long axis. The spiralizing action will begin to win near the ends of the cigar. This is proposed as the basic model for the beginning of spiral galaxy formation.

The model leads directly to the possibility of further metamorphoses in the inner parts of the galaxy. Rotation about the long axis of the cigar will mean that this rotation replaces the earlier one as the principal control upon the dynamics of the material involved. Thus, as soon as material from the original disc gets mopped up into the new motion it will be relieved of its former outward-spiralling motion and become susceptible to axial contraction of material along the cigar axis and to the initiation of the growth of a fresh disc at the cigar's mid-point and in a plane at right angles to the earlier disc. The axial contraction of the cigar is, in effect, another pair of convergent streams, with the capability, now enhanced by any slight winding-up of the (C1) cigar axis, of setting up yet another rotation axis and the growth of a fresh cigar (C2), at right angles to C1, and so on ....

On the grand scale this model provides, through the action of the OSC(B), for the continuing evolution of galactic structure and repeated nucleosynthetic reprocessing of its stellar material without continuing overall contraction of the system. In this sense, the major modification of Newtonian gravity introduced by continuum theory would appear an essential requirement. With the new modification, gravitational potential energy repeatedly alternates with energy of rotation, to which nucleosynthetic energy may contribute on each occasion. That modification very largely ceases to be available when the gas in the galaxy has dropped, as a result of stellar accretion, to a low value so that its motions are controlled by local fields other than

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[10] In the solar system case this outcome would have been inhibited by the coupling to the solar rotation.

galactic-scale gravity. This is proposed as the origin of the degeneration of spiral structures into the structureless elliptical form of galaxy.

At some stage in each metamorphosis there may be a period during which axial accretion of extragalactic material may occur. For example, globular clusters and H2 in the halo of the Galaxy, above the galactic centre, have significant velocities towards it. Such accretion should assist in providing the cigar-rolling function but is not seen as essential after the first occasion. How long that 'first occasion' may last will depend on the evolution rate, dependent in turn upon external parameters such as regional density and velocity patterns. It is not clear whether the characteristically large mass of ellipticals is an observational selection effect but if it is real it would be consistent with more accretion at an early stage having accelerated evolution.

A number of features of spiral galaxy forms appear to be supported by the proposed model. The 'cigar' shape in the model is identified as the progenitor of the bar seen in barred spirals and the origin of the principal spiral arms of a galaxy. Many galaxies, however, give the impression of having many more than two arms, although there are commonly two main ones, at least in the outer region. Intervening 'arms' may be strips of the earlier disc that escaped being mopped up into the cigar. To the extent that any spiral arm, inheriting a circular cross-section from its origin in the bar but becoming flattened by the circular shear regime of the disc, has an outer 'casing' of young blue stars (regarded in practice as the principal identifier of spiral arms) around a dense dust core it will appear double in transverse projection. This same flattening of the arm cross-section, inescapable in the case of many galaxies seen nearly on edge, makes it very probable that the self-rotation of cigar material disappears as soon as spiralizing takes over. All disc material not drawn into the dynamics of the cigar-rolling process will be spiralling outward under OSC(B) action, so may appear to be detached at the inner ends.

Where the projection angle of view is not too high the great majority of spiral arms are broken up by many fine oblique dark lines (dust lanes?) that radiate at a steeper angle than the arm itself. These have been interpreted as the result of shearing due to the differential rotation that winds up the arm. That explanation would be untenable if the arm also rotates around its axis, unless such structure were constantly renewed on a short timescale, as the arm rotates, which seems unlikely. A possible alternative is that these are disruptions produced by high-speed winds from near the galactic centre, driven by the electric gradient in the same manner as proposed earlier for the solar wind. Here, too the rapid renewal requirement arises if the arm rotates around it long axis; such structures would face the other way when they got to the far side of the arm, and they do not. One is therefore driven to conclude, as already suggested, that the cigar only continues to rotate around its axis while it is still rather straight, forming a bar, and that spiralizing the cigar stops this. In that case the transecting structures referred to at the beginning of this paragraph could be the result of either shearing or galactic winds.

Barred spirals seem to show the cigar either in the act of propagating axially across the disc of an earlier spiral configuration or of having its weaker-rotating tips sheared off into a spiral structure. Where the bar is straight and long, such propagation would need to be very rapid, or to be dynamically very dominant, to escape being wound up somewhat by the differential rotation in the preceding disc. That condition may only exist while there are very strong and broad accretion streams to drive it, a situation that may only obtain during the early period of drawing upon the galaxy-initiating concentration of matter in space. The pairs of oblique dark lanes along the bars of the five galaxies illustrated on pages 44 and 45 of the Atlas appear to correspond, not to the primary rotation of the spiral arms, but to the beginnings of a tertiary rotation at right angles to the axis of the bar. Only in this way can one account for the

straightness and apparently fairly circular cross-sections of the bars. If material does get sheared off the tips of bars, repeated metamorphic cycles might generate a plethora of spiral trails, in which case we may have evidence that some galaxies have gone through more than three complete cycles.

Some barred spirals, in which the bar appears to have the character of an elliptical galaxy, may be just that, with the bar material having run out of the gas that provides the dynamic linkage for its propagation. This comment points to the expectation that the inner parts of galaxies, being denser and where the highest velocities occur, will work through dynamic metamorphic sequences of the kind proposed much more quickly than the outer parts of galaxies. Thus the inner parts might become several stages ahead of the outer parts, to which the younger metamorphism never reached, giving rise to the possibility of a young spiral inside an older one, and on a perpendicular axis, as seen in NGC4314. Once the inner part has 'gone roaring ahead' in an evolutionary sense, the outer part will become isolated from the machinery of metamorphic change. Such differing rates of evolution between inner and outer parts of a galaxy, with perhaps progressively more of the outer parts getting left out of the process, could account for the ring of material seen in a number of cases and possibly marking the boundary between the inner and outer metamorphic states. In that material involved in a straight bar escapes OSC(B) action in respect of the bar's rotation about the disc-and-spiral-arms axis, it will orbit at a slightly different speed than disc or arm material at the same galactic radius, thus providing the relative shearing that could generate the ring.

