8

The Cosmic World

The Solar System

In the previous chapter we spoke of creation by reference to the smallest particles from which matter is assembled. Now we turn to the cosmic scene and examine the question of creation of the sun and its planets.

It is conventional to begin with a hypothesis. There was a beginning when the sun was formed by accretion of cosmic dust. Gravity brought the matter together and it nucleated to form the sun. The great mystery is how it all started and another mystery is how the planets formed once the sun became established. The unified physical account presented in our previous chapters gives us a new starting point for addressing these issues, because it has provided a phenomenological account of the nature of gravitation. Gravitation has become dependent upon the structured nature of the vacuum medium. This allows us to contemplate an analogy elsewhere in physics, one, indeed, from which the primary inspiration for the author's development of this whole theory sprang. The analogy arises in the state of ferromagnetism.

The electric interactions between atoms in a crystal can, under certain circumstances prevalent in just a few materials, generate forces we associate with ferromagnetism. The law of electrodynamic interaction developed in Chapter 1 finds application in the author's interpretation of ferromagnetism.* It is the same law as that used to explain gravitational force in this work. Furthermore, we have seen that the gravitational force depends upon the parallel motion of the graviton system, a condition which depends upon ordered motion associated with the lattice structure of the space medium. Random motion in a disordered lattice would suppress the gravitational action.

* H. Aspden, *Physics without Einstein*, Sabberton, Southampton, England, p. 48 (1969).

The analogy applies exactly within the ferromagnet. Ferromagnetism vanishes at the Curie temperature when the thermal condition of the crystal lattice is sufficient to upset the interaction forces and upset the critical energy balance favouring ferromagnetism. Logically, therefore, if there was a beginning when cosmic dust began to nucleate to form the sun, then that beginning might have been an event when the space lattice changed from a state of disorder to one of order. Gravitation then appeared, to form the astronomical objects we see today. Conversely, one day we might expect something to trigger the onset of disorder and gravitation may vanish, causing the sun to disintegrate and disperse its matter. Eventually order would be restored and we would begin a new cycle of creation.

This may seem to be mere speculation, but it is speculation with better foundation that the usual nebular hypothesis of creation. The reason is that, because gravitation suddenly appears, a special phenomenon will occur, which could not be foreseen in a system in which gravitation has always existed but matter is created gradually and then nucleated.

Dispersed matter spread over a vast region of space could be expected to contain at least some heavy positive ions and a corresponding number of negative electrons of relatively small mass. The mutual gravitational action of a gas containing such asymmetry in the distribution of charge and mass would cause an initial sun to form with a positive charge Q given by $G^{\frac{1}{2}}M$, M being its mass and G the constant of gravitation. The reason for this is that the mutual gravitational force between two heavy ions causes them to accelerate towards one another at a much higher rate than that operative between two electrons. It only needs a very small degree of ionization to ensure this build-up of central positive charge. The formula is derived in Appendix I.

Eventually, of course, the electrons will arrive to cancel the positive charge and assure the electrical neutrality of the body formed. In the meantime, these electrical effects are all that is necessary to set the character and principally the rotation of the newly formed sun. Also the eventual electrical neutralization by the inflow of electrons induces the creation of the planets.

In explaining these processes, the question of planetary creation will be addressed first. The source of the sun's initial angular momentum (denoted X) will be explained in the next section. Since angular momentum is conserved in the solar system, the value of X is that we measure today as the total angular momentum of the sun's rotation and the planets in orbit. Let R denote the radius of the sun in its primordial form. Given Q, R and X, we can write the following equation:

$$kQ^2/R^2 = X^2/mR^3 \tag{212}$$

where k is a factor introduced for reasons which will become apparent as we proceed, and m is a mass quantity other than M.

The equation relates the Coulomb interaction between the core charge $+Q$ and the balancing charge $-Q$ on the assumption that the latter charge is held at the surface of the system and associated with matter of mass m which has absorbed all the angular momentum X. k is a factor which qualifies these assumptions. The expression X^2/mR^3 is merely the centrifugal force of the mass m.

