5. *Gravitation*

The Nature of Space–time

It has been said by Hoyle (1964) that "there is no such thing as gravitation apart from geometry . . . the geometrical relationship between different localities is the phenomenon of gravitation". If we fall down it is because we are involved in geometry. It seems absurd to say this, but it makes sense according to Einstein. Gravitation is deemed to be a phenomenon due to the interplay between matter and space–time. Matter distorts the space–time metric. In Einstein's theory this distortion finds a way of expression which, in effect, makes gravitation a geometrical property of a mathematical formulation of space–time. Below, it is sought to portray the metric of what we call space–time in a truly physical form with a view to explaining gravitation in more meaningful terms.

It is convenient, by way of introduction, to imagine space as if it is a three-dimensional lattice of physical substance. Any physical portrayal of space with an added time dimension must still be three-dimensional even though mathematical space can be multi-dimensional. As already suggested in Chapter 4, a simple way of introducing time is to assume that the lattice has a rhythmic harmonious motion such as a regular cyclic motion. Since space–time is, almost by definition, the frame of reference for light propagation and the famous Michelson–Morley experiment shows that an observer at rest in the earth frame shares the motion of the light reference frame, the lattice of our space–time moves with the earth. However, there is no evidence that space–time has linear momentum. Therefore, it is probably true to say that the centre of mass of any substance forming space–time can be deemed to be at rest in an absolute frame of reference. Now, how can this be possible while we have motion of the space–time lattice in a linear sense with the earthly observer? This is a most basic question in physics.

The answer is equally basic and quite logical. If the lattice moves but the centre of mass is at rest, something associated with the lattice must be moving in the opposite direction. One of the earliest observations connected with gravity was that the water on the earth always moves downwards towards the earth's centre. Yet, the levels of the seas tend to remain constant as if their centres of mass remain a fixed distance from the centre of the earth. As is well known, there is something associated with the water moving upwards and this is water vapour. Whatever it is that forms the propagation velocity determining lattice of space–time may move but there may be a counter-motion of it in different form which does not affect the propagation properties. It can be said that with the earth's water we need the sun's heat to sustain the circulation. This implies energy and resistance in the space–time analogy. However, in reply it can be argued that the lattice has its rhythmic motion and that if parts of the lattice come loose these parts could deploy their motion to speed them in the reverse direction so fast that they hardly disturb the properties of the lattice as a whole. This is depicted in Figs. 5.1 and 5.2. Fig. 5.1 shows a lattice which may be regarded in the rest state.

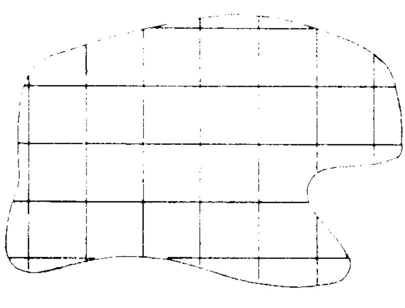

Fig. 5.1

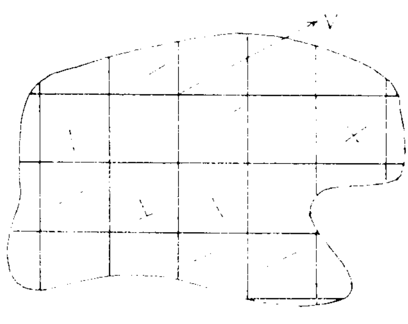

Fig. 5.2

It has a cyclic circular motion, not shown, which is like a vibration and which does not affect this argument. The lattice is the *E* frame of Chapter 4. The boundary is an arbitrary boundary enclosing any volume of space. Now, if we imagine that somehow this lattice moves with a velocity v, say, as shown in Fig. 5.2, it may shed some of its substance, expanding a little, and thereby allowing linear momentum to be balanced by the reverse motion of such substance. This reverse-moving substance is shown by the dotted elements in the figure. They are not held in a regular lattice pattern and have lost their vibration state. Thus, they may use their kinetic energy to sustain their high velocity motion in the inertial frame in the direction opposite to v. In the same volume of space such lattice motion could occur indefinitely because this substance could reform into lattice structure at the rear boundary of the lattice and yet constantly hold the centre of mass of space–time fixed in the inertial frame (vibration being ignored).

