# 9. General Discussion

## Relativity

The theory presented in the foregoing pages has developed steadily over several years. It will continue to develop, no doubt, at least as long as the author can see scope for its further advancement and has not been confronted with any refuting evidence. Certainly, the theory is not in its final form. This book is a stage in its development. In this final chapter some features worthy of review and which have emerged, in the main, after the previous chapters were written, are presented. Some are reserved for this last chapter because they have not yet stood the test of time and are perhaps more speculative than the main body of this work. This chapter is also the place where some questions can be asked. The anticipation of a few questions might help the reader's understanding.

Proceeding in this vein, we first pay attention to the subject of Relativity. Relativity is synonymous with the name Einstein. This book is entitled *Physics Without Einstein* because the theory presented offers an account of physical phenomena which does not need Einstein's theory at all. However, the author was not motivated to produce an alternative to Einstein's theories when he embarked upon these researches. The motivation was the understanding of a problem in magnetism and the pursuit of an idea concerning ferromagnetism, a subject not remotely related to Relativity. What is described in this book emerged as the author came more and more to believe in the aether medium. It was this belief which made Einstein's theory a factor to consider. According to Relativity, we can get by without speaking of the aether, though, as some say, Einstein's theory is a theory of the aether. Mathematically, there is no need for the physical aether. According to the author's theory, we can get by without speaking of Relativity. Physically, there is no need for sterile mathematical principles. It all depends upon one's outlook, and the reader can only be guided by whatever it is that suits him best. In this book, the author has made extensive use of the words "space-time". These words are used instead of "aether" simply because the reader might find them more acceptable. A well-known physicist advised the author that it was better to use "space–time". He said: "There is an aether, but it gets people's backs up to refer to it; it is better to call it 'space–time'." Having said this, the author does offer one comment to correct any false impression. The aether has come to have a classical meaning in people's minds. There are fixed ideas about the properties of the aether of the last century. It is a kind of mechanical medium providing the single and absolute reference frame in space. Yet, the aether should really be nothing more than that something which fills space. Its properties are a matter for observation, not preconception. All that has to be believed is that space is not a void, it is a kind of plenum. The words "space–time" imply a less definite notion of what it is that permeates space, and their use is, therefore, more consistent with the author's objectives. The question of whether space is a void or a plenum is not a matter of opinion. Philosophers can go wrong in wrestling with such a problem in the absence of factual information. The early Greeks believed that there had to be a void as, otherwise, there could be no motion. Commenting on this, Bertrand Russell (1946) has written in his *History of Western Philosophy*:

"*It will be seen that there was one point on which everybody so far was agreed, namely that there could be no motion in a plenum. In this, all alike were mistaken. There can be cyclic motion in a plenum, provided it has always existed.*"

The author's theory has shown how everything observed in fundamental physics can point to the existence of a cyclic motion, harmonious, universal and constant through cosmic time. Bertrand Russell's observation is, therefore, most important. He points out that philosophers can be wrong in interpreting the physics of space, even when using simple words as explanation. How much scope is there then for error in the mathematics of Relativity? Mathematics can be wrong when incorrectly applied just as words can be misleading if wrongly used. Can we really accept Hoyle's comment, quoted in Chapter 5, that "there is no such thing as gravitation apart from geometry"? The answer to this is that scientists have accepted Relativity as the explanation of gravitation. Perhaps they are a little unhappy with some of the recent discoveries, which do cast some doubt upon the theory, but it is still common belief that Relativity, if in a slightly modified form, is the tool for explaining the phenomenon of gravitation.

This introduces the next comment in a discussion. The question is why any alternative to Relativity is needed. If it gives satisfaction, why develop a new theory which lacks the elegance of Relativity and which presents ideas of a tangible aether having special properties which seem to depend upon too much hypothesis. Logically, whether or not there is an aether is not a matter of mere choice to a true physicist. It could be optional to a mathematician. If there is a tangible substance filling space, we may or may not need to refer to it in our efforts to unify physics. Relativity tries to avoid it, almost by cancelling its effect out of the mathematical equations. This is all very well, but the unification we all seek has not been forthcoming. There are too many mysteries in fundamental physics. Gravitation and electromagnetism were not unified by Relativity, much as Einstein and others have tried. In the field of elementary particle physics there is developing frustration because the theories are not advancing fast enough to cope with the experimental discoveries. The thought of unification in physics seems, therefore, that much more remote. Relativity has to advance rapidly if it is to adapt to the wider developing spectrum of fundamental physics.

The author's theory is an alternative to Relativity and, as has been seen, it covers the whole spectrum of physics, from the nature of elementary particles to gravitation on a cosmic scale, besides covering field theory and wave mechanics. However, where does this leave Relativity, if the author's theory comes to be accepted in its present or a modified form? One comment conceded by the physicist today is "General Relativity may be wrong, but Special Relativity is as firmly established as ever." It would be an easy matter to pass over this question of the validity of Special Relativity. In the words of Einstein (1921), the "principle of special relativity" can be expressed in the following proposition:

"*If K is an inertial system, then every other system K', which moves uniformly and without rotation relatively to K, is also an inertial system; the laws of nature are in concordance for all inertial systems.*"

Newton's mechanics can be used to show that this principle applies to mechanics. The question is whether it really applies to electromagnetic phenomena. A practical aspect of the principle is that it is not possible, if the principle is true, to determine the velocity of a system in uniform motion, without reference to something outside the system. Any measurement within the system should not permit evaluation of motion of the system relative to something else. Now, in the previous chapter, it was suggested that a very small difference between the mass of the graviton expected from the set number ratios of space–time and the mass needed to explain the value of $G$, as measured on earth, can be explained by the motion of the solar system in our galaxy. This means that analysis and experiment wholly performed in the earth laboratory can indicate the velocity of about 120 km/sec of the earth system in galactic space. This velocity can be measured separately from a study of the optical behaviour of surrounding stars. The fact that a similar result is obtained from direct observation and from the internal observation and analysis, if given credence, is wholly inconsistent with the assumption that special relativity precludes the determination of motion of one inertial system relative to another.