R. A. Lyttleton* in his book *Mysteries of the Solar System* has explained how magnetic forces exerted within a system of charge by its rotation and self-gravitation will force angular momentum outwards. Thus the transfer of the angular momentum X to a concentrated surface zone is understandable. In a sense this can be thought of as a phenomenon similar to the gyromagnetic reaction already discussed. The reaction angular momentum of the field absorbs angular momentum from the centre of the body and the primary balance of angular momentum is driven to the outer periphery of the rotating system, all as a result of the diamagnetic screening effects within the electrical core.

Once the equation (212) is established, the body is primed to create its satellite system. All that has to happen is for the Q charges to neutralize by slow discharge and as this happens the satellite matter of mass m will leave the main body. It will take up an eventual orbital position governed by gravitational balance between $M-m$ and m and the orbital centrifugal forces of m.

This is all rather simple and it lends itself to immediate verification because we can develop a formula for m/M which can be checked with observation. Note that $GM^2 = Q^2$ and write M as $4\pi\rho_m R^3/3$, where ρ_m is the mass density of the parent body. Replace X by $2MR^2w/5$, the formula for a uniformly dense sphere of mass M and radius R rotating at angular velocity w. Then (212) can become:

$$m/M = 3w^2/25\pi\rho_m Gk \tag{213}$$

* R. A. Lyttleton, *Mysteries of the Solar System*, Clarendon Press, Oxford, p. 34, 1968.

Now apply this to the sun, noting that the initial angular velocity w of the sun is found by summing the present angular momentum of the solar system and computing w from the above expression for X. This is shown in Appendix II to make w a little greater than 8 10^{-5} rad/s. G is 6·67 10^{-8} cgs units and ρ_m of the sun, assuming its present value still applies, is 1·4 gm/cc. We then find that if $k=2$ the planet/sun mass ratio given by (213) is 1/764. The observed value of this mass ratio is 1/745.

Next, let us check this same formula with the Earth's own satellite, the moon. The Earth has a ρ_m value of 5·5 gm/cc and w of the initial Earth before the moon was ejected was, according to Lyttleton,* 5·5 hours per revolution or 3·2 10^{-4} rad/s. This is easily verified by adding the moon's angular momentum in orbit around the Earth to that possessed by the Earth today. In this case we find that if $k=1$ we obtain from (213) a value of m/M of 1/83. The observed moon/Earth mass ratio is 1/81.

It follows that we have a viable theory of creation of our planetary system if only we can explain why $k=2$ for the sun and $k=1$ for the Earth. This is a vital clue to the understanding of the cosmic medium and the source of the sun's initial angular momentum. We find that we need to explore the field energy properties of the space medium of our earlier chapters, but on a cosmic scale.

Cosmic Space

Gravitation has been shown to be an electrodynamic action involving the graviton system of the space medium. The interaction energy associated with this action had two aspects. Firstly, there was a mere deployment of electric field energy between the interacting charge system and the space displacement system. This involved the Neumann potential. Secondly, and governed by this deployment according to the Neumann potential, there was a related amount of energy supplied to the kinetic reaction. This is a kind of thermal energy, generally known as magnetic field energy.

As might be expected, therefore, when matter comes together under gravitational attraction the loss of gravitational potential results in kinetic energy which we assume generates heat and is dispersed. Our observations relate only to the cause, the mysterious force of gravitation, and the ultimate effect, the creation of heat. What happens in

* R. A. Lyttleton, *Science Journal*, **5**, 53 (1969).

the intervening stages is not normally considered. It seems probable that if gravitation is a process arising from the involvement of the structured vacuum medium, then the kinetic energy could, in an intermediate stage, be energy associated with motion of that medium. We can then contemplate two kinds of motion, the thermal agitation of the lattice particles and the ordered rotary motion of a whole vast region of the lattice. The disturbances caused by matter are unlikely to affect the universal energy content of the ordered harmonious motion of the space medium depicted in Fig. 22, at least as far as matter acting on matter is concerned. In our next chapter we will see some interesting consequences of gravitational interaction between matter and the lattice of the space medium.

