The Source of Energy in the Cosmos

by

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Summary

We do not know what energy is, though it drives all systems. We describe it by what it does, or more loosely by its source e.g. gas, oil, electricity etc. We know that it can neither be created nor destroyed and that mechanical energy has a heat equivalent. This paper proposes a general process which underlies energy in all its applications based on a new model of the Universe.

My recent paper proposed that the whole cosmos is composed of just three components. The first is the sole fundamental particle of stuff from which all matter is made by accretion. I called it the ε-particle to distinguish it from the electron. These particles generate forces of attraction to or repulsion from each other by their rotation on their axes, which causes electromagnetic induction. Secondly, there is the medium of space which in this model is susceptible to electromagnetic induction, and through which the particles interact at a distance. Finally, there is electromagnetic radiation which transfers energy between atoms in matter.

This model is developed to show that all energy is in fact the work done by these forces of attraction between particles which are continually trying to bring them closer together. Such aggregation produces all matter, from protons, atoms and molecules to planets and galaxies. In this model the cosmos is infinite and in a steady-state. What maintains the steady-state is that ε-particles in the largest agglomerates among the stars can also repel each other so violently that they result in explosions, which reduce agglomerates back to ε-particles and scatter them across space. This provides a coherent, cosmic model of stochastic regeneration and redistribution.

Reference is made to analytical papers that I wrote over a period of ten years, which are the basis of the new model. Measurements are proposed to substantiate it.

A. Introduction

There are two things we know about energy. First, it cannot be created or destroyed. When we ‘consume’ it, we simply transfer it into a different form; the quality changes, but the quantity of energy is conserved. Secondly, this conserved form is always less available to bring about change than the original before its use; ‘consuming’ the energy degrades it.

In 1854 Joule showed that a quantity of mechanical energy, or work, was equivalent to a quantity of heat, which resulted in the First Law of Thermodynamics. From this equivalence the principle was extended by measurement to all other forms of energy such as electrical energy and chemical energy, expressed by the choice of constants in equations.

However, none of this tells us what energy actually is. We are left with in position of St Augustine with respect to time; we measure it, but what we measure, we know not.

We describe it by what it does. Nevertheless the term is extended from the everyday scale at which we observe its effects up to assertions about the components of the cosmos and down to interpretations at the level of fundamental particles.

There must be some Universal natural system which drives all these processes inexorably in the same direction, apparently to ultimate extinction. This analysis leads to just such a proposed system.

B. The conservation of energy

Energy is what drives all processes or 'systems'. Energy is derived from a range of sources i.e. mechanical, chemical, electrical etc. Energy is conserved. What is 'lost' in operating a process is gained in the environment e.g. as low grade heat.

There is no absolute level of energy as there is for mass i.e. the kilogram, which is really a definition. What is measured is the energy used for a particular operation i.e. the difference between the energy level before and the energy level after without specifying what these levels are.

Heat energy is a convenient indicator in all matter, but particularly in gases. The temperature of a gas describes the kinetic energy of its molecules, as they rush around and collide with each other. We sense this as heat, but at the molecular level it is in effect mechanical energy. When molecules collide, it is their shells of orbital electrons that take the impact because of their structure, which shields their nuclei. Temperature is measured by transferring heat energy from the gas to a calibrated instrument or thermometer which we can read, on the assumption that this does not change the average energy of the particles.

For this to be true, heat energy has to be a bulk phenomenon i.e. not just an isolated particle but many particles. The corollary is that cooling a gas reduces its energy by reducing the kinetic energy of its particles. If the temperature is reduced to zero, this means reducing the movements of particles to zero.

The result would then be a stable assembly of electron shells which are not disturbed and do not disturb each other. The temperature at which this would occur, if attainable, would be 0^{o} K, Absolute Zero. The correlation between temperature and energy implies that this would also indicate zero energy. However this cannot be true, because the atoms retain their shape which is determined by the motion of their orbital electrons. It is not their orbits but the perturbations of their orbits which are eliminated at Absolute Zero Temperature. Since electrons have mass, their velocities in orbit give them kinetic energy. Moreover the atomic structures of different elements have different numbers of orbital electrons, which implies that they have different quantities of kinetic energy at Absolute Zero. In addition, the motion of orbital electrons also relates to the motions of their nuclei such as spin, which means that nuclei have energy, even at Absolute Zero. Thus there is no zero energy as long as atoms retain their structure.