Einstein has jumped from an observation based upon mechanics and inertial frames of reference to one which involves electromagnetic wave propagation and electromagnetic frames of reference. The Michelson–Morley experiment is his key support. However, this experiment relates only to the observed behaviour of electromagnetic waves in the test apparatus of the laboratory. In detecting the velocity of the solar system, we can use the whole of the system as our laboratory. The velocity of light transmitted between the planets is our concern. Does this move at the velocity $c$ relative to the solar system or relative to the space–time medium permeating space between the planets? There is new experimental data of importance to this question, and it may well disprove Einstein's Special Relativity. It stems from some unexplained problems in observations made by new radar measurements, as will be explained below.

The author has explained the Michelson–Morley experiment on the basis that an astronomical body might have its own aether, or space–time, rotating with it and having a boundary some distance above its surface. This idea might sound old fashioned, but it is different from the idea of aether drag. Aether drag implies a slip or turbulence of the aether medium at the surface of a body. It is reminiscent of the attempts of Miller (1925) in performing the Michelson–Morley experiment at high altitude on Mount Wilson. Miller did not obtain the null result found normally. However, the results, though definite, did not indicate the full slip to be expected if the experiment were performed fully outside the earth's aether. It may be that the Theory of Relativity had become so well accepted by then that it did not fit the pattern of progress to pay attention to a small aether effect, which, notwithstanding the experimental care and skill of Miller, could be left for possible verification and likely rejection by others. This remark should be read in conjunction with some comments by Whittaker (1953), who writes:

"The idea of mapping the curved space of General Relativity on a flat space, and making the latter fundamental, was revived many years after Whitehead by N. Rosen (1940). He and others who developed it claimed that in this way it was possible to explain more directly the conservation of energy, momentum, and angular momentum, and also possibly to account for certain unexplained residuals in the repetitions of the Michelson–Morley experiment (reference to Miller, 1925)."

One may well wonder about the support for Special Relativity in the face of admitted weaknesses in General Relativity. If General Relativity collapses, the residuals in the Michelson–Morley experiment cannot be dismissed in this way. Then surely Special Relativity is open to question.

Now, to avoid this type of discussion, we can argue that, though there could well be some degree of aether slip between the earth's surface and the ionosphere, it would be risky speculation to explore that topic here. The author's theory does not require anything other than the null result of the Michelson–Morley experiment so long as it is performed anywhere in an earth-based environment. The earth's ionosphere is the boundary of the earth's aether. This is not an assumption made by the author to dispose of the Michelson–Morley problem. The quantitative analysis of the geomagnetic moment made it necessary to have the earth's space–time boundary at the appropriate height. Even so, a critic may then ask whether we can detect the motion of the earth's space–time. Would not a radio wave grazing past the earth through the earth's space–time not travel faster or slower, according to its direction, in comparison with one travelling just outside this medium? The answer is affirmative and, of course, the author's theory stands to be tested from such experiments.

We can consider whether experimental data are available from the delaying of radar waves grazing past the sun's surface. This is particularly interesting because it has bearing upon the recently reported tests of the Dicke–Brans theory, put forward as an alternative to the General Relativity of Einstein. Early in 1968, it was reported that a new and fourth test to verify Einstein's General Relativity quantitatively had been made by Shapiro and his collaborators. This is summarized by Gwynne (1968). The experiment consists in measuring the effect of the sun's gravitational field on a radar beam passing close to it. General Relativity predicts that the gravitational field should slow down the beam. The delay for the return journey of a radar pulse passing the sun in transit between earth and Mercury, a journey lasting about 25 minutes, should be of the order of 160 microseconds, depending upon how close the beam comes to the solar surface. As Mercury moves into and out of conjunction with the sun, the delay should rise gradually to a peak over several days and then fall in a similar manner after conjunction.

Now, before commenting upon what was actually observed, the reader is asked to consider two separate possibilities suggested by the author's theory, but which have, of course, not been taken into account in the reported analyses. Firstly, if the solar system is moving at a high velocity through space and if light waves travel *relative* to the medium in space, the sun will move appreciably during the period between the close transits of the outward and inward beams. If the sun has an aether extending some distance above its surface then it could be that one direction only of the beam might pass through this aether, causing the beam to be retarded or accelerated in its overall journey. Note that a transit distance of some half-million miles through the sun's aether rotating at a peripheral velocity of about 1·25 miles per second, the surface velocity due to the sun's rotation, implies a delay or advance of about 18 microseconds. This is found by noting that the beam is in transit at the extra velocity of 1·25 miles per second for a little less than three seconds, the time taken to traverse half a million miles at the speed of light. The time of 18 microseconds is the time taken to cover the 3·4 miles added in these few seconds. It follows that any errors of the order of 20 microseconds in the experimental observations are of interest to the author's theory. Secondly, if the sun moves through space at a high velocity, the path of the outward beam will not be where we expect it to be. It is the return beam which is seen in proper relation to the position of the sun. The distance of the beam from the sun in its close transit is important to the estimation of the Relativistic estimate of the delay, or to any estimate dependent upon the effect of solar gravitation. If the beam is not where we believe it to be, the theory is misdirected. To understand this, consider Fig. 9.1. Assume that the whole solar system moves steadily relative to the surrounding medium through which radar waves are propagated at a velocity $c$ subject to solar