Here, then, is another clue. The energy available from the gravitational accretion of matter forming the sun did not go directly into heat. It passed through a phase in which it sustained the kinetic energy of a body of space itself, as if the space medium associated with this accreting matter were able to move to absorb this energy. The photon unit of our earlier discussions demonstrated the scope for bodily rotation of space within an enveloping non-rotating space. The question posed then is the source of the angular momentum. Now this we have in abundance because the whole C-frame and G-frame system of space, as depicted in Fig. 22 possesses angular momentum on a vast scale. The problem is how to tap this source. It is here that we find the electrical action of the temporary charge Q of the initial sun performs a key role.

In Chapter 2 we saw that a charge would cause displacement of the space lattice, effectively transferring Coulomb energy to the corresponding Coulomb form of charge displacement in the space medium. The charge Q must cause such a displacement in the whole region filled by the accreting solar substance. This system has a special property. It is spherically symmetrical and the displacement is, or rather tends to be, radial from the centre of the system. As electric potential it always tends to minimize and degenerate into kinetic energy. This is not usually possible in an ordered system because it would mean contravening Newton's Third Law of Motion and introducing unidirectional linear momentum. It becomes possible in such a system in the presence of a radial field extending over a large range, because we can have rotation by borrowing angular momentum from the fund of angular momentum of the space medium. Thus the Coulomb energy of the charge Q can find its way into the kinetic energy of rotation of the space medium, transiently, pending the neutralization by $-Q$, and so fix a rotation which is shared by the sun itself. Eventually, much of this kinetic energy is returned as the neutralization process occurs. Some finds its way into normal thermal energy of matter and is dispersed. Perhaps the major part goes into the galactic motion of the sun. However, a small amount is probably retained and sustains the rotation of the space medium within the present sun.

This account lends itself to analysis and, once again, we can take comfort from the very pertinent numerical results which emerge.

Write ρ_0 as the mass density of the lattice system of space which is set in bodily rotation on a large scale. We assume spherical symmetry to permit such rotation without collision with surrounding lattice. Then, taking R now as the radius of such a sphere, the kinetic energy of this rotating space is given by:

$$(1/5)(4\pi R^3/3)\rho_0 w^2 R^2 \tag{214}$$

w is now the angular velocity of this space region.

It is coextensive with a region in which the charge Q is dispersed uniformly and cancelled by displacement generating a uniform space charge of opposite polarity and density σ'. Thus, the electric energy can be calculated as:

$$(3/5)(4\pi R^3/3)^2(\sigma')^2/R \tag{215}$$

We would like these to be equal to signify the possibility that the electric energy may have transferred to kinetic form, assuming that we can find a way of justifying such an action. This would give:

$$\rho_0 w^2 = 4\pi(\sigma')^2 \tag{216}$$

Now we search for such an action. We imagine that the space rotation is about an axis parallel with the universal direction of the spin vector Ω of the space medium. Consider a lattice particle of charge q describing its orbit of radius r at this angular velocity Ω, with its centre carried at speed wR about the remote central axis of the rotating space region. This is illustrated in Fig. 38.

The lattice particle is held in synchronism with all the surrounding particles in the non-rotating space environment as well as with those elsewhere in the rotating region. This puts a constraint on the particles due to their motion about the remote axis. They are displaced in a radial sense in a plane at right angles to this axis, the displacement being inwards or outwards according to the direction of rotation of the space region.