It is thus seen that in any volume of space we *can* have motion of the light reference frame without motion of the centre of mass of the carrier medium. The above account is not hypothesis. It is the only feasible physical answer to a basic problem in physics. We cannot be too rigid about what we mean by "lattice", and the question of its physical nature will be kept open until, later in this chapter, we adduce support for the above proposal. For the moment, it suffices to say that as long as one is prepared to use the words "space–time" we must be prepared to recognize that something termed "space–time" exists, as otherwise we would not need to refer to it. It is elusive. Though it apparently has mass properties it does not reveal itself in linear momentum interchange. It offers no resistance, inertial or frictional. We know that it does provide the carrier medium for light waves and that its frame of reference moves with the earthly observer. We suspect that its distortion by matter is the cause of gravitation. Furthermore, in the previous chapter it was shown that it had its own harmonious motion, two frames being, in effect, in dynamic balance. It was shown to have angular momentum yet could store energy without addition of angular momentum. It was suggested that it could have discrete units of its lattice structure in rotation to cause electromagnetic disturbance. These are our starting points in an effort to apply a physical interpretation of space–time to the explanation of what appear to be gravitational properties.

Tests of Einstein's General Theory

Einstein's General Theory of Relativity is supported by four quantitative tests. These are:

(a) The solar red shift;
(b) The deflection of stellar light by the sun's gravitational field;
(c) The slowing down of radar waves when subject to the sun's gravitational field; and
(d) The account of the anomalous component of the perihelion motion of the planet Mercury.

Tests (a), (b) and (c) have never really been supported by measurements accurate enough to be conclusive. Recently, measurements reported by Gwynne (1968) according to test (c), however, do look like affording fairly good evidence in favour of Einstein's results. Test (d) is the most important. It has really carried Einstein's General Theory for many years, though, as will be explained later, it has been challenged with some success in the last few years.

Now, in fact, tests (a), (b) and (c) are all closely related because they all stem from a common aspect of Einstein's theory which requires the velocity of light to be smaller in a gravitational field. As Fock (1964) interprets the equation:

$$n = 1 + 2GM_s/Rc^2 \tag{5.1}$$

"The fictitious medium of refractive index n is optically more dense in the vicinity of the sun than it is far away from it. Therefore, light waves will bend around the sun. . . ." In the equation, M_s denotes the mass of the sun and R is distance from its centre of gravity. G is the constant of gravitation.

It follows that if we can now derive the equation without using Einstein's Theory, any evidence supporting tests (a), (b) and (c) equally supports this new theoretical analysis. We have an entry to the problem because early in Chapter 4 it was shown that the velocity of light depended upon the energy density of space–time. Test (d) concerning the planetary motion is more challenging. However, we have our entry here, too, because, although space–time has no linear momentum property, it would seem that the lattice in Fig. 5.1 could rotate about a central axis without having to shed any of its substance and while keeping its centre of mass at the same point in the inertial frame. In the study of planetary motion we are dealing with angular momentum. Perhaps the angular momentum of the space–time in a planet cannot be ignored. If we allow for it, perhaps we can explain the problem with Mercury's perihelion.

Before proceeding, it should be mentioned why the red shift test is embraced by (5.1). A photon has conserved momentum $h\nu/c$ and the fundamental quantum of a photon is really momentum. It is not energy. This has been explained near the end of the previous chapter. With Planck's constant h invariant, the value of ν for a particular quantum will be set in proportion to c at the source. Thus ν, the radiation frequency, which must be constant throughout transit (ignoring any doppler effects), will be determined for any characteristic spectral emission according to the way c is determined *at the source*. In a strong gravitational field, according to (5.1), c will be reduced because n is increased, making ν lower also. It follows that light spectra emitted by the sun, which has a gravitational field at its surface much stronger than that on earth, will have lower frequency than spectra of earthly origin. This phenomenon is termed "red shift" because it corresponds to a displacement of spectral lines towards the red end of the spectrum.

