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General Discussion

The 2.7° Cosmic Background

In the opening paragraph of Chapter 3 reference was made to the recently reported detection of aether drift by an article in the May, 1978, issue of *Scientific American.** The closing words of this article were:

> It is possible, indeed likely, that there are large-scale structures that play an essential role in determining the nature of the universe. With recent measurements of the large-scale clustering of galaxies and the anisotropy of the cosmic background radiation we may be just beginning to detect that structure.

This is the outlook at the present time. It bears out the author's case for examining the space medium to find domain structures which relate to the creation of stars. The aether, as a real medium, must be revived in a new form. Unfortunately, there is far too much emphasis today on a direction of research which is based upon undue extrapolation of relativistic theory. The idea that G holds and that gravitation exists within matter of immense densities transcending the electric interactions in such matter and leading to the so-called black hole is very far-reaching speculation. The idea that time reverses is also far-reaching speculation. It captures imagination. An example of its consequences is available concerning the cosmic background radiation question and the measured 2·7° K temperature.

Davies,† writing in *Nature Physical Science*, exploits the coincidence that the energy density of starlight in our galaxy is comparable with this black body background. He deduces a temperature of 2·4° K from his hypothesis that:

* R. A. Muller, *Scientific American*, **238**, 64 (1978).
† P. C. W. Davies, *Nature Physical Science*, **240**, 3 (1972).

an observer at the present epoch should be able to detect black body background caused by the starlight of the subsequent cycle.

His ideas involve domains in space with oppositely-directed time sense, separated by regions in which time has no direction. Thus the cosmic background temperature measured in space anisotropy experiments is caused by radiation from the future. One may then wonder where we will be led by our researches if such interpretations find favour. However, Davies has provided a theory for the temperature of radiation, albeit rather lower at 2·4° K than the recognized value of 2·7° K, and any challenge should offer a similar result.

Let us see whether the theory put forward in the previous chapters sheds any light on this problem. We are concerned with the temperature of space itself, a temperature associated with what is called cosmic background radiation. Temperature is a property we associate with the thermal motion state of matter. It governs the transfer of energy from A to B. There is no energy transfer when the temperature at A is the same as that at B. Therefore, temperature is a measure of the intrinsic capacity of something at A to release energy when the so-called temperature is above the norm. If the condition at A is such that it can withold energy because this energy is trapped by local field conditions then this energy will not participate in the transfer process. The question then is whether it could manifest itself as a temperature as judged by the electromagnetic radiation field and yet remain secure against dissipation.

Consider the temperature expression:

$$T = T_0 + H^2/8\pi kN - \Phi m/k \tag{230}$$

Here k is Boltzmann's constant. N is the number of particles per cc. sharing the kinetic reaction energy of a magnetic field of intensity H, Φ is the local gravitational potential and m is the mass of the lattice particle of our space medium.

The theory presented has indicated that the magnetic field energy must be stored in a kinetic reaction state, even in the vacuum medium. It remains available for recovery as soon as the current producing the field subsides. Similarly, because gravitation is an electrodynamic phenomenon on the theory presented, we can regard the gravitational potential of each lattice particle as having released energy which must be stored locally by the thermal agitation of the particle. We suppose, as our hypothesis, that T_0, the basic temperature of the system, is the equilibrium temperature governing energy transfer by thermal action but that T is the temperature measured by our frequency radiation detectors.

The value of k is $1{\cdot}38\ 10^{-16}$ erg/°K. We know that N is $1/d^3$, where d is $6{\cdot}37\ 10^{-11}$ cm, supposing that in the vacuum medium only the lattice particles can conform to the Boltzmann energy conditions. Thus N is $3{\cdot}87\ 10^{30}$. Thus the highest magnetic field we can produce would not raise the temperature by any measurable amount. A value of H of 10^6 cgs units corresponds to a temperature of 0·000075° K.

The gravitational effect is more interesting. It does not depend upon N. Note that the energy has not been set equal to $3kT/2$, as is normal. Readers are reminded that early in Chapter 5 it was shown that the lattice particle has only two degrees of freedom and this means that energy is related to kT, as assumed in (230). From (155) it was shown that m is 0·0408 times the mass of the electron. Thus m/k is found to be $2{\cdot}7\ 10^{-13}$. In these same cgs units the value of the gravitational potential attributable to the combined effect of the sun and the Earth at a position near the Earth's surface is $9{\cdot}49\ 10^{12}$. (230) therefore does give a measurable temperature of:

$$T = T_0 + (9{\cdot}49\ 10^{12})(2{\cdot}7\ 10^{-13}) \tag{231}$$

in the immediate environment of the Earth. Note that the gravitational potential is really negative, making T greater than T_0. Also note that if we look at the vacuous medium near the Earth we must expect T_0 to be zero. The observed background temperature of space near the Earth given by (231) should then, in theory, be 2·6° K. This is quite good agreement with the actual value of 2·7° K. It is better than the value obtained by Davies. The test is also a direct verification of the mass of the lattice particle.