What we describe as thermal energy, therefore, normally involves the interaction of orbiting electrons, which is why what is measured in processes is the change of

energy. This is where the equivalence of mechanical and thermodynamic energy part company.

A particle which is completely isolated in effect has no temperature, however much it may be endogenously active e.g. by vibrating or spinning; as far as the rest of the Universe is concerned, it is 'cold'. If it cannot pass these motions on to other matter, the term 'temperature' is meaningless. However, it has mechanical energy by definition, and this is conveyed to other particles as soon as they come into contact, so that the temperature of the system rises. Vibrations of an 'isolated' particle may be communicated if they result in electromagnetic radiation, but if spinning subatomic particles radiate, for instance, it is not conventionally observed in the spectrum.

The ultimate definition of energy depends on gravity. The reasoning is that energy is defined as force acting over a distance, the amount of work done. The primary definition of force by Newton was the gravitational attraction between Earth and apple, which he observed to produce acceleration. This was a force which acted at a distance, but he extended the definition to directly applied mechanical force. Mechanical forces are then correlated with electrical and magnetic forces, and so on, to form an internally coherent system.

C. The degradation of energy

Energy which is useful for driving processes is degraded as far as utility for performing further work under the same conditions, because by definition the products are more stable i.e. less able to bring about change than the reactants. If they could, they would do so. They need to find another system in which to operate, but even if they do, the products of the further reaction are less available for further reaction, and so the overall result is a downward spiral. There are systems in which two opposing reactions occur simultaneously in the same medium, which is a dynamic equilibrium, but this is destroyed as soon as one or other inputs is removed, which must eventually happen.

However, there is an additional reason why comparison of energy levels may not be enough to make the process work. An additional energy input into a system is often required to enable the process of reaching a more stable state to be reached, even though the relative energy levels of the components suggest that this is attainable. For example, there are conditions under which molecules of the gases hydrogen and oxygen may be mixed without their combining chemically to make molecules of water, even though water molecules have a lower energy level, and so are more stable. The molecules are kept apart by their mutually repulsive shells of orbiting electrons. An input of extra energy is required in the form of heating the mixture to higher temperatures to increase the kinetic energy of the molecules, or by providing a spark which makes a localised hot spot. This causes some at least of the molecules to reach much higher velocities, so that on collision their electrons shells are disrupted and forced into a new configuration around both nuclei which is then more stable. Or they may form unstable species such as free radicals which initiate chains of further reactions to reach stable products. This additional energy is called the activation energy of the reaction, a barrier which has to be overcome for the main process of arriving at the more stable, lower energy state to occur.

The new configuration survives because it is more stable and resistant to further disruption, which is described quantitatively as a lower energy level, but the energy of collision has not disappeared; it survives as vigorous vibration or heating of the collision product. In fact the ability of the product to withstand this vibration is a condition of a successful reaction. This vibration is then transmitted also by collision to other molecules of reactants, or to another medium which causes an increase in temperature. This is described as an exothermic reaction.

The corollary of greater stability therefore is that the product is less reactive, and the chemical reaction eventually, and in this case rapidly, terminates. All atoms and molecules are subject to this kind of process because they all have shells of orbital electrons. It is these which determine the formation of further products. This is what we know as chemistry.

This tendency of energy to degrade is described as increasing entropy of the system. The concept of entropy was developed in relation to engines which undergo the Carnot cycle. However, it was extended by Clausius into a Universal principle that any change which occurs in nature is irreversible, and so accompanied by a net increase in entropy. This allowed him to state the laws of thermodynamics as: “the energy of the universe is a constant; the entropy of the universe tends always to a maximum.” Eddington added that, because of its continuously increasing character, “entropy is time’s arrow”; that is, the constantly increasing entropy of the universe is the physical basis of our concept of time.