In Chapter 2 it has been suggested that gravitation is a magnetic phenomenon. This is our basic assumption. We take gravitational energy to be magnetic energy. In Chapter 2 it was argued that magnetic energy was a condition of depletion of the primed energy level of the aether or space–time, as it is termed here. Magnetic energy is a *deficit* of kinetic energy in space–time, that is, a reduction of the space–time kinetic energy from its normal level. This kinetic energy is, of course, the energy of the harmonious rhythmic motion of the space–time lattice. Thus, following the analysis in Chapter 4, we may calculate the kinetic energy density of space–time as:

$$\tfrac{1}{2}(2\rho)(c/2)^2 \qquad (5.2)$$

since the E and G frame each have the same mass density ρ and each move at velocity $c/2$. A reduction in this energy density by φ corresponds to a reduction of c by δc, where:

$$\varphi = \tfrac{1}{2}\rho c\delta c \qquad (5.3)$$

In such a region the refractive index n of the space–time medium, normally deemed to be unity, may be expressed as:

$$n = c/(c - \delta c) \qquad (5.4)$$

From (5.3) and (5.4):

$$n = 1 + 2\varphi/\rho c^2 \qquad (5.5)$$

On the above argument about the relationship of kinetic energy change and magnetic or gravitational energy, φ may be equated to the gravitational potential energy per unit volume. This can be expressed by:

$$\varphi = GM\rho/R \qquad (5.6)$$

where M is a mass developing the gravitational field and R is the distance between M and the region of the E frame under study. It is to be noted that only mass in the E frame has gravitational properties. This follows from the discussion of the Principle of Equivalence in Chapter 4. For this reason the mass density ρ of only the E frame is used in the above equation. From (5.5) and (5.6) the equation (5.1) is obtained, showing that this theory leads directly to the same result as Einstein's without recourse to the geometry of a four-dimensional or multi-dimensional space–time medium.

To digress a little, it is important to bear in mind that this analysis has been pursued by reference to kinetic energy changes, even though it was shown in the analysis of space–time energy in Chapter 4 that it is really potential energy and not kinetic energy which is stored by doing work against the restoring forces between the frames of the space–time metric. It was there explained how it was equivalent to work from the kinetic energy analysis. This aspect of the theory will be further considered when the derivation of the fine structure constant is discussed in Chapter 6.

We turn next to the fourth test of Einstein's General Theory to see what alternative can be offered by the straightforward physical approach being pursued in this work.

Mercury's Perihelion

The mainstay of Einstein's theory is the explanation for the small anomaly in the motion of the planet Mercury about the sun. Newton's laws fail to provide the exact estimation of the perihelion motion of Mercury due to the perturbations of other planets. They fail if the assumption of conserved angular momentum is correct as applied to the matter constituting the solar system. The measured anomalous value of the perihelion advance for Mercury is 42·56 seconds of arc per century. Einstein's theory, which is inflexible in its estimation, gives a theoretical value of 43·03 seconds of arc per century. This is a most remarkable result. However, the measured value is really the difference between the measured motion of the planet and predictions of its motion as perturbed by the masses of other planets. Some of these masses have been of questionable accuracy. Least certain, in the past, has been Mercury's mass but this has had no effect on the calculation of its own perturbation, though it has made estimates for Venus's perihelion anomaly uncertain. Strangely, however, the calculations of the measured anomaly for Mercury have failed to cater for the possibility that the sun itself may not be oblate. Being such a massive body even a small degree of oblateness can cause a small perturbation affecting the anomaly. The problem of solar oblateness has caused Einstein's theory to come under attack in recent years. Dicke (1965) has argued that if the sun is oblate by as little as 0·005%, then the numerical estimate afforded by Einstein will be in error by 10%. Dicke said: "It must be emphasized that Einstein's General Relativity is without a single definitive quantitative test until the possibility of non-negligible solar oblateness is excluded." Then Dicke (1967) reported measurements of solar oblateness which point to a discrepancy of 8% in Einstein's result. The sun must, of course, be oblate because it is rotating and is gaseous. Centrifugal forces at its equator will, of necessity, develop the oblate form. Furthermore, the expected oblateness on this account is of the order measured by Dicke. Indeed, if the sun were not oblate we would be confronted with a problem of more significance than that presented by the perihelion anomaly.