The gravitational potential just presented is derived from $G(M_s/R_a + M_e/R_e)$, where G is the constant of gravitation $6{\cdot}67\ 10^{-8}$, M_s is the solar mass $1{\cdot}989\ 10^{33}$, R_a is the astronomical unit $1{\cdot}496\ 10^{13}$, M_e is the Earth mass $5{\cdot}977\ 10^{27}$ and R_e is the Earth radius $6{\cdot}378\ 10^8$, all in cgs units.

Gravitational Potential

It has just been argued that there is a kind of gravitational action between matter and the lattice particle system of space. We need, therefore, to examine more closely this idea that space can interact gravitationally with matter. First, note that we associate gravitation with a state of disturbance of the space medium caused by the presence of matter. If there were no matter disturbing the space medium, there would be perfect balance in the space medium, assuring that the lattice particles do not interact in the gravitational sense with other lattice particles. The electrodynamic interaction is not in evidence.

Now, when matter is present we expect an interaction with the lattice particles, because matter acting on matter does so via inducing a reaction in space and this is, presumably, provided by, or at least mainly by, the lattice particles. The doubt can arise because we have assumed that the E-frame or C-frame of space comprises exclusively the q charges or so-called lattice particles. Yet, we have spoken of the energy exchanges between electrons (or positrons) and lattice particles in order to set the r/d ratio used in deriving the fine structure constant. There could be a sparse population of electrons amongst the lattice particles forming the E-frame. One effect would be to increase the temperature of space as just determined. Since temperature is proportional to mass and relative population, the mass of the electron, being 24·52 times that of the lattice particle, would result in an increase in the temperature of the cosmic background by 0·1° K for one electron per 600 or so lattice particles. The 0·1° K discrepancy between theory and observation in the previous section could therefore suggest such an electron presence in the E-frame of the space medium.

It is of interest to note that the electron population contemplated is of a slightly higher order of magnitude than that we associate with the free electron population in conductors. Electrons, whether part of matter or part of the E-frame, may therefore exhibit the effects of gravitational potential φ in common with the lattice particles. φ at the Earth's surface is $9{\cdot}49\ 10^{12}$ cgs units, making φ/c^2 $1{\cdot}06\ 10^{-8}$ for use in the electron g-factor correction at the end of Chapter 5.

It remains to explain why we can take gravitational potential and assign the full interaction energy to the space particle involved in the interaction. It was important to the derivation of Einstein's law of gravitation in Chapter 2 that this gravitational interaction energy had a distribution in space as given by Fig. 12. How, then, can it be correct to presume that this energy is all vested in one of the interacting components?

The answer to this is that the distribution of energy given by Fig. 12 applies only to interaction between finite and separated bodies or particles of matter in isolation. If the distribution deduced for Fig. 12

were applied to a system comprising a particle of matter or a central body surrounded by space of uniform and infinite extent and having a mass interaction with the matter particle, we would obtain infinite energy densities in the space near the particle. This is precluded by the need for energy to disperse within the constraints of the overall interaction.

For such a system the reaction energy associated with gravitation optimizes differently and this causes us to reconsider the analysis leading to Fig. 12. We know that n is a positive integer over the range of x between 0 and r and that it is as low as possible to satisfy the optimization condition. Putting M as the mass of the central particle at 0 and m as an interacting mass distant r, we may represent the general distribution indicated by Fig. 12, using positive energy distributions, by the formulae:

$$\frac{kGMmx^{n}}{r^{n+2}} \tag{232}$$

for x between 0 and r, and:

$$\frac{kGMm}{x^2} \tag{233}$$

for x greater than r. Integration with respect to x over all space gives:

$$\frac{kGMm}{r}\left(\frac{1}{n+1}+1\right) \tag{234}$$

With $n=1$ and $k=\frac{2}{3}$, the result corresponding to the Einstein gravitation law and applying between discrete bodies:

$$\frac{GMm}{r} \tag{235}$$

follows from (234) as the gravitational potential energy of the system.

Now, if we regard m as $4\pi r^2 \rho dr$, where ρ is the mass density of a uniform medium enveloping M and we consider a spherical shell of radius r centred on M, the energy density at radius x, as given by (232) and (233) combined, becomes:

$$\int_{x}^{\infty}\frac{kGMx^{n-2}dr}{3r^{n}}+\int_{0}^{x}\frac{kGMr^2dr}{3x^4} \tag{236}$$

Note that we have divided by $4\pi x^2$.