Inspection of Fig. 38 will show that when the two motions are compounded the radius of the particle orbit must vary between

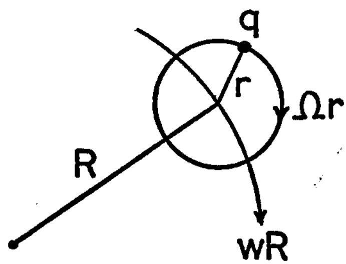

Fig. 38

$r(1+wR/\Omega r)$ and $r(1-wR/\Omega r)$ for the condition of synchronous motion to apply. In effect, the particle is moving at a steady speed in orbit about a new centre radially displaced from the remote axis through a distance wR/Ω. This corresponds to an induction of charge of density σ' given by incrementing the radius of a disc of charge density σ by this amount wR/Ω:

$$\pi(\sigma')R^2 = \pi\sigma[(R+wR/\Omega)^2 - R^2] \tag{217}$$

From this:

$$\sigma' = 2\delta w/\Omega \tag{218}$$

The value of σ is, of course, the charge density of the continuum, apart from a change of sign. We know from (132) and the preamble just before (132) at the beginning of Chapter 6 that:

$$m\Omega^2 = 8\pi\sigma q \tag{219}$$

where m is the mass of a lattice particle. As a mass density this becomes $m(\sigma/q)$, which is $8\pi(\sigma/\Omega)^2$ from (219). It is then of interest to see that if we double this, taking account of the equal mass density of the G-frame system, and equate the result to ρ_0, we obtain from (218):

$$\rho_0 w^2 = 4\pi(\sigma')^2 \tag{220}$$

This is the equation (216).

What this means is that the electric energy given by (215) can be converted into the kinetic energy given by (214) by the development of rotation which induces charge displacement owing to the synchronizing constraints, this latter charge displacement replacing the normal direct field displacement but deriving its energy from the pooled energy of the Ω spin of the space medium generally.

The formula (220) gives us immediately a value for w determined by the other parameters of the creation process. We know that σ' is $G^{\frac{1}{2}}\rho_m$. Thus:

$$w = \rho_m(4\pi G/\rho_o)^{\frac{1}{2}} \qquad (221)$$

This is independent of R.

Thus a whole expanse of the space medium begins to rotate at this angular velocity w, determined by the mass density ρ_m of the accreting matter. Electrical effects are balanced. The system goes faster and faster as it shrinks in size to the compacted form of a solid body or a gaseous body in equilibrium under its own pressure. The value of w at that time determines how fast the body rotates when created. The value of ρ_o needs some adjustment for this involvement of ρ_m, but we neglect this in applying formula (221), because our theory tells us that ρ_o is appreciably higher than the normal mass density associated with matter. Indeed, we will now calculate ρ_o using the data for w and ρ_m presented above in calculating the masses of the satellite systems of the sun and Earth.

(221) as applied to the sun gives ρ_o as 257 gm/cc and as applied to the Earth gives ρ_o as 248 gm/cc. These results are gratifyingly of the same order. However, better than this, there is general agreement with the absolute derivation of ρ_o from the main theory. We know that ρ_o is given by:

$$\rho_o = 2m/d^3 \qquad (222)$$

As we saw in Chapter 6 from (155) the mass m is 0·0408 times the mass of the electron, or 3·72 10^{-29} gm. The value of r/d was about 0·3029 with r as $1/4\pi$ of the Compton wave-length. Thus d is 6·37 10^{-11} cm. From (222) ρ_o is 288 gm/cc.

It is evident from this that, given the basic theoretical constants of the space medium determined in this work, we can, from (221) and (213), account for the angular momentum and satellite/mother-body mass ratio of planetary systems. The only parameter needed is the mass density of the matter which accretes to form the mother body. There is but one proviso. This arises from the perplexing problem of the factor k in (213). Why should k be 2 for the formation of the sun's satellites and 1 for the formation of the Earth's satellite?

Is this a measure of the uncertainty in the analysis, a 50% factor, or is there some special design in Nature's fabric?

The answer appears once we consider the domain concept of space.