It is submitted that, since three of the four tests of Einstein's theory have ready alternative explanation and since the theory fails to retain its validity in respect of the fourth test (and if invalid for one it is invalid for all), we must of necessity reject the General Theory of Relativity. The perihelion anomaly has to be re-examined and perhaps the best approach is along new fundamental lines. It seems unlikely that one can modify Einstein's ideas in some way, when after fifty years of effort to expand his theory to unify physics little of value has emerged. From the fundamental point of view it is important to ask whether we are concerned with an anomaly in gravitation or an anomaly in mechanics. Attention is diverted to the question of the conservation of angular momentum in the planetary system, bearing space–time in mind.

Rotating space–time has angular momentum whereas it does not have linear momentum. The reason is that the lattice system shown in Fig. 5.1 can rotate about a central axis without disturbing the lattice structure of any surrounding space–time lattice. It cannot move linearly without causing such disturbance unless it crumbles away at the interface and some of its substance travels in the reverse direction to reform behind the moving lattice. Alternatively, the lattice of the space–time system in the path of the moving lattice may crumble and be deployed in the same way. The result is the space–time property of no linear momentum but possible angular momentum.

Now, consider the motion of a spherical volume of space–time about a remote axis. If this space–time is rotating at a steady velocity within its own spherical bounds there is a steady angular momentum due to this. Also, however, we have to consider what happens to the displaced lattice substance in the reverse motion. This moves about the remote axis in an arc, whereas the centre of mass of the lattice is effectively a point in which the lattice mass in motion is concentrated. In effect, the lattice moves in one direction with its angular momentum about the remote axis given by $MX^2\omega$, whereas the lattice substance in reverse motion has an angular momentum in opposition of $M'(X^2+2R^2/5)\omega'$, where $M\omega = M'\omega'$. Here, M is the mass of the lattice and ω its angular velocity about the remote axis distant X from M. M' is the mass of the displaced substance and ω' its angular velocity in the reverse direction. This has involved the use of the parallel axes theorem. It is like having a compound pendulum having a spherical bob of radius R fixed to the arm of the pendulum in counter motion with a simple pendulum having a pivotal spherical bob rotating at a steady speed. Assuming the bobs are the same size, the total angular momentum per unit mass is evidently:

$$2\omega R^2/5 \tag{5.7}$$

If this argument is applied to the space–time contained within a planet rotating about the sun it becomes clear that (5.7) is a measure of the angular momentum of space–time due to such motion. If the orbit of the planet is truly circular, meaning that ω is constant, then the space–time angular momentum is constant, as is the component due to the rotation of the planet about its own axis. Then it would pass unnoticed. On the other hand, if the planet moves in an elliptical orbit so that ω varies we must expect space–time to make a contribution to the balance of angular momentum in the matter system itself. It is easy to calculate the effect of this contribution.

The Newtonian equation representing the motion of a planet around the sun, neglecting perturbation by other planets, is given in polar co-ordinates by:

$$\frac{d^2}{d\theta^2}\left(\frac{1}{X}\right)+\frac{1}{X}=GM_s/H^2 \tag{5.8}$$

M_s denotes the mass of the sun, taken as a point mass much larger than that of the planet, G is the constant of gravitation and X, θ are the polar co-ordinates. H is the moment of velocity of the planet in its orbit. If H is constant as applied to the planet only, (5.8) represents an ellipse with the sun at one focus. If, however, angular momentum is constant as applied to the system of matter *and* space–time, $H - \Delta H$ is constant, where ΔH is the expression in (5.7). Then (5.8) represents an ellipse which advances progressively in the plane of the orbit as the planet describes successive orbits. There is an advance of perihelion. The advance, measured in radians per revolution, may be evaluated as:

$$\frac{8\pi}{5}\frac{M}{P}\frac{R^2}{X^2} \tag{5.9}$$

where P is the mass of the planet. R has become the radius of the space–time lattice of the planet and X is distance from the sun.