For $n = 1$ the integral expression in (236) is infinite. For other n, the solution is:

$$\frac{kGM\rho}{x}\left(\frac{1}{n-1}+\frac{1}{3}\right) \tag{237}$$

Now, we know that n is as low as possible. $n = 1$ is precluded by the infinite solution. Therefore $n = 2$. Putting this in (234) gives the usual gravitational potential energy (235) when k is $\frac{3}{4}$. Thus, we can determine the energy density at a distance x from M in the space medium by putting $n = 2$ and $k = \frac{3}{4}$ in (237). The result is $GM\rho/x$, exactly the gravitational potential energy attributed to the interaction between M and ρ. Hence we have justified the remarkable fact that we can take an energy known to be distributed in space and assign this to the locality of the interacting mass in the space medium. This greatly strengthens the explanation for the temperature of the cosmic background radiation proposed in this work.

The Gravitational Deflection of Light

It is an acclaimed achievement of Einstein's theory that the deflection of light by the solar gravitational field follows from the law of gravitation derived using that theory. Since the same law has been obtained earlier in this work in terms of retardation of the electrodynamic interaction we need not dwell on the problem of gravitational deflection of light. However, the author has some reservations about the mathematical technique used by relativists to deduce the deflection and a few comments seem appropriate.

Firstly, the speed of light is justified theoretically by Maxwell's theory once it is accepted that c is the parameter relating electromagnetic and electrostatic units of charge. This relationship was established earlier in this work by arguments based upon Fig. 17. The parameter c used in that figure was shown to be halved by retardation. $\frac{1}{2}c$ became the speed of the lattice particle in its natural cyclic oscillations at the space frequency. Thus, indirectly, the speed of light at any position in the vacuum medium depends upon the speed of the bound lattice particles.

The question then is how gravitation may affect this speed. We have just seen that local gravitational potential is stored in the kinetic 'thermal' agitation of the lattice particles. This local thermal energy is deemed to come from a depletion of the local energy of the lattice particle and its counter-balance moving at the space frequency. Thus:

$$\Phi m + m(c/2)^2 = \text{constant} \tag{238}$$

Here Φ is taken to be positive because Φm is the gravitational energy of a lattice particle of mass m expressed as a kinetic energy.

Note that in explaining the nature of gravitation a mass in motion with the lattice at the space frequency was set in dynamic balance with the mass of energy added to gravitons moving in counter-balance with the lattice. The energy we associate with matter has an equal counterpart hidden in the space metric. Thus energy quantities and mass quantities need to be doubled in many instances to correctly represent conditions within the vacuum medium. When we speak of gravitational potential we restrict ourselves to the matter system moving with the lattice frame. Now, as we saw in deriving (97) in Chapter 5, the orbital displacement of lattice particles involves equal change of electric displacement energy and kinetic energy and, for dynamic balance, there are equal related changes in the graviton system. If we consider the total energy system, the kinetic energy of the lattice plus that of the graviton system can be deployed into 'thermal' motion to represent the basic gravitational potential energy and the equal amount of displacement energy can be regarded as counterpart energy of this gravitational potential hidden in the space metric. In this way (238) is fully justified.

In applying Boltzmann's constant to this lattice system, we regard the lattice particle more as a molecule comprising the mass m of the particle plus the counterpart mass m of the coupled graviton system. However, it is correct to use a mass of m in (230) because this equation represents energy in the matter frame only. Nevertheless, the coupling with the graviton frame assures that only one temperature is manifested by the space medium. The graviton system does not have its own temperature related to graviton mass.

The value of c given by (238) is less than the value of c for a zero gravitational potential. It is less by $2\Phi m/c$, exactly the value needed to explain the observed deflection of light by a gravitational field and in exact conformity with the result given by the Einstein formula.

The Clock Paradox

A report in 1972* on an experiment performed by Hafele and Keating† began with the words:

> Two American physicists with four atomic clocks flew around the world in search of the solution to the famous clock paradox raised by Einstein's relativity theory. They discovered that you age a fraction of a second while in flight, but the amount depends on the direction in which you are going.

It needs a rather special definition of one's rate of ageing in order to arrive at this conclusion from experiments on atomic clocks, but the Hafele–Keating experiment is certainly very important. It should be repeated at different times of year, however, in order to make its results more conclusive.

The rate of an atomic clock changes with its speed. This is to be expected from the Ives–Stilwell experiment mentioned in Chapter 3, which demonstrated the change of frequency of the spectral emission from fast moving atoms. This experiment on the so-called transverse Doppler effect was claimed to verify relativistic time dilation, and so confirm Einstein's Theory of Special Relativity. In Chapter 3 we saw how it may be explained without our conception of time variation and by retaining the traditional view that time has a universal constancy. The same argument applies to the flying clock experiment, which relies upon the same formulae insofar as it is a test of Einstein's theory.