Space Domains

We have used an analogy with ferromagnetism in the introduction to this chapter. This analogy will now be extended to the concept that space has two forms. Our basic space medium was found to have lattice particles immersed in a continuum of charge of opposite polarity. It had a C-frame and a G-frame rotating in the same sense. Thus it involved asymmetry of two kinds, an electrical asymmetry and an angular momentum asymmetry. The need for universal balance suggests that there may be other domains in space within which the lattice particles have the opposite polarities and the continuum also has its charge reversed. Also the direction of the angular momentum vector linked to the parameter Ω could change from one domain to the next. In the universe overall there could be balance, that is no net angular momentum and as many anti-lattice particles as lattice particles. A vacuum of space and anti-space domains is suggested.

Potentially each star, or pair of stars if binary, is a candidate for its own space domain. There is unlikely to be any gravitational action between matter in separate space domains. Hence gravitational interaction between stars would seem to be precluded on this model. This is not so, because, although stars formed in different domains may be de-coupled gravitationally at the time they were formed, they migrate across domain boundaries and they are gravitationally coupled when sharing the same domain. A loosely-connected gravitational action can then be envisaged as an average effect acting only between nearby stars. It is as if they are coupled by a chain subjected to sporadic jerks so that some links are disconnected at any given moment. Such a chain can, nevertheless, convey forces, especially if each link has the inertia of a star.

The need for such domains is soon apparent when we trace the source of the angular momentum needed to create a star. Now, as was explained by reference to equations (97) and (98) in the chapter on quantum mechanics, an energy E fed to the space medium involves an angular momentum addition of E/Ω and half the energy goes into kinetic energy locally. Conversely, if the space medium yields an energy E as gravitational energy it loses angular momentum E/Ω and kinetic energy $\frac{1}{2}E$. This angular momentum is assumed to go to the star.

On this basis we can write the gravitational potential of a lattice particle of mass m as:

$$\Phi m = \Omega H_m \tag{223}$$

where H_m is the angular momentum released by each unit cell of the space lattice. This is an angular momentum of $\Phi m/\Omega$ per mass m or $\frac{1}{2}\Phi\rho_0/\Omega$ per cc. Φ is the gravitational potential of a star of mass M distant R from the region under study. Thus the total angular momentum of the star becomes:

$$(AM) = \int_0^D \tfrac{1}{2}(GM/R)\rho_0(4\pi R^2)(1/\Omega)dR \tag{224}$$

This supposes that the domain is spherical and of radius D. The result is:

$$(AM) = \pi GMD^2\rho_0/\Omega \tag{225}$$

D is given by:

$$D^2 = S\Omega/\pi G\rho_0 \tag{226}$$

where S is the parameter angular momentum/mass of the star.

Now from (221) we can show that for any star this parameter S is simply related to mass/radius. This does not vary much between stars. The sun is typical and reliable as an estimate of the order of magnitude of this quantity S. For the sun the angular momentum is about $3{\cdot}2\ 10^{50}$ cgs units (at creation) and M is $2\ 10^{33}$. Thus, from (226) with G as $6{\cdot}67\ 10^{-8}$ cgs and Ω as $7{\cdot}8\ 10^{20}\ s^{-1}$, as known from the quantum mechanical chapter, we find a value of D dependent upon ρ_0. This mass density ρ_0 has just been shown to be 288 gm/cc. Accordingly, D becomes $4{\cdot}6\ 10^{20}$ cm or 480 light years.

We may expect the space domains to be measured in hundreds of light years from this account. Note that the domain boundary limits on the integration are necessary in (226). Otherwise the angular momentum fed to the star would be infinite. It increases as D^2. If, on the other hand, we say that the domain extends far enough to include numerous stars in proportion to D^3 then the angular momentum increases in proportion to D^5 and the angular momentum per star is still proportional to D^2. There must then be domains bounded in the manner indicated.