An anomalous advance of perihelion must, of course, follow if we ignore the effect of space–time. There is, therefore, nothing surprising about the perihelion motion of Mercury. Indeed, the fact that the discrepancy between the measured and theoretical value neglecting space–time is detected is a clear indication that (5.7) is not neglible. The mass of the space–time lattice can be deduced from observation. Attempting this, we note that it is unlikely that the space–time volume of the planet will be simply co-extensive with its physical form. It will be somewhat larger. The ionosphere limits of the earth suggest a location for the boundary. Let us guess that for the planet Mercury the space–time lattice has a radius 10% larger than that of the planet. Mercury has a radius of 1,500 miles, so this assumption puts the boundary 150 miles above its surface, about the same height as the ionosphere above the earth. Then, available data enable the mass density of the space–time lattice to be calculated. The mass P of Mercury is $3{\cdot}27\ 10^{26}$ gm. X is $5{\cdot}7\ 10^{12}$ cm. The radius of Mercury is $2{\cdot}495\ 10^{8}$ cm. The orbital period is 88 days. The anomalous perihelion advance measured, allowing for the solar oblateness, is 38 seconds of arc per century. From (5.9) it may then be shown that the mass density of the space–time lattice is about 150 gm/cc.

This is not conclusive until it is shown that the space–time lattice has a mass density of this order calculable from physical observation *in the laboratory*. Atomic physics affords all the data needed to evaluate the mass density of space–time, as will be shown in the next chapter. For the moment, it is worthy of note that the above explanation can be applied satisfactorily to the earth's perihelion motion and that of other planets, including Venus. But, more than this, we can take what seems to be an absurd result, this very high density of space–time, and make sense out of it in two immediate respects.

Firstly, common sense must tell us that, if the explanation of the Principle of Equivalence in Chapter 4 has merit, then the presence of ordinary matter in space–time is a mere disturbance in a heavier medium. The substance of the *G* frame has to balance the extra disturbance of matter which, as we know from observation, can have densities up to about 10 or 15 gm/cc. Space–time must be more dense, appreciably more dense, than this. 150 gm/cc is highly reasonable. Secondly, on the basis that the sun has a density of about 1·4 gm/cc and an angular momentum which is only 1% that of the planets in their orbits, we see that to add the angular momentum of the rotating space–time will make the sun have about the same angular momentum as the total of that of the planets. More will be said about this in Chapter 8. In the meantime, the reader should not underestimate the importance of the really great anomaly which has confronted us since the time of Newton. Angular momentum is supposed to be conserved in a complete system. If the solar system has been a complete system since the birth of the planets and before, how is it that the sun has so little of the angular momentum now belonging to the solar system? There is no problem if we recognize the role of space–time. Not only will it solve the anomalous perihelion difficulty, but we can see a sensible basis for explaining the creation of the solar system.

Another point which may have occurred to the reader is that this theory might preclude the existence of very high densities of matter. The reader who can visualize gravitational collapse of stars and contraction of matter to almost infinite mass densities should remember that he is assuming that *G*, the constant of gravitation, remains constant under such conditions. It is a convenient assumption encouraged by the inflexibility of Einstein's theory, but if gravitation has its origins in a real physical disturbance of space–time, as we believe, it may well not cater for some of the mathematical fantasies of the astrophysicist. After all, the physicist does not understand what gravity is, so he is being rather bold to assert that its action has no dependence upon the concentration of the substance exhibiting gravitation. All the author can offer ahead is an argument explaining *why* *G* cannot be constant when we consider really dense matter, and the encouragement that gravitation is explained and *G* is *evaluated* from atomic data.

Already, it has been shown that Einstein's General Theory of Relativity has no advantages over the present theory. All four of its quantitative tests have been derived by other means. The tests provide equal support for the theory under review and the theory under review has very many more advantages. Already, it has been shown that this theory has application to atomic theory. We have the link with wave mechanics and with field theory. We are ready also to turn attention now to the serious analysis in this work, leading us to the derivation of G in terms of the properties of the electron. This, of necessity, involves us in an explanation of the nature of gravitational force.