The clock paradox is a paradox evoked by applying relativity to the rate of time sensed by two travellers on separate journeys which they make at different velocities. When they meet again to compare their measure of the time taken there should be some confusion. The assumption is that they travel on outward and homeward journeys at uniform velocity and are only subject to acceleration momentarily when they turn around. Special relativity requires each clock to slow down when viewed by the bearer of the other clock, a rather paradoxical situation. The Ives–Stilwell experiment was concerned with time dilation as viewed by the observer at rest in the laboratory, but the atoms were moving fast enough for the motion of the laboratory, owing to the Earth's rotation about its axis, to be inconsequential.

* G. Wick, *New Scientist*, **53**, 261 (1972).
† J. Hafele and R. Keating, *Science*, **177**, 166 (1972).

Therefore, whether the experiment indicates an effect caused by speed relative to the moving observer on the Earth, relative to the non-rotating electromagnetic reference frame or, indeed, relative to some absolute space frame is not clear.

Certainly, the flying clock experiments had to take account of the component of speed attributable to the Earth's rotation. In this sense they could be said to relate more to the effects of centrifugal acceleration and so involve Einstein's General Theory of Relativity. The formulae are the same. This means that the experiment has little bearing upon the clock paradox, which remains a basic weakness at the roots of relativity. It is not a weakness and there is no paradox if one regards relativity philosophically as merely providing a technique useful in interpretation of physical phenomena. The weakness arises once one accepts relativity as physics and as sufficient foundation for phenomenological explanation.

The flying clock experiment also demonstrated the time dependence of clocks upon the gravitational potential. The clocks were carried at a high altitude in their journeys around the world. Hence their exposure to such a change of potential. In this regard the earlier experimental results of Pound and Rebka were confirmed.* The spectral frequencies emitted by an atom are higher, the higher the atom above the ground. This is a curious phenomenon. If the photon were a corpuscle having a frequency related to its energy it should, on this experimental basis, lose energy as it falls and gain energy as it rises. This seems the wrong way about. Yet if the photon is a wave one also has the problem of understanding how it can change frequency when moving through a gravitational field. Relativity provides suitable formulae but does not answer these physical questions.

The obvious answer to the author is to say that the atom exchanges energy with the space medium in dependence upon the local gravitational potential. Less photon energy is involved at the higher magnitudes of gravitational potential. Thus, bearing in mind that gravitational potential is negative, we have a higher magnitude of potential closer to the Earth's surface. This means that more related kinetic energy is held trapped in the space medium. This is energy which is proportional to the mass content of the atom. If then the atom produces a photon not all of the mass energy released is in the

* R. V. Pound and G. A. Rebka, *Phys. Rev. Lett.* **3**, 439 (1959) and **4**, 337 (1960).

form which governs the photon frequency. There will be a shift of the frequency spectrum towards the red end in proportion to the magnitude of the local gravitational potential. The red shift will be greater at lower altitudes. Hence the photon frequency will be higher at higher altitudes. This is merely a consequence of $E=Mc^2$ and the Principle of Equivalence. It does not need any support from Einstein's General Theory of Relativity. Indeed, the red shift as explained by General Relativity is not a strong test of that theory, as we have already seen in Chapter 2, where Dicke was quoted on this subject.

Mass-energy Equivalence

At this stage it is appropriate to come back to a theme mentioned in Chapter 3 when we discussed the transverse Doppler effect. Does electric interaction energy between charges in motion exhibit mass? This was the problem raised by Brillouin. We found in Chapter 3 that the time dilation evidence derived from the spectral emissions of atoms moving at high speed could be explained if the interaction energy does not increase as does the mass of the electron when speed increases.

The problem is really one concerning the seat of any mass resulting from such interaction energy. One could say that the mass effect is shared between two interacting charges. For example, the negative interaction energy component due to the Coulomb interaction between an electron and positron could be said to result in an equal decrement of mass of these two particles when they are accelerated as a pair to high speeds. In the case of the interaction between a proton and an electron, however, would the decrement be shared equally or in proportion to the masses of the two particles? In the latter case what happens if the interaction energy changes suddenly owing to a spectral emission? Does the inertia of the proton or its independence from the electron somehow preclude the 'relativistic' speed component of the interaction energy from governing the photon energy exchange? If so we would have the interaction energy exhibiting mass when we sense the behaviour of the hydrogen atom inertially but not exhibiting mass when we sense the spectral behaviour of the atom.