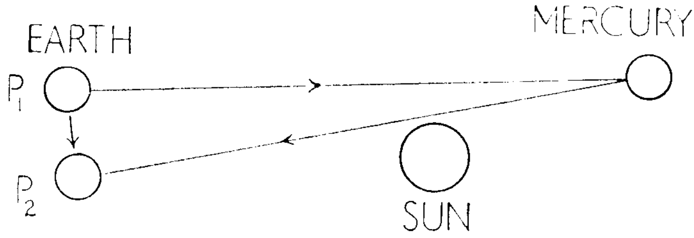


Fig. 9.1

gravitation, as explained in Chapter 5. In the figure, the earth is deemed to be at $P_1$, when it transmits a radar signal to Mercury. This signal is reflected when Mercury has the position shown, so the reflected radar signal returns along the linear path shown. Since light travels at the same speed as radar waves, the sun has the apparent position shown, at the time the radar beam passes it on its return journey. The return beam reaches the earth when the earth is at $P_2$. The radar beams are not truly linear near the sun, owing to the gravitational deflection, but we assume that this is allowed for in the separate calculations made in connection with the experiments. Also, the planets are moving within the solar system and doppler effects have to be accounted for. Our objective is only to consider corrections to be imposed upon the measurements if the motion of the solar system through a surrounding aether medium is introduced. From Fig. 9.1 it can be seen that the motion of the solar system is accounted for by the motion of the earth from $P_1$ to $P_2$. Because of this displacement between $P_1$ and $P_2$, there is a separation of the outward and inward radar beams adjacent the sun. However, we only see the position of the inward beam in relation to the position of the sun. Consequently, depending upon the direction of motion of the solar system, and depending upon which side of the sun the planet Mercury is seen, the outward radar beam will pass closer or further away from the sun than we believe. The result should be an increased overall delay of the radar signal on one side of the sun and a decreased overall delay of the radar signal on the other side. In any event the peak signal will be reduced in its total delay indication, because when one beam direction grazes the sun, the other is spaced away from the sun. This tells us that the observed delay should be less than that predicted and also that it should be shifted in phase as measurements are made over the period when the planet Mercury passes through conjunction. Furthermore, the results will depend upon the time of year when the observations are made. The solar system is moving in a certain direction in our galaxy. Sometimes this direction will have a maximum component, possibly at right angles to the radar beams. At other times it will have a minimum component in this direction. Thus, sometimes there will be a significant phase shift, whereas at other times of year there will be a less significant phase shift.* If the solar system moves at 230 km/sec, as believed, then since the two transit times between the sun and Mercury total about 400 seconds, we are speaking of a distance which could be as much as 90,000 km. This is enough to modify the gravitational calculations of the effect of the sun upon the radar beams by one or two per cent. This is small but, probably more important, could be the effect of bringing one beam outside the sun's own space–time. 90,000 km is significant enough for us to expect this. Then there could well be the 18 micro-second effect mentioned above and it would also correspond to the phase-shift just mentioned. Furthermore, if the velocity of the solar system were directed along radar beam paths, then, on such occasions, the outward and inward beams would both pass inside or outside the space–time of the sun. Then, there would be no modification of the delay.

It may be concluded that any evidence of anomalous delays of 20 microseconds or so is evidence possibly pointing to the galactic motion of the solar system and the rotation of the sun's own space–time. Any evidence of a phase-shift of the delay on some conjunctions and not others is strong evidence in support of both these features. If these properties are found then we may have means for estimating the speed of the solar system in our galaxy as well as its direction. If the measurements are made wholly within the frame of reference of the solar system, as they are, then we have evidence disproving the Principle of Relativity and proving the existence of the aether.

In the reports of Shapiro's 1967 experiments, as quoted by Gwynne (1968), it is clear that:

1. The measured delay was about 10% less than that predicted on Einstein's theory,

* There will also be a doppler shift and a slight deflection when a plane wave passes through rotating space–time. The doppler shift will result in an amplitude pulsation at very low frequency due to wave interference effects. A pulsar may be a star seen through a rotating space–time region located between the earth and the star.

2. The April–May measurements showed a lower peak delay and a distinct phase-shift of one or two days between the observed delays and those predicted from the apparent positions of the sun and the beams,
3. The August–September measurements gave higher results and showed little or no phase-shift, and
4. It was claimed that there were a number of "*slowly varying systematic differences in the results* (*about 20 microseconds on average*)", and stated that these have not yet been explained.