That introduces the question of the nature of the motion-coupling involved in, for example, the proposed axial extension of the cigar across the previous disc. I have mentioned that spiral arms are marked out by young blue stars. This suggests that the arms are principally gas and dust structures and the blue stars have formed from that. This would imply that the cigar/bar structures, too, contain a lot of gas and dust. The extent to which accretionary streams will drive the cigar rotation and elongation directly will presumably be limited to the width of the streams. Outboard of that limit the gas may be coupled to the rotation by magnetic means because, as outlined in Section 5, gravitational interaction between bodies orbiting around the cigar axis could generate a magnetic field along the cigar.

The observation that the young stars formed in spiral arms do not exhibit strong magnetic fields is consistent with my earlier comment that the spiral arms lack a pervading magnetic field. As discussed in Section 5 such magnetic fields have been inferred to exist within spiral arms under theories of interstellar polarization within the Galaxy. Under the present proposals the required particle alignments for that might be better achieved by the gravity-related electric gradient of the galaxy.

The blue stars in spiral arms will be of compositionally evolved character to the extent that the gas (and dust) has been cycled through a galactic centre and has then moved outward in the disc under OSC action.

The presence of many globular clusters in the haloes of galaxies, and the evidence from their spectra of their evolution in very prolonged isolation, raises the question of how they formed. In some cases the inferred timescale for the stellar nucleosynthetic buildup of the observed composition competes with, or even much exceeds (at ~20 Ga), currently acceptable ages of the universe under big-bang cosmologies. Their relatively small masses make them too small to form as isolated primordial gravitational condensations from a low density universe - the densifying action of a galaxy seems essential. Even the increased density in a galactic halo may be insufficient. The foregoing proposals regarding the evolution of spiral arms and the outward movement of material and stellar groups within them suggests that globular clusters may originate in bars or in spiral arms, get moved out in the galactic disc by OSC action, and

finally get so far out that they lose contact with the disc controls, enabling them to loop back to the galactic halo. All this would require that spiral galaxies were in existence before the beginning of the cluster's time spent in isolation.

The foregoing idea that the dynamics of spiral galaxies, as modified under continuum theory, would enable them to push material far out beyond the edge of the main disc is directly comparable with that proposed earlier, on a much smaller scale, for the possible origin of the Oort cloud beyond the edge of the solar system (see Appendix E). This seems to be supported by plots of the radial variation of gravitational potential within galaxies, based on observations of orbital velocities about the galactic centre. These, though they may need some small adjustment to allow for any RTV redshift present, suggest the presence of large amounts of mass well beyond the limits of the optically evident disc, and have been seized upon by the advocates of large amounts of cold dark matter (CDM) in the universe. In addition, the operation of the OSC within the disc must cause the orbital velocity variation with orbit radius to differ appreciably from that expected under pure Newtonian gravitation. This will need to be allowed for before firm conclusions can be drawn. While not in favour of CDM generally - see below - I do think the evidence here may yet prove persuasive. Continuum theory appears to provide for it to be there and there is no reason why it should not be quite ordinary matter.

Throughout this section the message will have come across that the evolutionary sequence needed to explain the complexity of galactic forms must require a very long time indeed. Painstaking critical-path analysis of the many stages involved will be necessary before a figure could be put on that time. The limits on that time, currently set by big-bang cosmology, could well prove hopelessly inadequate.

10. Cosmology.

(a) The cosmological redshift. I have shown (Appendix A and Sect. 6.c.i) that TEM wave propagation through aether embodying gas particles in random motion will redshift the waves in linear proportion to distance. Using the Sadeh et al. (1968) ground-level observation in air and my deduced extrapolative relation for RTV redshift, both given in Section 6.c.i, together with the following parameters for intergalactic space: temperature - 2.75K; density - 10-28 g.cm-3; composition - neutral atomic hydrogen (but ionized to the same small degree as ground-level air); yields a predicted Hubble "constant"

HP = 59.5 km. s-1. Mpc-1. This is well within the range of inferred values for H. Doubling the particle weight (neutral molecular hydrogen) requires an intergalactic density four times as great to obtain the same result.

These densities are much too high to provide an acceptable account of the cosmological redshift, however, unless one believes in widespread CDM - see later - and rather too high even for that. A density even as low as $^{10-38}$ g.cm-3 (App. A), is possibly more appropriate, particularly if a major part of the transmission path lies across galaxy-deficient voids in the universe. But help is at hand in the form of ionization, which was shown in Section 6 to be many orders of magnitude more efficient at producing RTV redshift than neutral particles are. Consquently, even an extremely low level of ionization would do. I therefore conclude that there is no problem in attributing the cosmological redshift to a TEM wave transmission effect, namely RTV redshift, and not to universal recession.