These are problems which need confirmed solutions. Very probably interaction energy due to Coulomb interactions does exhibit mass properties even when the interacting charges are not tightly bound in a rigid aggregation. This is suggested by the results obtained in Chapter 1 when electrodynamic properties were discussed. The inertial properties of a reacting system of electric charges were part of the case used to explain magnetic fields. If the reacting charges are similar in their mass properties the interaction between them would be a shared property as well. From accepted physics one can obtain many formulae purporting to give answers to all these questions. However, they are seldom applied in a way which confirms that they are valid. Uncertainties must therefore remain in physics which seeks to be all-embracing. They become the driving force which makes further research worthwhile. The mass to be assigned to the Coulomb interaction is one such question. It is fundamental to the issue of time dilation. Nevertheless, the author believes that the approach to this problem as just presented may well prove itself as we come to understand more about the nature of mass.

Moving E-frames

The optical experiments in Chapter 3 were reconciled by introducing the idea of a moving electromagnetic reference frame. This is a non-rotating frame of reference which moves linearly with the space lattice and which is formed by the rotation of a whole region of the lattice. The lattice particle structure has angular momentum attributable to such rotation and this has been called into account in discussing the creation of the solar system. Once in rotation such a region defines its own E-frame. Though non-rotating, this E-frame is determined by lattice particles which not only share the lattice region rotation but have the synchronous cyclic motion shared by all such particles within a vast space domain at the space frequency $m_e c^2/h$.

How can such a system of lattice particles move along a linear trajectory, as must happen if the Earth contains such a rotating region? The Earth's electromagnetic reference frame shares its linear motion through space. Would not the particles collide with those in surrounding space in the path ahead of the Earth's motion? Consideration shows that any build-up of particles at the leading surface of a moving space region would be matched by a particle deficit at the rear surface. This would set up electric fields through the region which would direct the particles freed from the structural bonds at the leading surface and result in their travelling through the whole region to take up positions in the lattice behind the region. The particles have very high speeds in their orbits with the lattice at the space frequency. Once released they can travel at such speed through the lattice to their new positions. Their momentum will balance the forward momentum of the whole region. Their population would be small for motions at normal galactic speeds and so they would not distort the lattice sufficiently to affect the analysis presented in earlier chapters. For example, as they travel at $\frac{1}{2}c$ in the opposite direction to a lattice which may move at, say, 300 km/s, there would be one freely moving particle amongst 500 lattice particles. The lattice distortion in such a case would be very local to the free particle and elsewhere the lattice would comply with the analysis for the undisturbed system.*

This is the simple answer to the Michelson–Morley experiment. The E-frame moves linearly with the Earth. The effects described cannot be detected magnetically because the reverse flow of free lattice particles relative to the E-frame is exactly balanced electromagnetically by the continuum charge within the region. This charge is at rest but relative to the lattice structure of the E-frame it also has a reverse motion.

Thus the linear motion is very elusive in manifesting effects physically, though the Michelson–Morley experiment is hardly inconsequential. It is only because relativity has cast such a large cloud over the subject that this basic experiment is insufficient by itself to give endorsement to the structured space model advanced in this work. Nevertheless, when we consider the rotation of the lattice region we have a different story. Angular momentum effects and magnetic effects come in evidence and have no counterpart relativistic explanation. Then bear in mind that under certain conditions, seemingly stimulated by charge polarization in matter, the lattice can share the rotation of a material body.

As the Earth rotates its space lattice rotates with it. This induces charge polarization throughout the Earth's body and atmosphere and is balanced, as we saw in explaining the geomagnetic field, by charge polarization in the substance of the Earth itself. Now, what happens when a body of matter on Earth, such as a flywheel rotates? It cannot induce rotation of the space lattice by mere mechanical means. It needs the charge polarization to encourage rotation and a very high concentration of charge would be needed to cause rotation at the

* The existence of free lattice particles may affect the theoretical evaluation of the fine structure constant. See discussion of this in Appendix III.

speeds we associate with the flywheel. However, it could have an effect, because there is the residual polarization associated with the Earth's rotation. If it is the charge density that counts and the body occupied by the flywheel substance has charge to offset that of the Earth's rotating space lattice, then this same charge can be deployed to cause rotation of the space lattice within the flywheel to the extent that is exactly in balance with this charge.

Equation (228) tells us that the charge density is proportional to the speed of lattice rotation. Therefore, there would seem to be no change in the rotation of the lattice attributable to the motion of the flywheel, because the charge density is the same. However, equation (228) needs correction. It only applies if the axis of rotation of the whole lattice system is parallel to the universal axes about which the lattice particles describe their orbits. If there is an angle between these axes then the charge density is proportional to the cosine of this angle. The Earth's axis precesses at $23{\cdot}5^{\circ}$ about an axis that may more likely be in parallel with the universal axial direction in space in the vicinity of the solar system. Hence we may need to regard the Earth's space boundary as nearer 200 km above the Earth's surface to account quantitatively for the geomagnetic moment. This modification is, nevertheless, extremely relevant if our flywheel can determine the applicable axis for space lattice rotation within the body of the flywheel or in its near vicinity. If the wheel rotates about an axis in alignment with the universal axial direction in space then we see that the lattice in the body of the wheel need not rotate quite so rapidly to provide the charge balance. Indeed, it would slow down by about 10%, that is 10% of the rate of rotation of the Earth, a very small amount.