The author merely suggests that these radar experiments *might* provide the long-awaited test of aether theory. It might be that, quite apart from the author's interpretations providing a possible alternative to Relativity, we already have the elements of the proof that Einstein's theories are invalid. It should not, however, be overlooked that the author's theory does give the same result for the gravitational deflection of light waves and the gravitational delay of radar waves in transit past the sun. What the author is pointing out is that there are corrections which have to be made to overcome the scatter on the measurements. These corrections are not available to Einstein's followers. Their use depends upon the recognition of a real aether medium. When they are made, it looks as if the formulae of the Einstein analysis and the author's analysis are correct, but Relativity has then lost its coherence. The author's theory may then have to be favoured. In making the corrections and finding a corrected result in line with Einstein's values, a result will emerge which is out-of-line with the proposals of the new Dicke–Brans theory, which predicts a smaller delay in the radar experiment of about the right order, but which does not explain the phase-shift effects.

Returning to the problem of the effects of aether drag, it has been suggested to the author that the assumption of a local aether is contradicted by the observed aberration of fixed stars. Due to the motion of the earth about the sun, distant stars appear to move in orbits approximately 20·5 seconds in angular radius. This is to be expected since the orbital velocity of the earth of $10^{-4}\,c$ gives a value of the angle through which the star appears to move of arc tan $10^{-4}$, in agreement with observation. It is contended that if aether is dragged by the earth no such aberration would be expected to occur. Also, the author has been told that the Fizeau effect provides evidence supporting Einstein or Lorentz theories. Experiment shows that with respect to the laboratory the velocity of light in water moving with velocity $u$ is increased by $u(1 - 1/\mu^2)$, a result predicted from the relativistic addition of velocities. $\mu$ denotes the refractive index of water. With aether drag it is supposed that the velocity increase would either be the velocity $u$ of the water or zero, according to whether aether is merely being dragged by the earth or dragged by water. Now, if this type of comment is typical of the general reaction to the author's proposals, the author can but ask the reader to take note of the fact that many phenomena were explained once in terms of aether theory. The aether has gone out of fashion and new text-books have been produced with all kinds of proofs that Relativity can be applied to explain phenomena. So much so, that even phenomena which once supported aether theory are taken to prove the validity of Relativity. Books on electrodynamics are regularly based upon Relativity as the starting point. The results are fascinating, but they cannot displace history. Aberration was discovered in 1725. If Bradley's aberration experiment ruled out the thought of aether, would there have been the tremendous interest in the nineteenth century that was displayed in aether theory? The light from the star is refracted at the boundary between the earth's aether and surrounding aether. Bradley's result fits the author's theory very nicely. The Fizeau result was explained on aether theory before Einstein was born. The velocity of light within a transparent medium in motion is determined partly by the properties of the substance and partly by the properties of the aether. Refractive index $\mu$ is $c/c_1$, where $c_1$ is the velocity of light measured relative to the substance and $c$ is the velocity of light in vacuo. Then, two densities can be specified. The density $\rho$ of the aether medium in vacuo and $\rho_1$, the effective density of the combined medium of aether and the material substance. In this sense, we can take density as something proportional to $(1+\varphi)$ in equation (6.32), so that, from this equation:

$$\rho_1 = \mu^2 \rho \tag{9.1}$$

As Whittaker (1951, c) explains, Fresnel assumed (9.1) and that when a body is in motion the part of the total density in excess of that of vacuous aether is carried along with it, whilst the remainder remains stationary. Thus, the density of aether carried along is $(\rho_1 - \rho)$ or $(\mu^2 - 1)\rho$, while a quantity of aether of density $\rho$ remains at rest. The velocity at which the centre of gravity of the aether within the body moves forward in the direction of propagation is therefore $(\mu^2 - 1)/\mu^2$

times the velocity of the substance, $u$. As Whittaker also explains, it was many years later that Stokes arrived at the same result from a slightly different supposition. He supposed that the whole of the aether in a body moves together but that, as the body moves, the aether entering in front augments the substance of the body to cause the aether within it to have a drift velocity $-u\rho/\rho_1$ relative to the body. This leads to the same result for the velocity of light relative to the body. This is also consistent with the author's proposal, which admits the space–time lattice to have mass energy associated with it so as to modify its propagation properties. The propagation velocity is fixed relative to the lattice frame in vacuo, but when matter is present, the disturbance of the lattice depends upon the energy of such matter and motion of this matter relative to the lattice. The predicted results of Fresnel and Stokes were verified experimentally by Fizeau in 1851, long before Einstein's ideas about Relativity.

At this stage in the discussion it is necessary to draw the distinction between large bodies, such as the earth, which can take their lattice with them as one rigid unit, and small bodies, such as the moving column of water, which cannot. This distinction is essential, otherwise it would be possible to detect aether properties from measurements on gyroscopes, pendulums, etc. The earth has been rotating long enough and is large enough to have its own special aether. Small bodies in the laboratory are not so priviledged. The author cannot explain, as yet, where the line can be drawn to determine whether a body has its own aether system or not. More experimental research, particularly in outer space, will help to resolve this question, but it is another matter to explain the reasons for any line of demarkation. It is safe to say that in the environment of earthly laboratory experiments the aether lattice appears fixed with that of the whole earth. Aether drag cannot be detected in the laboratory. It cannot be expected to occur. In the Fizeau experiment there is really no special motion of aether. It is simply that the velocity of light is governed jointly by the presence of aether at rest in the earth frame and by matter at motion with a body. To an extent, then, velocity of light can be said to be determined partly with respect to its material source, if it is generated in the earth frame. A gas atom excited to radiate light will, in its own reference frame, "see" the propagation velocity of its waves have some dependence upon its own velocity relative to the earth. For this reason, although the space–time lattice does not move relative to it, there can be doppler frequency shifts according to its velocity relative to an observer. This is in spite of the fact that, as shown in Chapter 4, the photon action is formed in the lattice of space–time whilst the atomic electrons are in their non-migratory state about the nucleus. More will be said about this in the next section.