The exponential growth in RTV redshift with distance (Sect. 6.c.i and Appendix A) means that for a short-range (1Mpc) Hubble "constant" of 59.6 km. s-1. Mpc-1 the mean effective value of H over a distance of 9000 Mpc will have risen to 165.5 km. s-1. Mpc-1. At this

distance the redshift (z) will be 4.965 (having been only 2.289 at 6000 Mpc) and the "age since emission" of such radiation will be 29.3 Ga. This redshift is about the maximum value so far observed but the age is about twice that currently considered acceptable within the framework of big-bang cosmology. A much lengthened timescale for the universe fits well not only with existing data on the evolution time requirements of some globular clusters but with my inference in the preceding section that a very long timescale is likely to be necessary for the complicated evolutionary sequences that galaxies appear to have undergone.

Recent work on the Hubble parameter gives qualitative (but too much) support for the expectation, under RTV redshift action, of a higher value when the redshift is higher. For the Virgo cluster of galaxies, with a mean redshift of 1150 km/s, a value H0 = 50-54 km/s/Mpc was reported by Tammann (1993), whereas for the Coma cluster, with a mean redshift of 6700 km/s, a value of H0 = 87-92 km/s/Mpc was reported by Pierce (1993)[11] . In big-bang cosmology such variation is open to interpretation as indicative of a deceleration in the expansion rate during the past 300Ma or so, though in this context too it would obviously be excessive, leading to a CDM requirement far in excess of any so far contemplated. Clearly much more work is required on the factors which may influence Ho determination by different methods.

(b) Intrinsic redshifts of galaxies, and CDM. It is clear under the present proposals that galaxies will exhibit some intrinsic redshift, increasing with the path length through hot gas within the galaxy. Thus gassy galaxies are expected to show higher intrinsic redshifts than those, e.g. ellipticals, that have exhausted much of their gas content by accretion into stars or by expelling it under OSC action (Sections 4 & 9). In addition, a variation with galactic attitude is also to be expected, breaking down on detailed examination of a galaxy into some sight-line-route-dependent variation. For a nearby cluster of galaxies any intrinsic redshifts will form a higher proportion of the total redshift than for a distant one so will be easier to distinguish.

From Holmberg's 1961 study of 76 bright galaxies in the nearby Virgo cluster I obtain the following arithmetic mean redshift "velocities" for the different (old classification) galactic forms: E (990 km/s); SO (1017 km/s); Sa (1437 km/s); Sb (1241 km/s); Sc (1669 km/s). The "velocities" are strongly population-dependent, with a progressive increase from E to Sc apart from a reversal of the trend for Sa-Sb, which may not be inconsistent with the evolutionary scheme outlined in Section 9. The conclusion by some workers that one population is passing through another is, I consider, unacceptable without a good reason for it.

On the contrary, I conclude that the 679 km/s difference between E and Sc is a primary measure of intrinsic RTV redshift variation in galaxies. That means that the "cosmological" component (i.e. produced along the intergalactic part of the transmission path) for the Virgo cluster is 990 km/s (or less if the average E-type does not have zero intrinsic component), not the 1150 km/s cited above. This means Ho for the Virgo cluster is correspondingly lower, further increasing the difference, compared to the Coma cluster, mentioned above.

Numerous analyses of the galactic redshift dispersion within clusters, without regard to galaxy type, have been carried out on the assumption that it measures the velocity dispersion within the cluster. Many clusters, and particularly the centrally condensed Coma cluster, give the strong impression of having been a very long-lived grouping. These workers have applied the virial theorem to the data and have invariably inferred a need for much more mass within the cluster volume than is seen as galaxies, to ensure that the velocity dispersion does not result in disintegration of the cluster.

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[11] Both at the R.A.S. meeting of 8 October 1993.

Big-bang cosmologists have seized upon this apparent evidence for lots of CDM, which they need to provide a gravitational antidote to the universal expansion process (imposed, without - it seems - any comprehension of its cause, as an additional agent on all universe activity) to stop it making the expansion accelerate. If the intrinsic redshift variation, due to RTV redshift, were removed from these data sets it is obvious that a much smaller variation, due to true velocity dispersion within the cluster, would remain. The resulting much-reduced cluster mass requirements could provide useful control on the limited amount of ordinary-matter CDM in the outer fringes of galaxies, envisaged in Section 9.

I suspect the extraction of intrinsic RTV redshifts from cluster data will leave low enough residual velocity dispersions to confirm that most clusters are stable, long-lived associations so may have formed as such from the start.

(c) Quasars. These exhibit a wide variety of characteristics which encourage discussion in terms of the TEM wave transmission effects outlined in Section 6. Yet, as I shall show, not all becomes plain sailing. Redshifts, as is customary, will be expressed in terms of z (= $\delta\lambda/\lambda$).

Quasars have typically very high z, but actually ranging from less than 0.2 to at least 4.89. Thus low-z quasars overlap the *highest-z* galaxies. Large quasar redshifts are associated with extraordinarily wide emission lines, notably Lyman α. The very high energy output requirements - see below - justify the view that some of the line breadth is a proper indication of source temperature. RTV redshift, on the other hand, whether intrinsic (i.e. produced within the source region) or produced during intergalactic transmission (i.e. "cosmological"), carries an expected association with corresponding RLV line broadening that appears theoretically (Appendix G) to be independent of the temperature of the region responsible. Thus it should be possible to sort out the RLV line broadening belonging to the RTV redshift (assuming the actual source velocity is insignificant), and hence deduce a source temperature, but not to distinguish whether the redshift is intrinsic or cosmological.

An important consideration here is that just as RTV redshift builds up more slowly with distance during low temperature transmission, so also it builds up more slowly with time. The generation of a virtual image at the antisource point by deflection scattering should, to be sure, produce an image with much greater redshift than the direct transmission from the source. To acquire that extra redshift will require the same extra transmission time and (circuitous) distance of travel as would be necessary for its acquisition by a direct route (assuming the same temperature and other gas conditions for both routes). Consequently the idea of a virtual, highly redshifted image at the antisource point is no panacea for the source energy problem; for a given amount of cosmological RTV redshift, the distance and the intensity loss through the inverse square law and through deflection scattering are the same, irrespective of whether the image is direct or virtual.