This theory may, therefore, give pointers to sensitive experiments which could be performed on rotating systems to see if there is a very small amount of angular momentum exchange or electrical charge adjustment when rotation is initiated or stopped for different orientations of the rotation axis. This would be a most direct way of verifying the existence of the proposed space medium and determining the axial direction about which the lattice particles rotate.

Note that we are led from the analysis of the optical experiments by reference to Fig. 20 in Chapter 3 to suspect that there can be local rotation of space lattice in the presence of rotating apparatus. However, it would be absurd to suggest that the lattice could readily rotate at the full speed of rotation of the apparatus and pass undetected in our observations. Accordingly, there must be a mechanism limiting the rate of rotation under normal circumstances and the one proposed above seems the most logical. Equally, one should not exclude the prospect that it might be possible to induce rapid rotation of the space lattice under certain circumstances.

This raises all kinds of interesting questions. We have seen that an electrical charge induction within matter can stimulate the spin of the space lattice. Once spinning as a result of the deployment of this electrical energy, there is radial lattice particle displacement which generates a magnetic field and holds electric charge in matter in a compensating electric balance. The body and rotating space lattice will tend to stay together in their onward migration through space. Therefore, should it not be possible within the laboratory to establish the coupled rotation of a body and the coextensive space lattice? The answer must be affirmative and the consequence is that we have here basis for putting this theory to its test, possibly with practical consequences.

Let us examine the energy content of such a system. A sphere of the space medium of mass density ρ_0 (only evident in rotation and not evident in linear motion) is set in rotation at angular velocity w. It has a radius R. Its kinetic energy due to rotation has a density given by $\rho_0 w^2 R^2/5$ ergs/cc. We know that ρ_0 is 288 gm/cc. Thus the energy density is about $60v^2$ ergs/cc, where v is the velocity of the sphere at its perimeter. If v is of the order of the speed of sound or the speed of gas molecules in air at normal temperatures and pressures then this energy density becomes about $8\ 10^{10}$ ergs/cc. This is $8\ 10^9$ joules per cubic metre. If the rotating space medium were somehow to be created naturally in the atmosphere this is the energy density one might expect it to possess. Furthermore there would be some electric charge displacement which could involve ionization of the air in the spherical form of the object. As the object slowed down the energy could sustain such ionization for a while. The object would be in a balanced buoyant state and would display no inertia, except that due to its rotation, though it would stay with the rotating air which it has ionized. But how could it be created? It requires a radial electric field to induce the rotation, as we saw from the creation of the sun. Perhaps a lightning discharge involving pinch in the discharge channel due to its self-electrodynamic contraction could separate electrons and ions in a radial sense along the discharge path, at least for a long enough period to induce the spin. This is all speculation, but it is a fact that thunderballs produced in thunderstorms are spherical in form. They glow as if ionized but their energies are far in excess of that one associates with ionized air. This was discussed in *Nature** in 1970. So difficult is this question that the proposal was made that the thunderball is a nuclear phenomenon. From evidence presented in the paper the task is to explain why the thunderball has an energy density which is independent of its size and of the order of $2\ 10^9$ J m^{-3} to $5\ 10^9$ J m^{-3}.

It is submitted that the phenomenon of ball lightning is a phenomenon of the space medium. The scope for applying ball lightning to practical ends was discussed by Ritchie† as long ago as 1963. However, it can hardly be applied unless the mechanism underlying its creation is understood, as it is potentially destructive. In this connection the thunderball has been related to the vast destruction at Tunguska in 1908‡ when what appears to be a comet collided with the Earth and yet appeared to impart no momentum able to leave a crater. Comets themselves have weird properties which resemble the characteristics of the rotating space medium presented in this work, but it is beyond our scope to enlarge on such a theme.

Within the laboratory there is evidently scope for seeking to induce what may be termed 'vacuum spin'. An electrical or magnetic coupling is needed and there is scope for tapping some of the angular momentum of the space medium. Thus any experiment in which there appears anomalous torque deserves more serious attention than one would think. One example of such an experiment is that reported by Zinsser§ in 1975.

There is another phenomenon which involves unusual angular momentum properties. It is the mysterious mechanism of the tornado. It has been argued very convincingly by Vonnegut** that the energy of a tornado comes from the electrical discharges we associate with thunderstorms but that there is mystery in the source of the very substantial angular momentum of the tornado. Vonnegut speculates that the energy somehow concentrates the angular momentum of an ordinary whirlwind and, of particular interest in view of the foregoing comments, he goes on to make two statements:

* M. D. Altschuler *et al.*, *Nature*, **228**, 545 (1970).