## Electromagnetic Energy Transfer

Not only is Relativity in trouble today. There are increasingly-apparent difficulties with the problems of electromagnetic radiation. The duality of wave and particle theory is a contradiction in physics which has come to be accepted without concern. However, there are other questions. When a photon travels through a material medium is its momentum $h\nu/c$ or does it change as the propagation velocity in the medium changes? The same problem posed by the electromagnetic waves is a matter of concern to Penfield (1966). Cullwick (1966) analyses this momentum difficulty and calls the resulting discrepancy in the formulations "virtual momentum", because "it cannot be regarded as true momentum". Waldron (1966) shows little patience with wave theory by presenting a new corpuscular theory of light; photons and even energy quanta in radio waves are deemed to travel as ballistic particles. These references are all of recent date. They do serve to demonstrate that there is something lacking about our understanding of the processes of electromagnetic energy transfer. The author is, therefore, very much in line with the trend of looking for something better to provide answers to the conflicts surrounding the subject. In the early chapters of this book it has been suggested that waves do not convey energy at their propagation velocity. This sounds heretical, but it is logical if we retain the duality theory. Energy quanta, or, more correctly, momentum quanta, are a feature of the author's ideas about energy transfer. The photon action has been explained in a manner consistent with the evaluation of Planck's constant and the derivation of the basic formulation of wave mechanics. All that the reader is asked to accept is that electromagnetic waves are a mere disturbance of the energy already permeating space. Waves travel without carrying the energy along with them. It is not a new idea. Indeed, the idea that waves need not carry momentum or energy was put forward long ago by de Broglie (1924). It was also proposed by Bohr, Kramers and Slater (1924). The waves become mere disturbances of space and are able to trigger off events involving quantized interaction with space itself. Experimental facts, such as electron-positron creation from the vacuum state, or theories such as Dirac's (1958) ideas about holes in a "sea of charge", all fit together in a pattern encouraging the belief that space itself provides the action and the energy associated with wave propagation, whereas the photon event is merely triggered by these waves. The phenomenon of energy transfer in quanta was expressed quite simply by Eddington (1929, b) when he contrasted his "*collection box*" theory with his "*sweepstake*" theory. When waves are intercepted, do we have to wait until enough energy has arrived and been collected to trigger the photon event? Do we collect energy separately for each frequency before releasing the quanta? Eddington argued that the photoelectric effect disproved this. Instead, he submitted that the waves contribute energy to "*buy a ticket in a sweepstake in which the prizes are whole quanta*". Even here, the physicist has an answer. Experiment has shown that photoelectrons do not accumulate energy transmitted to them by electromagnetic waves, nor do they exchange energy in a kind of sweepstake. The time scale needed for such exchanges makes the idea untenable (see discussion of Yoffe and Dobronravov experiments by Kitaigorodsky, 1965). All the evidence shows that energy transfer is in discrete quanta. The energy transfer is between matter and space or space and matter. In space, electromagnetic waves do certainly appear to exist. Wave theory is so successful in explaining interference and diffraction phenomena. Where the energy quanta come from or go to in photon-wave interaction is not discussed in modern physics. The best we have is the problematic Poynting vector, our tool for understanding how energy is transported by electromagnetic waves. However, we have no insight into the way in which this energy collects and is focussed to generate the quantum. The author has offered an explanation and supported it by quantitative evidence. The reader who does not like what the author is offering in Chapters 1 and 2 has an uncertain alternative in what is already available.

The author has contended that it is absurd to expect there to be energy radiation from the accelerated electron. The absurdity is underlined by pointing out that no accelerating field is allowed for in the analysis and that remote from the electron one relies upon assumptions about energy transfer which have no foundation in truth. Why should we assume that an electromagnetic wave conveys energy? Experiment shows energy transfer to be in quanta. The reader who cannot reject the formulation for the energy radiated by the accelerated electron should ask if it is ever used. Surely, it is used in numerous theoretical treatments. Yet, has it ever been verified? If the formula is applied to a typical radio transmitter and all the conduction electrons in the aerial co-operate in developing a high current at a high frequency it will be difficult to derive enough radiated energy to sustain one photon per minute or per million wave-lengths. To apply the radiation equation and arrive at sensible results, one has to assume collective oscillation of the *collective charge* of all the electrons. Their interaction is vital to the analysis. Therefore, why do we talk about electrons radiating energy? Electric current oscillations generate electromagnetic waves. These are energy oscillations in the aether. The waves are propagated and the waves are the catalyst in the process of energy transfer.

A wave will seldom be produced by one single photon event at the source. In practice, millions of photons of similar frequencies contribute to develop wave radiation. Further, their actions overlap in time, either because the energy release mechanism has a finite lifetime or because the energy is released at different positions in a radiating source and the wave takes time to travel from one such position to the next. This means that even if all the photons produce exactly the same frequency radiation, it is likely that their occurrence is conditioned by the wave itself. The first photon in a series will presumably release its energy without experiencing any external conditioning action, but the wave component developed by this photon must affect the timing of energy release by other photons. Otherwise, their occurrence at random phase will substantially cancel the wave amplitude by their mutual wave interference. It is essential that the existing wave disturbance of the same frequency must influence the time of each photon event contributing to the wave component at this frequency. The photons will, therefore, tend to develop radiation in phase with one another, and will inject their momenta into the radiation field additively.