D. The macroscopic interpretation

If we are to apply such concepts to the Universe, we need to consider them in relation to current models of the Universe, which have evolved considerably since the days of Clausius and even Eddington.

a. The expanding Universe

If energy can be neither created nor destroyed, it must all have been contained in the initial conditions from which expansion occurred, the kernel of the Big Bang. This kernel must have been perfectly ordered, whatever it was, because it has been downhill for entropy ever since. Entropy will not increase to its maximum extent because of the increasing separation of galaxies into which the Universe will for ever after be divided. Hydrogen will be completely burnt up in stars, followed by the metallic elements, so that the lights will go out. The hydrogen left in stars which are not massive enough to initiate nuclear reactions will just stay cold. The stuff which is the remains of nuclear reactions will stay as isolated lumps of rock, devoid of any means of staying warm. You might argue that the frozen state becomes the new order, because there is no means of bringing about change.

What makes it worse is the apparent acceleration of expansion of the Universe, which has been recently discovered. The phenomenon which is said to be driving it is thought to be some kind of energy, but we do not know what form it can take. So dark energy. This too must have been contained in the kernel in the Big Bang before there was time and space, because there is no means in this model of generating it on the way to the present. It has just taken a long time to express itself, but this is no more

than an instant in the progress to infinity which is the ultimate destination. Nor does its kinetic energy potential have any way of being realised, because there is nothing out there with which it could collide.

This is what the model predicts energy to bring about, but it is no closer to saying why. So what exactly is energy? What is the physical basis of its origin as opposed to what it does? How does it remain constant, while the Universe apparently runs down?

b. A Steady-state Universe

My model of a steady-state Universe has just three components. These are particles of stuff of which all matter is composed, a medium of space in which these particles of stuff exist, and electromagnetic radiation which transfers energy from particle to particle through the medium of space. The object of the present paper is to show that energy, as we define it, is the product of electromagnetic induction between these particles of stuff.

The hypothesis is that there is one species of particle of stuff of which all the matter of the Universe is composed. Matter is formed by accretion of such particles. This particle has the size and stuff of an electron but without electric charge, which does not appear in this model. I have called the particle the ε-particle. All ε-particles spin at the same rate, which gives them electromagnetic properties, but their axes are randomly inclined at different angles, so that in principle no two are the same. These two properties of an individual ε-particle never change.

The medium of space in which these particles exist has the property of being susceptible to electromagnetic induction. The spin of the ε-particle causes polarisation of the medium of space around it, the maximum being on the plane on which the equator lies, diminishing to zero at the axis of spin. When two ε-particles spin in opposite directions, an electromagnetic resonance is set up between them which generates a force of attraction that pulls them together. By contrast, if they spin in the same direction, there is a dissonance and they repel each other. These forces of attraction and repulsion diminish with the square of the distance between the ε-particles, but there is no cut-off point.

This Universe is infinite in time and space. Starting from a cloud of such ε-particles, like molecules of a gas, observations in a straight line in any direction would show that half of them appeared to be rotating from left to right, and the other half from right to left. This would be true, whichever direction was chosen, in spite of all the particles being identical, because it depends on where the ‘north’ pole of the axis is pointing, as well as its orientation as a line. There would be no net direction of rotation, just as there would be no net direction of the axes; by definition the Universe cannot have a bias of direction or spin. The random translational motions of the ε-particles would lead to the formation of clumps of particles under the influence of the forces generated by spins, and these would be the seeds of matter. This is a stochastic process in which each ε-particle is drawn to a clump by the maximum force of attraction available to it in its environment, which depends on the resultant of all the forces that the other ε-particles generate. These forces are not simply the sum of all the attractive forces, because the geometry means that not all can attain the location which would give them maximum force of attraction.

The optimum arrangement which they can form under their particular circumstances may be considered a position of stability for that 'clump'. This depends partly on the location where it forms and partly on its size, because the larger it is, the less directional is its resultant force of attraction. Different 'clumps' may form different 'species' of aggregate i.e. the 'clumps' would fall into the same geometrical pattern of aggregation. Nevertheless, this is the process by which protons, and then atoms, and then combinations of atoms could form.