The fantastically high energy outputs that have to be inferred for quasars if they are presumed to be at cosmological distances corresponding to their redshifts, have led to much discussion of black holes, or rather, of their white outsides ("white holes"). The problem could be much alleviated if a sizable part of the redshift could be allocated to intrinsic origin in an extensive high-temperature source, thus greatly reducing the source distance. Such a source would also have a high radio output, as observed in quasars, but here too the power requirements would be reduced.

These possibilities are a replay of the discussions of the 1960's, before the redshifts had been recognized. The short-term variability of 3C 273 and of many others have been thought to set tight limits on the diameter of the source. Clever schemes, highly restrictive as to the details of the motion involved, have been invoked to explain apparently highly superluminal

velocities of source transport within the source region, inferred on the basis of distance assuming the entire redshift to be cosmological.

In this context it needs to be borne in mind that, under continuum theory, there is nothing whatever to stop transport velocities relative to the observer exceeding c, providing there is nowhere a velocity discontinuity in which the jump exceeds *c*. Since, under continuum theory, a velocity discontinuity is physically impossible the proviso is of none effect. Superluminal transport velocities, will however, involve large refraction effects, especially if seen from the side. Therefore, even if the source cannot be brought close enough to lower the inferrable transport velocities to subluminal, to explain source variability or motion, there is still no problem in principle.

Consider the case of the quasar 1928 +738, with zem = 0.302, reported by Pearson et al. (1986) to have blobs moving at an apparent velocity of 12.5c (based on H0 = 60 km/s/Mpc) across the line of sight. To reduce the transport velocity to luminal (as would be appropriate for transmission of energy without high-velocity flows) would mean the distance (cosmological) part of the redshift would reduce to 0.024 and the intrinsic component required would be 0.278. If the foregoing arguments as to quasar distances are to be of importance higher up the z scale it would seem that sources will have to be invented that have much larger intrinsic z than the latter figure. We shall see.

Surveys have suggested that if z is treated as a straightforward measure of distance the number density may increase with distance, leading to the conclusion that quasar-type sources occurred at a higher number density in the past than now. If a substantial amount of *z*, but presumably quite variable in size according to source conditions, is attributed to intrinsic conditions this will shorten the overall distance scale and accentuate the picture of more quasar-proneness in the past. It would be nice to fit that into an early history of galaxy formation - see later. If *z* becomes no more than a guide as to the maximum distance of an individual quasar it will be necessary to fall back on association on the sky to guess whether any belong to obvious clusters of galaxies having much lower redshifts. Some galaxy-quasar alignments may involve quite small physical separations, with a possible impact on interpretations as gravitational lensing.

Finally there is the question of whether, and to what extent, virtual imaging by deflection scattering into the source antipoint occurs, as outlined in Section 6.c.ii, and developed theoretically in Appendix B. If it does, it might account for the relative scarcity of redshifts (is it still the case?) just beyond 2.0. That could readily be checked by checking catalogues for antipoint, or near antipoint, coincidences, bearing in mind that the antipoint virtual image (AVI) might be so altered from the source that they appear in different catalogues, e.g. the source in an optical catalogue and the AVI in a quasar one. In any case an AVI would be many magnitudes fainter and have a significantly higher redshift than the direct source image to which it relates. I have used the Hewitt & Burbidge 1987 catalogue of 3681 quasars for a trial check. Of the 112 quasars having z = 3.0 or more, none appear to have a lower-z quasar within the catalogue at or close to its antipoint. If virtual imaging does occur - possible evidence for it in the Earth's atmosphere is mentioned in the next Section - then questions such as the possible introduction of polarization and whether it can modify the spectral index of the quasar would be of interest. Also there might be the possibility of a very weak second-stage virtual image (i.e. after 4π of deflection) providing some sort of overlay on the source image itself, detectable only because of its redshifted content.

Possibly germane to this question is the presence, for quasars with z > 2.0, of the "Lyman α forest" of absorption lines, amounting to 400 or more lines *for* z > 3.0, ranged progressively shortward of the fully redshifted Lyman limit emission line of the quasar. They have widely

been interpreted as due to gas clouds along the light path from the quasar. As already suggested, the inferred temperature of these clouds might be drastically reduced (from the several times 104K commonly inferred from the width of such lines) by allowing for RLV dispersion along the route. If that route was actually the very circuitous one associated with the observed quasar actually being the virtual image of some other object, the formation of that image would involve effectively sweeping an extremely large volume of intergalactic space, not just a single path. This would enable the clouds to be much fewer and farther between in intergalactic space, but the observed line-depths may be too large for the spectrum to be a composite overlay of this kind. The ionization inferred for these clouds could arise from mass loss particle fluxes from galaxies and (as suggested earlier for the solar corona) not be a proper measure of temperature. That would avoid the risk of conflict with the 2.75K general temperature inferred from the microwave background.