Now, bearing in mind that photons are liberated from excited atoms, and that such atoms may be moving at velocities of the order of $10^4$ cm/sec owing to their thermal energy oscillations, the actual frequency of the wave in the observer's reference frame will differ from that sensed by each atom. This arises from doppler effects. To understand this it is better to think in terms of the key quantity, photon momentum. The frequency of a photon in the space–time reference frame is determined by the momentum imparted to the frame in the energy transfer process. If the atom is moving, the release of more or less energy is needed to develop the same momentum reaction because, relative to the atom, the photon will move at more or less than the speed of light. It moves at the speed of light relative to the frame determined by the space–time lattice and any bulk effect of matter present (a reference to the Fizeau experiment). The frequency of the photon is dependent upon the velocity of the atom emitting it, since momentum has to be velocity-dependent for energy quantization in the transfer process. It is not surprising, therefore, to find a thermal broadening of spectral lines generated by hot gas. The point of this discussion is to show that waves are an essential part of the process of forming photons. The timing of the emission of a photon is conditioned by the phase of waves of similar frequency. The timing of the absorption of a photon is similarly conditioned.

Although it is not necessary to wait until enough energy is collected from a wave before a photon can be absorbed, a certain very small time must elapse. The weaker the wave amplitude, the longer the period during which the absorbing electron is absorbing momentum. In this time the momentum of the electron can change, and in its interaction with the wave one could expect to receive a slightly weaker photon, meaning less momentum transfer or lower frequency, due solely to the very weak wave. It is possible that there could be a frequency shift apparent when waves transmitted over long distances are intercepted. It is absurd to think that the frequency can change in transit between two points not in relative motion. We should, however, not be surprised if measurements of very weak signals indicate an *apparent* frequency reduction. This is worthy of note here because there have been some recent claims that there is a frequency shift of spectral lines in passing massive objects, it being implied that light from stars is caused to lose some of its frequency in grazing past the sun. Such a phenomenon is outside the scope of the author's theory, though it is consistent with the author's opinions to believe that possibly with very weak signals one appears to receive a lower frequency than is really received.

As indicated in the footnote on page 194, the pulsar may possibly be nothing more than a star which happens to be seen through a rotating space–time region. Since it has been shown that an astronomical body can have its own electromagnetic reference frame rotating with it, light in close transit will undergo both gravitational deflection and doppler shift. The two effects will interfere, causing the transmitted light to be amplitude-modulated and pulsate at a low frequency. Pulsars are rare because their line of sight has to pass close to a massive non-radiating, but rotating, astronomical body. The doppler frequency shift incurred by the wave is a function of angle of incidence between the wave and the space–time velocity at interception. But for the gravitational deflection in transit through the rotating space–time, the doppler shift at exit would cancel that at entry. However, the small angle of gravitational deflection causes a small doppler shift in the stellar light seen after transit. This shift varies across the light beam. As a result, parts of the wave interfere at a frequency which is very small. This causes the radiation from the star to pulsate at this low frequency.

The fact that the pulsar is causing such problems to theoretical physicists at this time is merely an indication that they really should rethink some of their ideas about the aether. The above explanation is, of course, rather speculative, but it seems to be more in keeping with the rest of physics than some of the current ideas on the cause of pulsar behaviour.

## The Nature of Spin

Spin angular momentum is one of the most perplexing problems. The standard half-spin angular momentum quantum has been assigned to particles without regard to the direct effect on magnetic moment, though with regard to its effect on the measured ratio of spin magnetic moments. Much of Chapter 7 has been founded upon such analysis. Now, how is it that spin angular velocity and spin angular momentum need not be directly related for the right answers to emerge from these studies? An attempt at a reconciliation will be made below, though not without reliance upon hypothesis.

First, in Chapter I the electric charge in linear motion was considered and found to have kinetic energy, magnetic energy and a velocity-dependent electric field energy. These energies were all of equal magnitude, but one was negative. A separate electric field energy exists in association with the charge. It moves with the charge and it determines its mass. One of the positive velocity-dependent energies moves with the charge. It causes mass to increase "relativistically" with increasing velocity. The other two compensating velocity-dependent energies belong to the field or space–time. They are a mere field disturbance. If now such a charge is deemed to be spherical and at rest in the electromagnetic reference frame, what happens if it rotates about an axis through its centre? Is there any magnetic effect? There must be, because we found the right answers for magnetic moments on this assumption in Chapter 7. Since there is no charge outside the spherical surface bounding the charge, the magnetic spin moment must originate *within* the sphere of charge. On the other hand, mass, which is a scalar quantity, unlike magnetic action of a current vector developed by the motion of charge, is related to the electric field energy, the total of which is fixed with the mass and does not depend upon spin. Therefore, when we talk of spin, meaning that the charge is spinning, we expect magnetic effects, but need we expect mass effects or angular momentum? If we do think of angular momentum, are there two components, one due to rotation of charge and contained wholly within the charge sphere, and the other due to rotation of field energy outside the sphere? It can be shown that if we merely assume that all the field energy, within and outside the sphere, rotates with the charge at the same angular velocity, then the angular momentum is infinite. Therefore, we are forced to recognize that any rotation of the field energy outside the charge sphere must involve a limiting boundary or a slip action by which the angular velocity decreases with radial distance.