Since this is essentially a process controlled by geometry, the implication is that it would produce a population of aggregates which fall into species in their own right, but with different stabilities. It is possible, therefore, that they could combine to produce aggregates of still greater stability, if they could come together in the same location. However, this is not enough to trigger the reorientation of bonds between particles that would be necessary to form the more stable structure. This is where the additional input of 'activation energy' is required; it breaks some of the bonds in order to bring about a new, more stable aggregate. This is essentially chemistry, which is the aggregation or combination of disparate aggregates to form more stable compounds. All this is facilitated by the perpetual turbulence and movement of stuff in the Universe, which in effect is a kind of mixing process, though it never reaches completion.

All the forces in the Universe at all scales arise from electromagnetic induction by the spins of ε-particles. There are three basic forces of physics: gravity, the electroweak force and the strong force. The model proposes that these are different manifestations of the same force differentiated by the distances at which they act and the mode of detection by us. There is also the implication that if two ε-particles approach each other close enough to touch in a dissonance mode, they form a binary unit which may to all intents and purposes invisible. Nevertheless, they would still be stuff, and this would make its presence known if it came into mechanical collision with other matter.

All the processes of accretion are reversible by the same processes which formed them. In the extreme case accretion may lead to some agglomerates becoming so large that the internal forces between particles cannot reach any state which satisfies their need for attachment. Bulk turbulence may bring into close contact clusters of particles which, far from having attractive tendencies in common, in fact have quite the opposite. This is inherent in the initial definition of the ε-particle which is that opposite rotations attract but like repel. It is not that the orientations of individual particles change, because that is precluded. It is simply that under extreme conditions clumps of ε-particles may form which have the opposite tendencies to the bulk, purely as a statistical result of random motions, and if bulk turbulence brings the clumps into close proximity, their only solution is to leave in a hurry i.e. blow the whole body apart in an explosion. If the conditions are severe enough, collisions would reduce atoms to scattered protons, and protons to dispersed ε-particles, so that the whole process of accretion could begin again. This is the feedback system which allows the system to be sustained for ever.

It seems unlikely that solid materials could ever reach such a state of internal turbulence. Almost by definition they must have been stable enough to form, though of course they may be vaporised in the explosion. However, it is the gaseous material,

specifically hydrogen and helium which could undergo the extreme violence needed for regeneration by explosion. Nevertheless, solid materials could certainly be vaporised by collision, and dispersed in the same way, though perhaps less frequently than gaseous accretions because of their physical dimensions.

Apart from transmitting forces, the medium of space also transmits electromagnetic radiation from body to body through its susceptibility to electromagnetic induction. The acceleration of ε-particles generates rotating electromagnetic dipoles in the medium of space adjacent to them. Activation energy separates them from the particle structures, and then they speed away at the velocity of light, because they are light. The dipoles have a frequency of electromagnetic rotation that is characteristic of the ε-particles which generated them. The greater the velocity of the ε-particles through the medium of space at the instant of their generating the dipole, the higher the electromagnetic frequency and so the higher the energy of the light emitted.

It is the rate of response of the medium of space to electromagnetic induction which limits the velocity of light *in vacuo* to the Universal constant value. It is this emission of energy in the form of rotating electromagnetic dipoles which also limits the velocity of particles of stuff to the speed of light *in vacuo*.

Such dipoles travel completely independently through space, again by a process of successive electromagnetic induction of the medium of space, until they strike another body having structures of ε-particles with which they can resonate, so as to become absorbed. Their electromagnetic frequency of rotation decreases exponentially in transit through space because they generate secondary electromagnetic dipoles as they travel, which keeps the total energy of the whole 'particle' of light constant. This process eventually reduces all emissions to the lower electromagnetic frequencies which are observed in the 'background' of the Universe today.

E. Discussion

The chief driving force behind this analysis is Occam's razor, which says that the simplest systems are likely to be the best. The trend in modern physics has been towards ever more complex, and sometimes mysterious, explanations. While the manifestations in actual practice may indeed multiply as the science proceeds, there ought to be simple principles which underpin all phenomena, and the Universe itself. No one made the Universe complex just to confuse us. Much useful analysis can be carried out with consideration of bulk, abstract parameters such as heat and energy, but it ought to be possible to relate these to the physical environment. Thus heat can be considered at the micro level in terms of the motion of particles. But what about energy? Yet energy is supposed to drive every process, natural and man-made.