The Nature of Gravity

If space–time is not something real, then it is simply imaginary and serves as a mere exercise for the imagination. If it is real we cannot dispose of it, as Einstein does, by mere mathematics. If has, therefore, to be portrayed in physical terms. Above, the lattice of space–time has been deemed to become crumbled at its forward boundaries when in motion. What does this mean physically? The simple answer is that the lattice is probably an array of electrically charged particles. At the boundary, particles come out of their lattice positions and travel through the lattice. This can be fully supported by a rigorous analysis of an electrical space–time system. Imagine the lattice to comprise identical particles of electric charge permeating a uniform electric continuum of opposite charge. The particles mutually repel. For zero electrostatic interaction energy, these particles form into a simple cubic array. Their arrangement is different for minimum electrostatic energy, the normal assumption in physics. However, we are dealing here with space–time. In laboratory experiments, where electric charge can be separated to store energy and provide a system which tends to be restored to its original state by tending to minimum energy, we deal only with relative quantities. Negative energy in a relative sense is possible in such analysis. On an absolute basis, in space–time, negative energy is beyond imagination. We are not dealing in relative terms. The system is absolute. This is the key to the analysis, because it means that the stable state of space–time is not one of rest. The zero energy condition is not the one of zero restoring force. Electrostatic forces will occur in the system of electric particles and continuum described above and will be finite for zero electrostatic interaction energy. Such forces are balanced by the centrifugal forces of an orbital motion, the harmonious motion of space–time already introduced. The time dimension comes into space–time because the rest condition of space–time would have minimum energy which is *negative*. The fundamental energy condition applies everywhere in space. The interaction energy cannot be negative in some parts and positive in others. Each lattice particle in the E frame of space–time must satisfy the same energy condition. This assures a kind of symmetry and causes the particles to be arranged in a simple cubic array.

When the lattice is in linear motion, some particles must exist in a free state. They are the lattice "substance" displaced by the motion. They do not form part of the lattice array (see Fig. 5.3), but because they are present the lattice will have expanded. This follows from electrostatic charge balance considerations. Space is electrically neutral on a macroscopic scale. This will be further analysed in Chapter 8. The freed particles can deploy their kinetic energy to travel at speed in the direction opposite to the linear motion of the lattice, as shown by the arrows in Fig. 5.3.

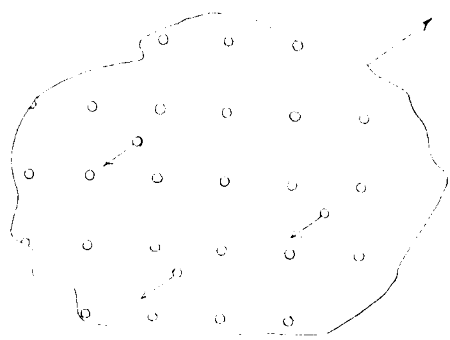

Fig. 5.3

Ignoring the existence of free particles, which, because of their rapid transit through the lattice, tend to meld statistically into the background charge of the electric continuum, we can now illustrate the harmonic motion of the E frame. Firstly, note that each electric particle in this frame is attracted to a neutral rest position in the continuum. Each particle is held displaced by a state of motion. The whole particle lattice forming the E frame moves in a circular orbit so that each particle is subjected to the same centrifugal action and can retain its position against the electric forces urging it to the rest position in the continuum. As is evident from the analysis already presented, this continuum is part of the G frame which provides the counter-balance to the motion of the E frame. Indeed, both the E frame and the G frame move in counter-balance in the same circular orbit relative to the inertial reference frame. In Fig. 5.4 the broken