(d) The Big Bang, nucleosynthesis and the microwave background. My proposed attribution of the cosmological redshift entirely to RTV redshift due to random motion of the propagating medium at a temperature of 2.75K means there could have been no big bang. Consequently those nucleosynthetic products, notably the high cosmic helium abundance inferred from stellar spectra, hitherto acclaimed as exclusive features of big-bang cosmogony, require accounting for in another way, or perhaps in more than one. I can offer three suggestions. One is that the exceptionally high first ionization potential of He (footnote[12]) causes it to remain preferentially on the surfaces of stars during electric-gradient -related mass loss processes so that the observed He/H ratio there is not cosmically representative. The second is that, as proposed in Section 7(c), hydrogen- burning in stars is accompanied by electron-positron annihilation arising from the presence of mass-loss residual electrons, and that this postpones the onset of helium burning until a higher He/H ratio has been attained. (The much longer timescale, and therefore more stellar nucleosynthetic recycling, made possible by abandoning the Hubble expansion time as a limitation seems unlikely to have much effect on the eventual He/H ratio.)

The third is that white holes, of which quasars may be evidence and have been thought of by many as possible progenitors of galaxies (though I have made no attempt to incorporate this into the galaxy evolutionary scenario outlined in Section 9), might have appropriate nucleosynthetic capabilities. To bring any such capability into play for the supply of material for the construction of galaxies would require that, despite the mass-consuming power of a continuum-theory-type black hole, the outer (white hole) part still had the property, in common with that inferred herein for massive bodies in general, of external mass loss by the electrical expulsion of positive ions. As pointed out earlier, the available ratios of electrical to gravitational force on ions are very large, so it seems likely that external mass loss would so dominate events that the black hole would eventually be deprived of infalling matter and the means to sustain the pressure needed for its continuance. Thus, on continuum theory, black holes and the quasars that may contain them may eventually "go out with a whimper" when the mass of the object has been sufficiently reduced, partly by mass consumption and partly by scattering the material into the intergalactic medium. The problem with the Schwarzschild black hole is that there seems no way of stopping it from sucking in and eating all its neighbours, and there is no good evidence that this is happening anywhere.

The microwave background appears directly attributable to the isotropic TEM wave generation expected to be generated by aether in the random motion associated with low-density gas throughout the observable universe. To do this the value of *c* must, as proposed for other reasons, vary with aether density. The fact that the radiation has a black-body spectral distribution and not the one that would be associated with a gas having Maxwell-

[12] At 24.58 eV it is the highest of any element. Only F, Ne and Ar exceed 15 eV.

Boltzmann velocity statistics is attributable, perhaps, to the ubiquity of the radiation causing it to behave as in a cavity. For that to be the case, the Universe may need to be many times older than the time required for radiation to traverse it, or the observable part at least. The reasoning here is similar to that involved in understanding the black-body-like radiation continua from the exteriors of stars.

(e) The size of the universe, Mach's principle and Olbers' Paradox. As stated in Sect.10.a, if all the redshift (4.89) of the highest redshift quasar is treated as cosmological RTV redshift its source age would be about 29 Ga, for an Ho of 60 km/s/Mpc. In the subsequent section on quasars I argued for a substantial slice of that z to be allocated to intrinsic source redshift. The amount that could be so allocated is very uncertain at present so we can only guess here, for discussion purposes, that by so doing the furthest object in the observed universe might be reduced to no more than 20 Ga light-time away. Whether that represents seeing nearly to the edge of the Universe there seems no way of telling until true quasar spatial density counts are found to go down as telescope sensitivity is increased enough to get beyond the distance uncertainty now introduced by the idea of substantial intrinsic redshifts. Unfortunately it seems doubtful that true spatial density counts will ever be unambiguously achievable within a continuum theory framework.

Mach's Principle, espoused in Section 2, requires some kind of limitation of the effective size of the Universe. I am unclear as to whether sheer size, and therefore length of communication time will do that. If not, the requirement for a finite total mass introduces awkward cosmogonical constraints - see below.

Olbers' Paradox seems to require that if the universe behaves as an enclosing cavity for radiation the black-body temperature is only 2.75K - far below night-sky luminance levels from other sources. The RTV redshifting continually applied to any higher-temperature radiation traversing the universe ensures that it all eventually becomes indistinguishable from the rest of the "cavity radiation".

(f) Cosmogony. Any theory in which everything is ultimately made out of the same stuff invites cosmogonic speculation. In the case of the big-bang theory, speculation has had to invent a whole new set of physical laws just for the first 10-33 s., or whatever. Continuum theory, on the other hand, seems likely to be able to survive on something very close to uniformitarianism.

It is not at all inconceivable that the most elementary of particles, say electrons and quarks, might get "invented" by endlessly moving aether, preserved and gradually built up in numbers as a result of those configurations happening to be stable. Their essential characters could depend on simple attributes of the aether, such as its only-slightly-varying density, the speed (c) of propagation of disturbance through it and the fact that it consists of electric charge. The observed very uneven distribution of galaxy clusters and huge voids in the universe suggest an origin by some sort of seeding and reproduction sequence. For that to be the case, yet result eventually (by mutual interaction) in particles of all kinds that are identical at locations that are so far apart that they may never have had any material exchange, is at first sight a difficult scenario to accept. It seems to require a kind of DNA gene control to ensure that an identical range of progeny always results.

But it is not out of the question if stability of a particle (i.e. dynamical configuration) is the criterion. It is in the nature of continuum theory that particles that "don't work", i.e. are not stable enough configurations for their purpose, simply fade back into the plethora of motion. After all, life on the Earth is thought to have evolved by an arduous sequence of natural selection of the fittest or stablest from an endless supply of random trials. Nucleosynthesis may turn out to be all that is required, given some quarks and some electrons or positrons.