The system proposed in this paper could scarcely be simpler: just three components as the origin of all the variety of the natural world. A good deal of ingenuity has been necessary to turn their interactions into a rational account of the major phenomena which are the subject of physics, but the outcome is a coherent system supported by a succession of analytical papers over the past ten years. Moreover, actual measurements have been proposed to elucidate some of the most intractable problems, such as how to detect the existence of the medium of space.

This has required me to range across many facets of the physical sciences, which makes it difficult for specialist reviewers to assess, which is why I have had to publish my papers on my own website at www.churingapublishing.com . It is difficult to accept changes of paradigms unless you can see the whole picture. Even then it worries specialists that my conclusions are in conflict with some of the biggest names of twentieth century physics. However, my belief is that common sense and extensive experience of qualitative analysis of systems justifies the conclusions.

It began with a critique of the expansion model of the Universe, the 'Big Bang'. Its mystery has captured the imagination of physicists and public alike, but it still offends against simple common sense. Operating systems have inputs and outputs. A model in which the Universe began with a kernel from which everything was formed, and created time and space as it went along is strange indeed, especially when my analysis shows that there is no such 'thing' as time or space in the terms used by mathematical physics (1). However, what is particularly unacceptable is the idea that the expansion should go on for ever, that the lights should go out and everything should cool to some rock-bottom temperature. If that was the future of the Universe, what was the point? There must be room for a more acceptable interpretation.

It was not my intention to dismiss anyone's measurements, but it seemed to me that alternative, and more rational, interpretations were possible. The evidence for explosions in the Universe is compelling. Astronomical observations show that it is a turbulent environment and explosions certainly occur. The problem lies in ascribing the quality of electromagnetic radiation received on Earth to a single explosion which occurred 14.7 billion years ago and generated a progression of qualitative changes in matter. (We are made of stardust, or nuclear waste!). It would make much more sense if this process is going on in all the explosions which are being continually detected, apparently in random locations. These were observed at the rate of a few a week when my analyses started. Now they are ten a day, because of improvements in technology. Thus there appear to be 'kernels' spread out all over the Universe, even within the limits of our own detectors.

This is really compatible only with a model in which the Universe is infinite in time and space, but it raises another question. If the Universe is infinite in time and space, and always has been, where is the feedback system which allows the Universe to regenerate itself. There must be one, or the Universe would burn out. Indeed it would already have done so. This would require turning metallic elements back into hydrogen. The only places where this sort of process could happen must be in stars, possibly in explosions of stars. The conclusion was my first paper which proposed that the Universe was regenerated part by part by explosions occurring stochastically as the appropriate conditions of agglomeration formed (2). A later paper showed how this might occur for atomic nuclei (3).

This is essentially the model on which the current paper elaborates, and it immediately brought me into conflict with a host of the conventional theories of physics. There seem to be three main justifications for interpreting perfectly valid measurements as evidence of the expansion of the Universe: the redshift of light from stars, the accumulation of heavy elements in stars and the background of microwave radiation in the Universe. The following papers address this evidence, not necessarily in chronological order.

The logic of the current redshift argument seems to be circular. So redshift occurs because the Universe is expanding, and the Universe must be expanding because light from stars is redshifted. What eventually settles it for me is a simple chemical argument. If you took a sodium lamp to Alpha Centauri, and switched it on, what colour would you see? The universal response is 'yellow' of course, which is just as well, because the colour of light emitted is determined by the energy levels and structure of the atom, which also determines its chemistry. If these changed with location or velocity, we would have location- and velocity-dependent chemistry. This would throw the whole of science into doubt, because Universality is its fundamental assumption. In addition you cannot see light until it has been detached from the particle structure which has generated it i.e. until it is in free space. Unless the atmosphere of the star modified it, and there is no evidence from our Sun that it can do that, any reduction of electromagnetic frequency must occur in transit between the star and the Earth. This is evidence that the medium of space exists, and that it has the property of susceptibility to electromagnetic induction.

My proposal is that the electromagnetic frequency of a particle of light decreases exponentially in transit by electromagnetic induction with the medium of space. The same process generates a secondary particle from the primary particle, so that the quantity of energy being conveyed remains constant. (I accept Planck's relationship which says that energy of a quantum of light is proportional to its electromagnetic frequency). This analysis makes it possible to determine the existence of the medium of space by measurements on Earth which compare redshifts with trigonometrically measured star distances (4).