† D. J. Ritchie, *Journal of I.E.E.*, **9**, 202 (1963).

‡ J. Stoneley, *Tunguska*, W. H. Allen, London (1977).

§ R. G. Zinsser, 'Kinetobarische Effekte—ein neues Phänomen?', *Umschau*, 5, 152 (1975).

** B. Vonnegut, *Jour. Geophysical Research*, **65**, 203 (1960).

> ... it is possible that the vortex is initiated directly by electrical energy ... an understanding of ball lightning may very well be necessary if the tornado puzzle is to be solved.

We see from this that the space medium may provide many of the missing answers needed to complete our understanding of the enigma we regularly encounter in physics.

The Hadron Ether

The author's first publication* showing the structured space medium described in developed form in the previous chapters appeared in 1960. The fine structure constant, the geomagnetic field and reference to the basic law of electrodynamics in the context of gravitation were the prime features. Years later, the author found that this basic form of electrodynamic law could have been extracted from Maxwell's treatise, but in pursuing the subject in ignorance of this there was advantage in discovering the more general law applicable between ions and electrons. Nevertheless, it was in this early 1960 publication that the need for the space medium to contain lattice particles of mass $3{\cdot}7\ 10^{-29}$ gm was firmly asserted. In the second edition of the work published in 1966 the theory had been extended. The vacuum model then assumed the form outlined in this book. Space itself contained particles of mass energy 2·587 Gev constituting a G-frame which was in balance with a frame comprising the lattice particles. It was recognized then that these latter particles had an energy attributable to twice their effective mass, owing to the 'buoyancy' of the sea of energy pervading space. Thus the energy of these lattice particles is about 38 kev. The muon and the electron were seen as intermediate leptons between these two energy quanta in space, the 2·587 Gev quantum and the 38 kev quantum.

This was in the 1966 version of the author's published theory. Having deduced the need for the 2·587 Gev particle as the key to the derivation of the value of G, the author did look for support in the scientific literature of the time. There was, indeed, some speculation in 1966 about the existence of a really fundamental heavy particle which might decay to form elementary particles. Of special interest was the fact that evidence of parity breaking and a violation of Lorentz invariance in the decay of the kaon led to guarded assertions

* H. Aspden, *The Theory of Gravitation*, Sabberton, Southampton (1960).

that there might have to be an aether after all. Something in the vacuum was reacting with matter in high energy experiments. A link with gravitation was even suggested by Phillips* writing under the title 'Is the Graviton a Goldstone Boson?' This greatly encouraged the author and stimulated the 1966 publication, in spite of the hostile climate of opinion against proposals founded upon analysis of the aether medium.

The problem, it seemed, was that gravitation was the realm of the relativist to whom the aether is an anathema, whereas the particle physicist is intimately concerned with experimental data and its empirical formulation and can speak about 'broken symmetry' without colouring the argument by reference to the aether.

In any event, as the reader will have seen, the scope for progress turned out to be more in the realm of particle physics than in the cosmological terrain of relativity. But what is the progress towards recognizing the basic aether particle forms at 2·587 Gev and 38 kev? In particular, what is the progress in recognizing that the 2·587 Gev quantum is the graviton? This book has been written to stimulate thought in such a direction. There is independent progress, judging by the papers being published at the present time.

Bardeen and Tye† have written about the scope for a new light Higgs boson of approximate mass energy 50 kev. The Salam–Weinberg model is their base. Matsuki‡ has written about the effects of the Higgs scalar on gravity and speaks of the strong graviton proposed by Salam. Such a graviton has a mass energy measured as a few Gev. However, the methods of these authors differ greatly from the semi-classical methods used by the author in this work.

Occasionally, one does see direct reference to the hadronic aether. Koshiba§ writing in 1975 used a title including the words 'Does Hadronic Ether Exist?' Bailey and Picasso** in their 1970 paper on the anomalous magnetic moment of the muon referred to the hypothetical leptonic boson which had been predicted to exist in the field medium in order to explain slight differences between the theoretical and experimental g-factors for the electron and the muon. A mass of the leptonic boson of about 3·8 Gev was predicted. This was, of course, well before the discovery of the psi particles, but, as was

* P. R. Phillips, *Physical Review*, **146**, 966 (1966).

† W. A. Bardeen and S. H. H. Tye, *Physics Letters*, **74B**, 229 (1978).

‡ T. Matsuki, *Progress Theor. Phys.*, **59**, 235 (1978).

§ M. Koshiba, *Jour. Phys. Soc. Japan*, **38**, 305 (1975).

** J. Bailey and E. Picasso, *Progress in Nuclear Physics*, **12**, 62 (1970).

explained in Chapter 6, there has been mounting evidence indicating that certain heavy particle forms were needed to complete the picture of elementary particle interactions.