Thus the processes of cosmogony would all be in the same evolutionary direction of increasing size and complexity of the particle assemblages. This seems in stark contrast to the route being pursued in connection with a Grand Unified Theory for fundamental particles. Here the aim is to find (I would say create) the so-far-fabulous supermassive Higgs boson from which all lesser particle fry are thought to derive. The shattering mentality that currently prevails in particle physics seems content to seek an ultimate Aunt Sally without bothering about her original manufacture! If you bash something to pieces it doesn't usually fall apart nicely into the separate components with which it was built. From a continuum theory perspective I suggest that increasingly vigorous collisions will be expected to produce an increasing range of quasi-stable aether dynamic configurations including a few of an increasingly vigorous nature, some possessing correspondingly greater aether throughput (i.e. gravitational mass). Such collisions are thus exploring what aether is capable of being turned into and not necessarily what nature has ever done on her own. That might be of some use but not on anything like the scale of an understanding of nature.

If Mach's Principle is going to require a material universe of finite size (though the rest of it could consist of just plain aether), the process of seeding of material particles by random chance, suggested above, with more turning up in some places than in others, would require stretching to an unacceptable extreme to include the possibility that the volume so seeded was exclusive. Without being able to prove it at the present time, I think it likely that for the purpose of Mach's Principle the influence of distant matter decreases eventually to negligible significance at the point in question. In that case if, as seems very probable, the distance of negligibility is much less than the size of the material universe (even if substantially reduced by deduction of an intrinsic component from quasar redshifts), the value of big-G is fixed not by its size but by its density within the relevant region.

Just as the timescale for the early buildup of organic materials on the Earth has proved to be several times longer than has been necessary for its full flowering since Precambrian time, so it seems probable that the already much lengthened timescale which I envisaged for the evolution of galaxies may well be only a fraction of that occupied by the precursory buildup of material particles in the form, perhaps, of just hydrogen, to a density, at least locally, from which galaxies could begin to form.

Thinking along these lines, in which the density of matter within the Universe is gradually built up to a level suitable for gravitational condensations to begin to form, suggests that early condensations, with the Universe density at a lower level, should (for reasons set by the Jeans criterion) have been much more massive than those produced later. Were those earliest condensations to become quasars? [13] And were the next-formed ones to become the giant ellipticals which thus had a head start, both in time and in mass, along the evolutionary path?

In such a scenario there appears no good reason why the process of primary particle genesis should have stopped now. The notion that the highly interactive particle environments available now in the universe represent more favourable situations for primary particle genesis (as favoured recently by Hoyle and his co-workers, within a big-bang framework) may be counteracted by the presence of lower aether density in many such cases, such as stellar interiors. If black holes really exist there can be a debate as to whether the mass of the universe is increasing, stable or decreasing. That could nicely replace the herein-superseded (?) debate as to whether the Universe is dense enough to stop expanding. It could well turn

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[13] This is made possible if subtraction of intrinsic redshift turns some quasars into nearby examples, thus overcoming the apparent shortage here. Alternatively one could argue that the nearby ones have had long enough to have "gone out with a whimper" but that savours somewhat of special pleading as to the epoch in which we live.

out that all the processes needed for cosmogony, given a supply of aether in random motion, are still in place and working, if only we can learn how to observe them. That, in turn, means asking the right questions. Low temperature, low density physics might be a more representative experimental context in which to attempt this but the probabilities of anything interesting happening within a human lifetime might well be too close to zero!

Anyhow, the very fact that the continuum theory form of cosmogony proposed above raises hope of the possibility of being able to "do it again" in some modest and restricted form, and thereby to test the theory, could give it the scientific high ground in relation to the big-bang theory of cosmogony which, by its very nature, it appears can only ever be "tested" by mathematics that have been tailor-made to fit it from the start.

Just as the stature of relativity has grown greatly in the light of supposedly diagnostic tests (which, where they do give the right results, I have suggested here may well do so for a quite different set of physical reasons) so it will be important to look for means of testing the present proposals in more closely controlled ways than are possible by relying on the heavens for examples. That is the subject of the concluding Section.

11. Ground-based effects and possible checks.

It is in the nature of the present proposals that the main effects only build up into comfortably observable quantities when they they operate repeatedly and on a very large scale. Thus the phenomenon of mass has been proposed as the comparatively minor external by-product of the aether motion pattern that constitutes a particle. Thus, too, the hopefully diagnostic effects of TEM wave transmission are only expected to become obvious for very long and/or very hot paths. Both of these favour the heavens as a testing ground and a very large number of possible checks can be envisaged. Nevertheless, several ground-based tests and observations have already been done that seem important and should be repeated with the fresh objectives offered by continuum theory in mind, and with the advantages of modern instrumentation. I shall mention these first and then add a few ideas of my own.

(a) The Sadeh et al.(1968) test for RTV redshifting. This experiment, described in Appendix A, outlined briefly in Section 6.c.i and applied to the cosmological redshift in Appendix A and Section 10.a, should certainly be repeated. Demonstration of a proportionality to absolute temperature would be diagnostic in distinguishing it from ideas on the effect of gravity. Bearing in mind the strong dependence of RTV redshift upon ionization, and of ionization upon temperature, any increase with temperature would probably suffice.

(b) Brightness distribution of the daylight sky. Because of its potential importance and the fact that this was what led me into consideration of a continuum theory in the first place, the references mentioned in this subsection are given in the footnotes[14,13].

Tousey & Hulburt put forward a modified Rayleigh scattering theory to take into account the effects of ground reflection, dust and haze. To give an approximate match with their

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[14] R.Tousey & E.O.Hulburt (1947). *Brightness and polarization of the daylight sky at various altitudes above sea level.* J.O.S.A., **37**, 78.

S.Chandrasekhar (1950). *Radiative Transfer*. Oxford.

S.Chandrasekhar & D.Elbert (1951). *Polarization of the sunlit sky.* Nature, **167**, 51.