If the exponential decline is confirmed, it would make the stars much closer than present predictions. Stars currently thought to have been present just after the Big Bang were in fact shining just about the same time as our own Solar System was formed i.e. we are contemporaneous. This throws into doubt the temporal sequence of events which the expansion theory predicts, and provides evidence that it is probably not an expanding Universe, but steady-state and so infinite in time and space. In addition, the electromagnetic frequency of light from far-off galaxies would have declined considerably in transit, probably down to microwave or even radio wave frequencies by the time it reached us. It is not surprising, therefore, that the Universe has background radiation in the microwave.

The medium of space must itself be particulate, because there seems to be no way in which the alternative, a continuum, could perform its functions. I have named these particles of space microgranules to distinguish them from other particles. If a particle of light is travelling by electromagnetic induction, this must take place in the exact location of the particle, because otherwise the inductive effect would be spread throughout the continuum. The only model seems to be that orientation occurs in successive microgranules along the line which is the path of the particle of light. The microgranular nature of space is explored in another paper (5).

This brings the argument to the nature of light itself. Light is emitted when an electron accelerates through space. The electron may be accelerating back into its orbit around an atom after being displaced by some means, or it may be accelerating between

ε-particles in a chemical bond. The result is induction of an oriented dipole in the adjacent medium of space. In conventional theory this is an oscillation along a straight line which polarises in empty space as a wave. My model sees it as a circular induction in which successive parts of the periphery of the circle are ejected into space as the particle travels along the bond, and move away at the speed of light. The result in space is not a circle but a short, rotating, polarised spiral with the poles at the beginning and the end, because the front leaves the ε-particle structure before the end. The rate of rotation of the dipole corresponds to its electromagnetic frequency of oscillation. The rotating electromagnetic dipole or RED travels through space until it strikes another particulate structure with which it can resonate (6).

Previous attempts at a particulate model of light, by Newton amongst others, have foundered on the problem of diffraction, which seems so obviously a wave property, even though light definitely acts as a particle too. Hence Einstein's fudging of light as 'wavicles', which soon became photons, and the acceptance of 'wave/particle duality'. However, the RED model shows that diffraction is caused by deflection of RED particles by each other. This gives all the correct observed angles. Light is definitely composed of particles. This is another confirmation of a medium of space which is susceptible to electromagnetic induction.

Objections to the expansion theory of the Universe soon run into relativity, the dilation of time, distance, mass etc, problems which have to be confronted. There are two ways of tackling this. The first is to devise a clock which absolutely cannot undergo time dilation, if dilation means stretching out the intervals between the extremes of a pendulum's swings. This was achieved by devising a clock which depends only on radioactive decay, and does not involve electromagnetic radiation in any way. Clock time is measured by counting the number of sparks given off by a radioactive element, choosing a certain number of sparks as a time-interval and telling the time by calculating how fast this number decreases by exponential decay (7). Time measured by such a clock cannot dilate, because the sparks are completely independent of each other. They depend only on the number of radioactive nuclei at any time. This is confirmed by the fact that the decay curve is exponential. Since the sparks are independent events, it is impossible for the random intervals between them to dilate, any more than intervals between the making of a cup of tea at home and the scoring of a goal in a football match. It is simply that one event occurs later than another. There is nothing to dilate.

The analysis of mathematical physics showed that it does not include time as a continuous variable, whatever the algebraic equations say. The reason is that the variables of algebra must represent numbers at every stage, and these are the numbers of time-intervals. The claimed dilation of time must in fact be dilation of the time-intervals, which is an analytical device. The same is true of length-intervals. But it is not possible to estimate the dilation of intervals by use of the intervals themselves.

In fact time does not exist as such, not like a long piece of elastic which can be stretched. Relativity dilates the time variable as a way of keeping observations consistent in form with the usual non-relativistic equations. There may certainly be an interval between events in the sense that one event may follow another, because the output of one system may become the input of another, but the interval between them is then determined by the rate of transfer of matter and information between them, the

limit of which is the velocity of light *in vacuo*. This is constant. In effect the length of the interval is determined by counting the wavelengths of light in the line between them. Since the velocity of light *in vacuo* is constant, the interval can be expressed either as a time-interval or as a distance-interval (8).