It seems very probable that there is an angular momentum within the charge sphere due to the charge rotating with its electric field. Also, there must be scope for another angular momentum component determined by the angular velocity and extent of its effect upon the electric field outside the charge. This latter component of angular momentum may well be independent of that possessed by the charge itself within the charge sphere. This argument is consistent with the use of the zero spin condition and its inter-relation with mass in the composite particle forms discussed in Chapter 7. It is also consistent with the assignment of a standard half spin angular momentum quantum to such a particle form. All that this means is that the surrounding field has its own rotation pattern. See also Appendix III.

It is of interest to ask how the proton and the neutron acquire their half spins. In discussing the origins of nucleons it must be remembered that the creation process involves graviton expansion. If one graviton expands to its lower quantum state of mass 3,189 $m$ (see page 140) and then stores the energy of a nucleon of mass of the order of

1,836 $m$, this graviton can provide dynamic balance and gravitation for the nucleon while still having a total mass and an angular momentum with the $G$ frame roughly equal to those of the normal graviton. This leads to the rule that there is one graviton in close association with each nucleon. The nucleon assumes the spin $h/4\pi$ because it takes up a place in juxtaposition with a graviton and thus replaces an electron of spin $h/4\pi$. In taking up this position it probably exchanges its zero angular momentum state, developed during its creation, with that of the electron. On this basis, the neutron and proton each have a spin of $h/4\pi$, but the deuteron has a double half spin, probably because it forms in the manner depicted in Fig. 7.13 and needs two gravitons to balance it.

Where does the $E$ and $G$ frame angular momentum of the nucleon come from if it only has a spin $h/4\pi$? The lattice particle and the electron have been presumed to have zero or negligible total angular momentum, because spin was in balance with the $E$ and $G$ frame orbital quanta. The quantum $h/4\pi$ is the spin needed by the electron for balance. It is insufficient for a heavy nucleon. By the action of formation of the approximately normal graviton, just described, a quantum of energy of 1,874 $mc^2$ is released, but this order of energy has to be reabsorbed if the graviton is to provide proper gravitational balance and dynamic balance for a nucleon and other $E$ frame substance. In fact, it is inappropriate to imagine that there are both normal and "approximately" normal gravitons. All gravitons are the same. It is just that, for each nucleon accounting for about 1,874 $mc^2$ as gravitating mass energy, there is a certain continuum volume adjustment, that is, a continuum charge which can be allowed in the gravity calculation. The gravitational effect of the nucleon mass can, therefore, be catered for without special compaction of a graviton beyond its normal size. Minor volume differences will exist between gravitons in the presence of matter, but on balance the gravitons will retain their basic size, corresponding to their mass of about 5,064 $m$. It follows that any angular momentum considerations involve us in examining the action of full graviton expansion to form the charge continuum or, at least, some well expanded form such as the positron. Now, the angular momentum of such a graviton is really taken away by the lattice particles which come out of motion with the $E$ frame. They have zero total angular momentum, including their claim to that carried by the balancing graviton. As long as these lattice particles remain lattice particles, there is no angular momentum available. The graviton energy can be deployed into forming some lattice particles as electrons or positrons. This has been suggested in Chapter 8. However, this will do nothing for our angular momentum problem because electrons and positrons have little, if any, residual angular momentum when spin, orbital *E* frame and *G* frame balance are considered. Finally, if we use the energy to form nucleons, there is still no angular momentum available to prime the *E* frame motion. This problem will not be answered. It is a matter for further speculation. Possibly there is a clue from the fact that stars rotate. Where does their angular momentum come from? Can it be that their formation involves a reaction by which the *E* and *G* frame angular momenta of matter and even some of the space–time substance itself is set in balance? This is hypothesis, and best left for the future.

A question of more immediate importance is the explanation of how graviton energy can exist without direct evidence other than the nuclear processes or gravitation. Why is it that matter can move without there being evidence of energy of gravitons moving also? How can the extra energy in space–time which is needed to provide the *G* frame balance for matter in the *E* frame move with this ordinary matter and go undetected? The simple answer to this question is that, when matter moves, electric charge constituting such matter is in motion. Mass in motion requires charge to be in motion. When the energy of *G* frame balance moves, it is being transferred from one graviton to another. Possibly, even, the gravitons are not migrant charges but migrant energy quanta which settle at successive locations by forming the charge continuum into singularities corresponding with the existence of the graviton. Energy in motion need not develop momentum. It has to be carried by electric charge to convey momentum. In this regard the photon is carried by the *E* frame lattice, which is a metric formed from lattice particles, an array of electric charges. It is submitted that one graviton can form by compaction of electric charge as another expands. If the volumes sum to the same amount, before and after this event, then energy has been transferred without the motion of electric charge.