[13] D.M.Packer & C.Lock (1951). *The brightness and polarization of the daylight sky at altitudes of 18,000 to 38,000 feet above sea level.* J.O.S.A., **41**, 473.

N.L.Barr (March 1953). *Brightness of the atmosphere.* U.S.Naval Medical Research Institute Report.

observations these authors found it necessary to assume that, even on the clearest days, the air above 10,000ft altitude scattered some 35% more than theoretically pure air. Chandrasekhar and Chandrasekhar & Elbert tackled the same problem. While the latter approach gives a somewhat better account of the polarization effects observed from the ground, neither accounts fully for the intensity distributions measured by Packer & Lock and by Barr from aeroplanes flying at various heights.

The most notable discrepancies between the modified Rayleigh theories and observation 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 400, as an upward bulge of the isophotes from a 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.

As outlined in Section 6.c.ii and treated more fully in Appendix B, deflection scattering such as that introduced by continuum theory has the property of producing anti-source point brightening. Moreover its amount depends on only the cube root of the particle number density whereas Rayleigh scattering depends directly on the particle number density. The observational evidence is therefore consistent with Rayleigh-type scattering being progressively superseded, with increasing height, by deflection scattering . The data did not include measurement of colour, which could have been particularly informative in view of the wavelength-independent character expected of deflection scattering, as compared with the λ-4 dependence of Rayleigh scattering. Clearly it is important that this work, and any other that has been done in this field since 1953, should be looked at again in the light of the present proposals.

(c) Nuclear fusion experiments in ZETA and SCEPTRE III. This work, done in the late 1950's, mainly at Harwell, was in both cases reported enthusiastically to be well on the way to reaching the necessary temperature for fusion. In both cases, however, a not-understood "premature thermalization" was reported, meaning that the observed temperature was much higher than expected on the basis of energy input, despite no evidence of fusion, in the form of thermal neutron output. The temperature was "measured" by observing the spectral line-width looking along the gas discharge in the toroid. I suggest that the emitted line-width may have been increased during its passage to the observation window by the RLV spectral dispersion expected under the present proposals - see Section 6.c.iii. There must be other work on nuclear fusion now in progress, involving very high temperature plasmas, in which there may be a chance of checking this. If the effect is indeed present it could still be giving a false impression of the temperatures actually attained, with possibly major economic/ political repercussions.

(d) Source frequency changes on passing through the rotating solar atmosphere. Sadeh et al. (1968) also reported observations, for two successive years, of the frequency of the 21cm hydrogen absorption line of the radio source Taurus A as it passes annually nearly behind the Sun (I am not sure how close). They found a drop of more than 50Hz (35 parts in 109) at the point of closest approach together with an asymmetry in which the frequency was higher to the east than to the west of the central position, for several degrees on each side. If the solar atmosphere has a small refractive index the TEM waves will travel slightly more slowly through it, lengthening the transit time and lowering the frequency during approach to the median position and raising it above normal during re-emergence to the west. Although this might be the cause of the "redshift" at mid-passage, the expected asymmetry is not only the opposite of that observed but also would not be expected to persist for so many solar radii.

The observed asymmetry is a feature exclusively expected of continuum theory, and is associated with rotation of the atmosphere, which adds to the speed at which the waves are conveyed towards the observer and shortens the transmission time on the east, and lengthens it on the west. The expected amount is upwards of ±4 parts in 109, depending on how far from the Sun the rotation is effective.

These observations should be repeated, together with similar ones on any pulsar that may be suitably located. If a sufficiently stable transmitter can be put into a space vehicle around behind the Sun, with enough power not to be swamped by solar radio noise, this might provide an even better check.

(e) Solar eclipse effects on the motion of a paraconical pendulum. In the 1950's M.F.C.Allais reported (as mentioned in MFO 1960) a sharply defined change in the pendulum motion during the period of totality in Paris. This result was brushed off by the establishment but should be looked at again as a possible interference by the Moon with the gravity communication path between Earth and Sun that is implied under the present proposals. The offset of the effect towards the early part of totality might relate to the slight modification of the gravity direction under the Orbital Stability Criterion (Sect. 4) but seems too big.

(f) The experiments of M.Q.Majorana (1919 & 1921). These relate to changes in apparent weight of a 1.274 kg lead bob when in the proximity, or otherwise, of a large mass (9 tonnes) of lead. The results, of order 10-12, can be interpreted as showing that the bob's gravitational response to the Earth is slightly distracted by having to provide a response to the presence of the nearby, above , below or surrounding, lead mass. Unfortunately the experiments are not adequately described to give any idea of experimental uncertainty. In a solid the aether-pumping axes of particles may not be entirely free to adjust their orientation in response to an aether density gradient, as is required under the present proposals. If such an effect were to be demonstrated it would mean that quasi-solid bodies like the Earth may actually contain more mass than is evident from the external gravitational field - a remarkable turn-up for physical thinking!

(g) Orbital tracking of artificial Earth satellites. The velocity of such satellites is almost entirely with respect to the Earth's gaseous envelope. The situation with respect to optical aberration is therefore analogous to that of a binary star (see the discussion in Section 3.a) and no aberration is to be expected. I suspect that aberration was allowed for in the days of optical tracking (now it is all done by ranging techniques, apparently) but the correction was not big enough to know whether it did any good.