The reason for introducing relativity into the argument is that it is used to explain the hyperbolic increase in force needed to accelerate a particle of mass near to the speed of light. According to the relativistic argument, increased force is required because mass and distance increase according to a hyperbolic function with velocity, and time also dilates hyperbolically at these speeds. This may preserve the form of the equations, but does it make sense? The preceding paragraphs suggest not.

A more convincing argument is that during the acceleration of the particle of stuff it is being increasingly opposed by the medium of space through which it travels, even if all other matter has been evacuated to allow the process to occur. The problem of trying to calculate this effect from a model of conventional opposing forces is that the equations always show eventually that one newton of force equals one newton unit of force, which is not helpful, and so I had to find a new approach. In fact the solution is to define the increased force as an increased number of newtons of force, and the problem is how to calculate that number. I have inserted a new parameter *R* the Inertial Resistance Factor into Newton's Second Law (no less!), so that the force at any velocity is *R* newtons. However, this is not the force required to produce that velocity, but the force required to produce acceleration at that velocity. Evaluation of the parameter *R* was then straightforward by the device of using the inverse of a rectangular hyperbola which has an asymptote, and inserting the known fixed values at slow speeds and the speed of light. The value of *R* was then the ratio of the speed of light to the difference between the speed of light and the velocity in question (9).

This demonstrated that it was possible to construct a model for the observed acceleration of particles of stuff at relativistic velocities which did not involve dilation of the parameters of mass, length and time. It required a much simpler modification of the Second Law. This may be considered to provide additional confirmation of the existence of the medium of space. The next question, however, was why does the velocity have an asymptote at the speed of light *in vacuo*? Where does all the additional energy go? The answer is that acceleration of a particle of stuff causes electromagnetic radiation to be formed by the particle and ejected into space to be soaked up by the walls of the accelerator. Energy which was applied to cause acceleration is instead transported to the walls of the apparatus. At the velocity of light *in vacuo* all the applied energy is immediately radiated away, so that no acceleration can be produced. This is the origin of the strange paradox the velocity of light *in vacuo* is also the limiting velocity for particles of stuff.

The conclusions from this are that the medium of space exists, that it is susceptible to electromagnetic induction and that there is electromagnetic induction between the particle of stuff and the medium of space which produces electromagnetic radiation when the particle accelerates.

Further confirmation of this sort of process is the structure of the atom which I have constructed on the basis of these analyses. When Rutherford discovered that the atom had a positive nucleus in which almost all of the mass was located, the first thought

was that the electrons orbited around the nucleus, like the Earth orbiting around the Sun. This model was dismissed by traditional theory as impossible, because the moving charge would lose energy, and so the atomic structure would run down, which it clearly did not. The problem was 'solved' by Bohr who located the electrons in arbitrary chosen shells, which fitted the spectroscopic data extremely well. No one seemed to have noticed that the Sun did not tire of attracting the Earth by exerting its gravitational forces.

My proposal is that the electron would 'lose' energy if it accelerated in a straight line, because it would generate a particle of light, as described above, but regular circular motion does not constitute acceleration. Acceleration calculated in this context is a geometrical construct for forces in mechanics. Electrons in atomic structures would 'lose' energy only when they accelerated back into orbit after being displaced. This does not happen with uniform motion with electrons, nor for that matter with the Earth. As a matter of interest, another of my analyses suggests that no body in the Universe can travel in a straight line because of the changing forces of gravitational attraction which this entails. So would all these curvatures result in a loss of energy? It would soon become a static Universe.

As a result of these considerations I proposed an electrodynamic model of the atom which went further than abolishing the Bohr shells, but depended only on the fact that like charged particles would avoid each other. In a later paper I proposed a new structure of the nucleus which contained no neutrons, built the nucleus entirely of protons and made up the electrical balance by putting electrons into the nucleus. The intranuclear electrons have been forced into close orbit around the proton assembly under the conditions which apply in stars. Such an atom has both intranuclear and extranuclear electrons (10).

This rearrangement led to the even more radical thought that all the matter in the Universe is composed of just one species of particle of stuff. Its spin was the source of all forces between particles, as described above. I called it the ε-particle (11).