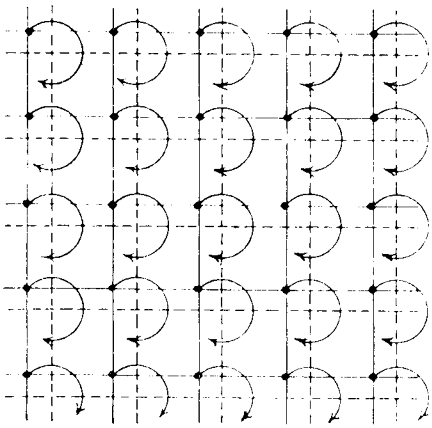

Fig. 5.4

lines show the position of the inertial frame and the full lines show the position of the E frame. The electric particles forming this frame are depicted each in circular motion with the frame. Fig. 5.5 shows the way in which the orbits of the E frame particles are diminished around a gravitating system of matter not illustrated but deemed to be centrally located in the system shown. Gravitation involves magnetic forces, and these affect the balance between the centrifugal

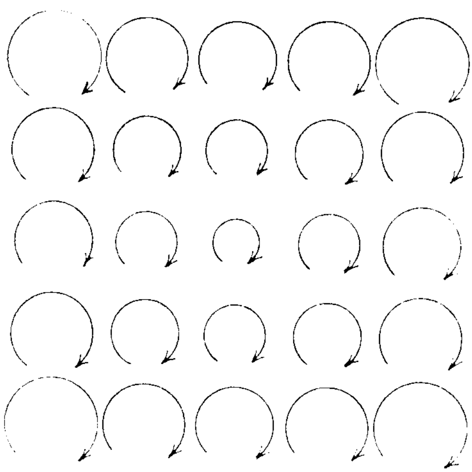

Fig. 5.5

force and electrostatic force on each E frame particle. Said another way, in the light of the argument in Chapter 2, the diminution of the kinetic energy or, more correctly, the diminution of the electrostatic energy is the magnetic effect corresponding with gravitation. Remember that in Chapter 2 it was suggested that there was a small priming energy in space–time which set the condition from which a reduction of energy corresponding to magnetism was possible. This is consistent with the zero electrostatic interaction energy condition discussed above. This is the lower limit of energy reduction, or the upper limit of magnetization or gravitation. It will be better understood when Planck's constant is evaluated in Chapter 6.

Since the E frame is the electromagnetic reference frame, there can be no direct magnetic force between these particles forming the lattice. In contrast, since the charge of the continuum in the G frame is moving at velocity c relative to the E frame it has its own mutual magnetic interaction which exactly cancels its mutual electrostatic action. This follows using the law of electrodynamics presented in Chapter 2. At any instant the charge is in parallel motion. Exact cancellation of the mutual forces in the continuum explains why it can form into a continuum. It is unlike the behaviour of charge in a particle subject principally to self-repulsion.

We are now ready to explain gravitation, subject to two minor comments. Firstly, note that there is no question of propagation delays in the magnetic interaction forces between G frame substance. Motions are mutually parallel but constantly changing direction. Yet, field energy between interacting charge is the same even though the directions of the current vectors are changing. Hence, unless the sources of these vectors move in the electromagnetic reference frame, either by coming together or separating further apart, there is no reason for a propagation phenomenon. It can be said that gravitation, as a magnetic force, is propagated at the velocity c, but this requires motion of the gravitating bodies and is not related to the universal motion of space–time. Secondly, note that, if the G frame comprises the same magnitude of charge as that of the lattice particles in the E frame, it is difficult to understand how the G frame can have the same mass density and so have the same orbital radius. These are requirements of the balance condition under study. The only answer available is to assume that the G frame has some rather heavy elementary particles of charge e (positive polarity), sparsely populating the G frame, but providing the mass needed for balance. These particles are termed "gravitons". Their existence is supported by abundant evidence to be presented. They are the seat of the reaction which causes gravitation.