Today we find stars clustered together in regions, as if the gravitational effects between adjacent stars have brought them in closer proximity than at creation. There are several stars close enough to the sun to lie within the single domain just discussed. Such speculation, however, runs contrary to the popular idea of the expansion of the universe, and we will not develop this theme. Instead, we will adhere to the domain theory now developed and consider events as the star crosses a domain boundary.

We know that during the transit there is a breakdown of gravitational action across the boundary. This we will discuss later from the viewpoint of events on Earth as our Earth is affected by the corresponding phenomenon. The main point is the balance of the charge Q. Until the primordial sun forms its satellites it rotates with its full initial angular velocity. Thus Q is preserved in the core in balance with the radial displacement effect discussed by reference to Fig. 38. The charge $-Q$ has settled at the periphery of the sun and is kept there by the balance of charge in the space medium. Note that the radial displacement of lattice charge in space creates the uniform charge distribution within the rotating space medium but it also leaves a shell of charge at the surface. The state of electrical balance is that shown in Fig. 39.

A key issue is whether the material substance of the body has a larger radius or a smaller radius than the rotating space region. We have assumed them to be coextensive but they may not be quite coextensive. Much will depend upon whether the body developed its form in good time before the arrival of negative charge. If it developed in stages then the space region could well be of smaller radius and the body thereby inclined to shed a higher proportion of its mass as a satellite.

Therefore, in Fig. 39, both alternatives are shown. The full circle depicts the form of the body and the broken circle depicts the form of the space region. There is charge balance in both of the upper figures.

Now let us see what happens when the whole system finds itself on the other side of a space domain boundary. This is shown for both systems in the lower part of Fig. 39. The space charges have reversed because the rotation of the space medium has retained its inertial effects. We presume that the direction of the spin vector Ω

is much the same between adjacent domains. There is now a complete unbalance of charge. Magnetic effects due to rotation will appear and transfer angular momentum to outer regions and the matter charge $-Q$ will be set in centrifugal balance with the Coulomb interaction. In one case, however, where the matter charge $-Q$ is within the space boundary, the Coulomb interaction is

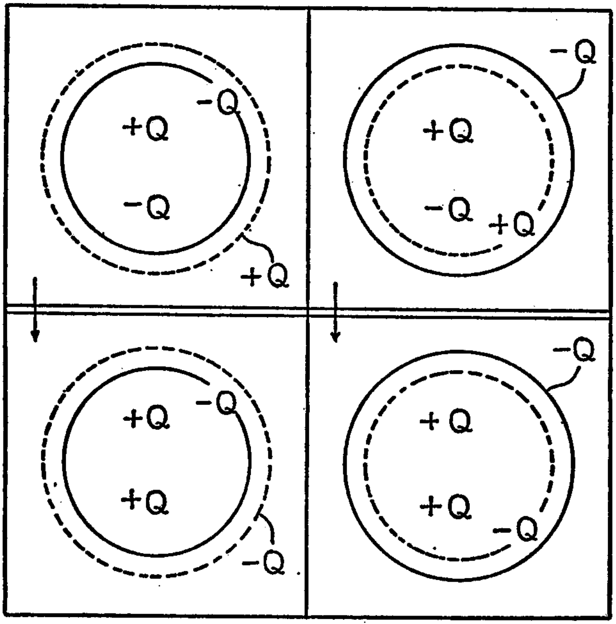

Fig. 39

$2Q^2/R^2$, whereas in the other case, where the matter charge $-Q$ is located outside the space boundary, the Coulomb interaction is Q^2/R^2. It all depends upon whether the $-Q$ charge at the space boundary is effective in producing any force on the matter charge. Thus the factor k in (213) will be 2 for the sun and 1 for the Earth, under these circumstances. No doubt the matter shed by the Earth in forming the moon resulted in the Earth's space boundary settling outside the eventual form of the Earth.

The key assumption made above is that the centrifugal balance between charge and surface matter is established before the system decays by electric discharge. This is very probable when one