F. Conclusions

If this model of the Universe is correct, the relentless force which drives everything in the same direction, which we call energy, is built into the very fabric of which all matter is composed. The forces which the rotation of ε-particles produces continually pull them closer together. The closer they are, the greater the forces between them. They tend to form clumps which have stability of sorts. However, the Universe is full of movement and turbulence, which bring them into contact, and provide the particles with new opportunities to interact and reach another state of relative stability. What prevents them from coalescing into one large clump is that they are separated by time and space. Clumps which would find one another attractive may be in different places, or since they are continually evolving, they may arrive in suitable conditions for merger at different times. They are ceaselessly trying to form associations, but find themselves stuck in different levels of stability until the opportunity to change presents itself.

We call these states of temporary stability 'energy levels'. Clumps of matter are continually trying to move from a higher energy level to a lower energy level. An

alternative statement of the same phenomenon is that they are continually trying to achieve a state in which the aggregate forces between their ε-particles increase. Expenditure of energy is the work against bonds in the existing order less the work done by the forces pulling it into the more stable arrangement. This will be a negative quantity, because the forces between ε-particles in the new order are by definition stronger than the forces between them in the old; this is why the change occurred. The difference will be released as heat.

The expansion model of the Universe implies that this process continues *ad infinitum*. There is no end to change in this direction, until eventually no further change is possible. All the clumps in which change has occurred are far apart, the thermonuclear reactions have ceased, all is cold. Ironically this may be considered as a state of minimum entropy, as long as it is accepted that the complexity of the product is extreme indeed. It depends on the scale on which you judge order.

However, there is a much more encouraging prospect in the steady-state model which provides a feedback system, though not necessarily on our timescale. When a clump reaches such a size through agglomeration that its internal turbulence is no longer sustainable, it explodes into space, breaking up the structures which have formed inside it and reducing them to various stages of particle association, even as far back as ε-particles. This is the accretion process in reverse which goes back to the beginning again, a feedback system. Not that it may be necessary to reach the supernova stage to reverse all the stages of accretion. The extreme turbulence within a star may produce collisions which destroy nuclei and protons, like the colliders on Earth. The net result is to maintain the proportions of agglomerates in the Universe i.e. heavy elements at a constant low level. This is a dynamic equilibrium on a grand scale.

As far as the components of the model are concerned, there seems to be adequate justification for reinstating the medium of space, now with the property of susceptibility to electromagnetic induction, because it solves problems which are otherwise difficult to address. One which has not been mentioned above is the rate of propagation of the force of gravitational change. This may provide an alternative to some aspects of general relativity. The astronomical measurements proposed to demonstrate the exponential decline of the electromagnetic frequency of radiation in transit through space should confirm its existence.

The existence of particles of stuff at the level of electrons is beyond dispute, but it remains to demonstrate their rotation or at least the claimed effects of their rotation. This might be possible by observing the distribution of directions of electrons in a stream, whether they all follow a straight line or are normally distributed. Still better, to avoid group interactions, it would be desirable to send them singly in a straight line to observe whether they are deflected to left or right. There are hints in the uncertainty principle that they might not follow the line. In addition particles which are detected by breaking up protons in colliders ought to be single ε-particles or fragments of stuff which contain whole numbers of ε-particles, making allowance for ‘electric charges’.

Light particles are well known i.e. photons, but each particle of redshifted light from stars should have two or more electromagnetic frequencies, the redshifted electromagnetic frequency which is already observed and a secondary electromagnetic

frequency which is generated by induction to maintain the energy being transferred through space constant at the original level, which is of course the electromagnetic frequency generated on Earth.

Finally, the angles of chemical bonding of atoms in molecules, which is often quite complicated, may be directly related to their structure at the level of the ε-particle.

Thus the generalisations about the Universe which have been commonly accepted may be misleading. Clausius was wrong to assume that all natural processes are irreversible. He reckoned without the stars and feedback in the form of explosion. Similarly Eddington was wrong to describe entropy as time's arrow. It all depends where you are, and when. What actually occurs is that the output of one system becomes the input of another *ad infinitum*. The output may be explosion, the input may be the beginning of the process all over again.

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Papers by A.C. Sturt

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