Now consider a particle of matter at rest in the E frame. In Fig. 5.6, this particle denoted P is shown with the continuum of positive charge streaming past it at velocity c relative to P. Note that we take the lattice particles to be negative. The approach velocity of the continuum relative to P is c and the recession velocity is c, but to maintain continuity the continuum has to speed up a little in passing

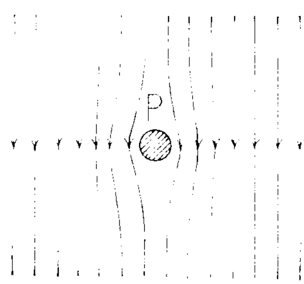

Fig. 5.6

the particle owing to its effect as an obstruction. This means that the integral of the current vector quantity or charge-velocity parameter applicable to the continuum is *independent* of the physical size of the particle P. It is like saying that the quantity of gas passing through a pipe in unit time can be measured at either end of the pipe without worrying about the nature of any partial obstructions *en route* within the pipe. The charge-velocity parameter or current vector is what gives rise to electrodynamic action. It therefore follows that there is no direct electrodynamic action seated in a particle of matter at rest in the electrodynamic reference frame. However, there is an indirect effect. Since P is at rest in the E frame it moves with the space–time universal motion about the inertial frame. It needs to be balanced. It is balanced by something in the G frame. As already indicated, the mass of the G frame is attributed to "gravitons". These are all that is available to accept disturbance due to P and provide balance. Their disturbance consists in their contraction slightly to become a little heavier. Mass is inversely proportional to radius. As is shown in Appendix I, electric energy is inversely proportional to radius, for any charged particle. Since $E = Mc^2$ applies to such energy, mass is an inverse function of the physical radius of a charged particle. Now, if the particle of matter P causes a nearby graviton in the G frame to alter slightly in size, we do have an electrodynamic effect. A current vector parallel with all current vectors associated with all other elements of matter is developed. The current vector is directly determined by the mass of the matter causing it. Consequently, there is a mutual force of electrodynamic attraction between regions of space–time containing matter. Effectively, there is a mutual force of attraction between all elements of matter. This is the force of gravitation.

The test of this theory is the evaluation of the constant of gravitation. To proceed in this direction, let dE denote the rest mass energy of a particle of matter causing the graviton disturbance. To balance this, the graviton has to increase its energy by dE also. From equation (6) in Appendix I, the energy of a graviton charge e can be expressed as:

$$E = 2e^2/3x \tag{5.10}$$

where x is the radius of the graviton. If E increases by dE, x is reduced and there will be a continuum charge increase by the elemental volume change $4\pi x^2 dx$ times the continuum charge density σ. The electrodynamic current vector developed by dE is then:

$$(6\pi x^4 \sigma / e^2) dE \tag{5.11}$$

as is found by differentiating (5.10) and substituting dx. Note that, since the charge moves at c relative to the electromagnetic reference frame, though in its small space–time orbit which does not give rise to relativistic mass considerations, the electrostatic charge is equal in magnitude to the electrodynamic current vector.

Using the electrodynamic law developed in Chapter 2, it follows that the force of attraction between two spaced mass energy quantities like dE is the product of two quantities such as (5.11) divided by the square of the separation distance. By analogy with Newton's gravitational force, we find that the constant of gravitation G is, simply:

$$G = (6\pi x^4 \sigma c^2 / e^2)^2 \tag{5.12}$$

c has been introduced to convert energy into mass, using $E = Mc^2$.

This equation shows that in order to evaluate the constant of gravitation it is necessary to determine the mass of the graviton, and so x, as well as the lattice spacing of the E frame, and so σ. In short,

G becomes a simple property related to the parameters of the system comprising space–time. It is important to note that the gravitons have not merely been invented to provide this explanation of gravitation. They are the energy source for the creation of matter, and much of the analysis in the following pages is concerned with their role in creating elementary particles. The mass of the graviton is calculable in terms of the mass of the electron. It depends upon the *geometry* of space–time, curiously enough. It gives the *exact* value of G when used in (5.12). Further, there is experimental evidence indicating the existence of this unusual particle.

Summary

The concepts on which wave mechanics were explained in Chapter 4 have been presented in a manner more dependent upon the physical form of space–time. It has been shown that all four quantitative tests of the General Theory of Relativity can be explained by this new space–time theory. The potential of this new theory in explaining the nature of gravitation and evaluating the constant of gravitation has been outlined. It remains to analyse space–time rigorously now, in order to deduce theoretical values of the fundamental physical constants.