(h) Downstream transport of a light beam in a wind tunnel. In principle, under the present theory, a beam of light fired across a wind tunnel will suffer aberration in opposite directions on entering and leaving the stream. According to some crude calculations, the precision of collimating the beam, together with the cross-section and hypersonicness of some existing wind tunnels, should enable this effect to be detected if present. The main uncertainties would be the distortion of the tunnel window with and without flow, and whether the gas pressure used was so low that the aether environment in the flow was not entirely isolated from the influence of the stationary casing. Any reduction due to the latter, however, would be of interest in the context of the size of the aether-velocity averaging volume indicated by the Sadeh et al. result. That result indicates that the amount of redshift is of the order of only 10-13 of that to be expected from an ideal standard in which the aether r.m.s. transverse velocity changed, every mean particle interval within the gas, by an amount equal to the most probable particle velocity in the gas (Appendix A).

(i) Equivalence of electric and gravitational fields. The enormous ratios of the electric to the gravitational force on electrons and protons, noted earlier, appear to rule out any experimental test of this equivalence. Electric forces would swamp any experiment.

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d . That will release a lot of energy not previously (?) taken into account in calculations of stellar evolution. To match the radiated energy loss from the star will then require a much lower contribution from the PP 1 chain. Thus, in general, stellar evolution will take longer than hitherto thought but that won't matter if - see later - the limitations of the Big Bang timescale are removed. potential in the Sun, so the Sun must have a way of destroying or accommodating all those excess electrons.One possibility in the present case concerns the fate of all the electrons stripped off the ions forming the solar wind (see sub-section (c) below). These electrons will be attracted to the Sun, their flow setting up a potential gradient opposite in sign to that of the gravitational field, especially at levels below the main ionizing level and above where the electrical conductivity of solar material begins to rise steeply. I suggest that this may substantially negate the electric gradient at upper photospheric and lower chromospheric levels. Other evidence of the electron excess at these levels is mentioned below. Stark broadening has been widely regarded as importantly present in the spectra of other stars, especially dense dwarfs, precisely where the present proposals would expect it to be strong. My experience in other fields, however, indicates that such pronouncements from authorities sometimes lack motivation to delve into the possibilities. RTV redshift and the variation across the disc is due to zenith-angle variation of the transmission distance through the solar atmosphere combined with an optical-depth-controlled variation in the depth of the source point in the solar atmosphere. The form of the redshift rise towards the limb enables the radial thickness of the redshifting layer (assumed uniform for simplicity) to be estimated. The radial thickness of the layer must be less than 14,000 km. The redshifting rate in this layer must be about 100 times that obtained by extrapolation from the Sadeh et al. result for air, using pertinent gas parameters. This shows, not surprisingly, the presence of a much higher degree of ionization than in air. Independent sets of observations by Finlay-Freundlich and M.G.Adam show that at the centre of the disc the redshift is only about half the ~ 0.6 km/s relativity prediction (though it varies appreciably with the source depth of different spectral lines), decreases by about 0-15% to a minimum at a solar zenith angle for the emergent ray of about 60°, rising steeply thereafter by 50-400% to up to 1.5 times the relativity value at a solar zenith angle of 80°, the closest to the limb at which it was possible to centre a measurement, owing to the finite size (1.6% of the disc diameter) of the measurement patch. It is clear that by the limb the actual redshift must rise to several times the relativity value. The popular statement is that the relativity redshift is confirmed by these observations and (where people bother) that the changing view direction of convective motions associated with flocculi is responsible for Doppler shifts giving the variation across the disc.the effect seems to provide an excellent account of the origin of the 2.75K cosmic microwave background, linked to the cosmological redshift (Sect. 10.a). This is made essential if, as proposed, the explanation of the cosmological redshift no longer requires a big-bang origin for the Universe. The extent to which the effect may also be involved in discrete radio sources will require investigation., etc. but the attenuation function will, in the practical case of a source point of finite size and intensity, probably make their contributions negligible. Thus the detail of the source is not lost and a much-attenuated (and redshifted; also spectrally dispersed - see below) virtual image of the source appears at the anti-source point. Thus the present proposals, by producing a very large number of very small individual scattering actions, escape the source-blurring consequence that killed the quite

different redshifting proposals of Finlay-Freundlich (1954, 1959, 1960), which involved a very coarse form of scattering.Charged particles influence aether motion to an enormously greater extent than neutral ones, as measured by their ratio of electrostatic to gravitational force. Consequently ionized media have greatly enhanced RTV redshifting ability. for electrons and 1.24 x 1036 for protons. It will be additionally enhanced for electrons because their low mass gives them a very high r.m.s. velocity for any given gas temperature.2.74" westward deflection of starlight, at the equatorial limbs, on passing through the solar atmosphere, mentioned in Sect. 3.e.ii. To the extent that the solar atmosphere co-rotates with the Sun the deflection will increase with height above the limb. A reduction in transmission velocity with decrease in aether density was proposed in Sect. 1, was suggested as the cause of the gravitational light deflection in Sect.3.e.i., and will be raised again below (Sect. 7.h) in connection with processes in stellar interiors and in black holes. The possible effect of local random variations in density is outlined later in this section (Sect. 6.d). Apart from the obvious problem, introduced by the new theory, of distinguishing the source or absorber temperature after the line has been modified by RTV dispersion, line profiles are also studied to infer stellar rotation. Some of the high rotation rates inferred for early-type stars may not be correct. The fall in spin rates during evolution may be less than has been thought.+20) ions typical of ~107K plasma.. (See also Appendix G.) Differential aether velocities along the wave-train propagation direction that vary during the passage of the wave-train will stretch and compress the waves. This process will be cumulative with propagation distance but, being a balanced random process, the r.m.s. value will grow as the square root of distance. Thus spectral emission lines will get wider but for absorption lines the effect may be slightly different because it is the spectral continuum that is being spread.