Importance of Unification

The idea of providing a unified account of gravitation and electrodynamic interactions has been recognized as important in physics for more than one hundred years. It is an obvious step towards the simplification of our understanding of Nature's fundamental fabric. In recent decades the mysteries of elementary particle physics have been deemed to be linked to the further progress in solving this basic problem of unification. But why is it important? Certainly, it is a challenge for enquiry by the theoretical physicist and progress towards a solution will put existing knowledge of physics on a firmer basis. This apart, the solution may lead us to valuable knowledge of practical importance, knowledge which otherwise we may not acquire. What, therefore, has been achieved in this book and why is this of importance?

Hopefully, the reader has come to believe in the possibility that there is a structured aether which regulates the values of the fundamental physical constants. This has academic value. Hopefully, also, the reader may have come to realize that the mysteries of the creation of our solar system are not necessarily outside our grasp. More knowledge of this kind is gratifying to our curiosity. Specifically, however, we have addressed the problem of electrodynamic interaction between current elements. It has been found that the magnetic field theory universally accepted has its limitations. Its valid application is restricted to problems involving at least one closed circuit interaction, and then only if the current carriers have the same charge/mass ratio. Magnetic field theory was based upon phenomena related exclusively to electron currents. What, then, is so special about interactions involving charged particles of different charge/mass ratio? Where is the practical application for such knowledge?

The answer may well coincide with the answer to the question: 'What is the most urgent and most important technological problem of our time?' Fusion power. Our attempts to emulate the energy generation processes of the sun by triggering fusion in heavy isotopes of hydrogen. Early efforts concentrated on techniques of magnetic confinement by which energy was concentrated to a critical level required for the nuclear reaction. All these efforts have been thwarted by instabilities of the electrical arc discharge which should self-pinch to concentrate the energy and impart this energy to the ions of the fusion process. This whole process is concerned with the transfer of energy from electrons to ions. Interactions between charged particles of different charge/mass ratio are vital to this fusion process. Yet, if we have inadequate understanding of the electrodynamic laws, as suggested in this work, is it surprising that progress has been retarded?

Another approach to fusion power is that of inertial confinement. This depends upon the injection of energy by accelerated particle beams. A recent review of progress is presented in the November, 1978, issue of *Scientific American* at p. 50. Electron beams and, it is stated, ion beams, are now being considered in the experimental attempts to stimulate fusion. Here, one may run into the problems of the anomalous acceleration of ions now evident in some experiments. It is proving very difficult to explain how energy is transferred from electrons to ions in the plasma experiments being performed. Indeed, there is mounting evidence that something is wrong with the laws of electrodynamics which we suppose regulate the interactions between electrons and ions. The author has drawn attention to this evidence in a recent publication* and argued that the true law of electrodynamics is the one derived in Chapter 1, as also published in a 1969 journal.†

It is submitted, therefore, that progress towards fusion power can be aided by a more rapid understanding of the fundamental physics involved in electrodynamic interactions. Here, then, the ideas in this book do assume practical importance. More than this, however, there is the suggestion in the foregoing pages that the phenomenon of the thunderball might be explicable and that from such understanding one might be able to control the storage of energy in the vacuum itself. Perhaps such an energized object could be propelled into a thermonuclear reactor and caused to release its energy to trigger the fusion reaction? But how can such ideas be explored if one does not admit the phenomenon on which they are founded? Belief in the aether medium is essential to such research, and it is interesting to read that the study of ball lightning has already been encouraged in USSR in connection with thermonuclear research. Kapitsa's

* H. Aspden, *IEEE. Trans. Plasma Science*, **PS-5**, 159 (1977).

† H. Aspden, *Jour. Franklin Inst.*, **287**, 181 (1969).

investigations in this context is reviewed in the 1977 work *Lightning*, edited by R. H. Golde and published by Academic Press (see Chapter 12).

Finally, on another note underlying the importance of enquiry into the aether medium, one should keep in mind the close connection between the gravitational stability of matter and the electric polarization of the rotating space medium suggested in this book. Here may be the means for developing the link between the earthquake and the unusual electric phenomena often associated with earthquakes. These take the form of lightning displays sometimes occurring in advance of the actual earthquake. Also it is reported that radio interference can exhibit certain anomalous features immediately prior to the earthquake* and there has been speculation about whether the monitoring of radio interference could give early warning of earthquakes and so help avert disaster.† It may, therefore, be of great importance for mankind to reconsider his scientific doctrines and re-examine the scope for a revival of the aether in the active vocabulary of physics.

* M. Markert, *New Scientist*, **70**, 488 (1976).

† R. E. Hill, 'The Radioquake Mystery', *Intercom*, 17, December, 1978; and H. Aspden, 'A Perspective on a New Enigma', *Intercom*, 21, December, 1978.