Another problem might seem to be that of gravitational effects of free migrant lattice particles. Such particles are needed to provide the reverse motion balancing the general motion of a lattice. If the free particles are loose in the inertial frame, there is motion relative to the

$E$ frame. How is it that this does not upset the gravitational analysis? Firstly, relative to the $E$ frame the linear motion balances that of the continuum charge. There is no resultant electromagnetic effect due to linear motion. There is, in theory, an effect due to the apparent motion of the free particles at the angular velocity $\Omega$ relative to the $E$ frame. The free particles have deployed their velocity in the $E$ frame orbit into a linear motion in the inertial frame. Hence, they move relative to the $E$ frame in an apparent orbital sense which should develop an electromagnetic effect interfering with gravitation. To answer this, remember that the linear motion of the space–time system which causes the particles of the lattice to be freed is, in fact, only caused by graviton transmutation. The continuum volumes are adjusted in this process, as matter is created. In fact, the basic parameters of the space–time effects are readjusted. It must, therefore, be assumed that in this process the electromagnetic effects of any free charge are allowed for in the balance, just as the effects of the graviton charge are allowed for.

## Electrodynamics

In Chapter 2 the distinction was made between primary charge and reacting charge. The analysis leading to equation (2.8) can be criticized on the ground that reacting charge will have a velocity component in the direction of the applied magnetic field. This makes it difficult to contend that the term $K_R$ is the true kinetic energy. In fact, this problem is merely part of the greater problem that the actual kinetic energy of charge present and available to react may exceed the magnetic field energy requirements. The answer to this difficulty appears to be that $K_R$ is a component of kinetic energy added as a result of the application of the magnetic field. Further, not all free charge can be classed as reacting. All charge is presumably primary unless it is needed for reaction purposes. Heavier free particles will react in preference to lighter ones of the same polarity, but only a proportion of the heavier free particles present may be deflected by the field to become reacting.

This is tantamount to saying that not all free charge in motion in a magnetic field is subject to electrodynamic force action, at least at the same instant. Undoubtedly, this is a difficult proposition to accept, but, if Nature is pointing in this direction, we should not be unwilling to explore its further meaning. Also, the reader is reminded that in this book we are confronting electromagnetic problems, many of which are hidden unnoticed in the subtleties of mathematics in other treatments.

One currently accepted argument is that the diamagnetic moment of free charge is constant (see, for example, *Handbook of Physics*, 2nd edition, 1967, McGraw-Hill, p. 4–193). Analysis shows that as the applied magnetic field increases, electric field induction occurs along the orbit of the reacting charge. This is deemed to accelerate charge to keep the angular momentum, and so the magnetic moment, constant. Kinetic energy increases to keep in proportion to the applied field strength, as equation (2.7) requires if the reaction magnetic moment is not to change.

Now, what does this prove? Does it mean that free electrons in a metal are not diamagnetic? It merely indicates that a single electron will provide a definite magnetic moment in opposition to an applied magnetic field. Diamagnetism, as such, has to do with a multiplicity of electrons. We are concerned in (2.7) with a summation of all the effects of many reacting charges. The reacting or non-reacting state of a particular charge can be determined selectively, as suggested above. Hence, whereas the above regular argument proves that there should be a constant magnetic moment opposing any applied field action, if all charges behave alike, the author prefers the statistical selection as a better alternative. It then becomes irrelevant to argue that the reacting moment of a single electron is unchanged by changing field.

Some authorities require all charge to react in the same way and then invoke statistical argument to explain an overall compensation of magnetic moment. This is contrary to the authority of the above reference which specifies that free electrons react to oppose a magnetic field by developing a magnetic moment which does not vary as the field changes. Complete statistical compensation is, however, impossible to justify. Those who claim it, exemplified by Van Vleck (1957), seem primarily concerned with field-dependence of energy and not magnetic moment. They seem to make their error, a rather grave error, in using a formulation of the form:

$$\sum M = -\frac{\partial E}{\partial H}$$

to show that the energy quantity $E$ does not vary with a change of the magnetic field $H$ when the magnetic moment of free electrons is statistically evaluated. It is a most curious mistake because this formula itself contains the implicit assumption that there is no diamagnetism present. To be correct the value of $M$ should include also the magnetic moment directly attributable to the applied field $H$. History may one day show that this particular error has been a major set-back to the progress of theoretical physics. It has prevented the earlier development of the analysis on pages 30 and 31, analysis which could have helped considerably in the understanding of the gyromagnetic difficulties later to be discovered.

To conclude this discussion, a few final words could be said about the relevance of the Trouton–Noble experiment to the new law of electrodynamics presented in Chapter 2. The experiment did not involve the translational movement of the capacitor *relative* to the earth. The motion of the earth around the sun was taken as the motion which should induce any manifestation of electrodynamic action. It follows, therefore, that, if the electromagnetic reference frame can be said to be moving with the earth, there is no experimental electrodynamic effect to be expected anyway. As none was found, nothing has been proved. The empirical derivation of the law of electrodynamics is open to criticism on this account. There remains the theoretical derivation and the evidence of its successful application to phenomena, such as ferromagnetism and the explanation of gravitation. These should be sufficient to establish the law. As to the empirical derivation, can it really be expected that a charged capacitor should tend to turn *in its own inertial reference frame* if moved linearly through space relative to an observer? This is an impossibility. It is a contradiction in terms since there could be many observers with different relative linear motions, all involving different amounts of turning action (in different directions) but in the same inertial reference frame. Then, the electrodynamic reference frame alone remains as the reference for such actions. It either moves linearly with the capacitor, or it does not. If there is no measurable linear motion, and there were to be a turning action of the charged capacitor varying according to different uniform velocities of such motion, then Einstein's Principle of Relativity is disproved. It seems, therefore, fairly safe to accept that the experimental data are consistent with the empirical derivation of the new law of electrodynamics presented in Chapter 2.