MODERN AETHER SCIENCE

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The book follows the author's 'Physics without Einstein' published in October, 1969. It is an attack on those abstract philosophical dogma which are impeding the development of physics. Also, the author records progress made in expanding the physics of the earlier book, particularly on the formation of the solar system, the stability and structure of the atomic nucleus, and the periodic reversals of the earth's magnetism. The treatment is deliberately non-mathematical, inasmuch as a basic comprehension of the universe need not be founded in mathematics. It is shown that the aether has to be revived for complete understanding of physical science.

A mathematical extension of the new ideas presented in this work will be published separately under the title of 'Aether Science Papers' and will be available from the same publishers.

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Introduction

The old foundations of scientific thought are becoming unintelligible. Time, space, matter, material, ether, electricity, mechanism, organism, configuration, structure, pattern, function, all require reinterpretation. What is the sense of talking about a mechanical explanation when you do not know what you mean by mechanics?

The paradox is now fully established that the utmost abstractions are the true weapons with which to control our thought of concrete fact.

So said the philosopher Alfred North Whitehead in his *Science and the Modern World*, 1925. But surely weapons are not needed to control belief in what is true in Nature. Abstraction can surely have no lasting place in science. Physicists have had rather more to assimilate than has been possible and have lapsed a little into a world of abstraction. Whitehead must be wrong. The old foundations of scientific thought were intelligible to their creators. To say that they were becoming unintelligible merely implies developing weaknesses in the minds of later generations of scientists. There was impatience at the difficulties of fathoming and charting that sea of energy permeating space—the aether. And so, many pretended that the aether does not exist and did so by abstract mathematical formulations. History will one day show that they were wrong. In this work we will explore the modern evidence proving that the aether is a reality. We will proceed without mathematics and we will attack abstraction, and, in particular, we will attack Whitehead's problem of understanding mechanics, by explaining the nature of mass.

A mathematical analysis is provided in the author's book *Physics without Einstein*, but this new work goes beyond the scope of that book by incorporating the results of further research and exposing some weaknesses in existing theories. A solution to the mysteries of the creation of the solar system is an important original feature presented in this work. It is anticipated that the evidence provided will convince the reader that the ever-present aether deserves his attention, but if the reader is left with doubts it is hoped that this book will stimulate him to voice them and to seek to resolve them constructively. The true form of Nature is already set. It needs imagination and analysis and a will to defend as well as criticize any theories put forward, if we are to find a way to comprehend the sub-structure of Nature. In this book the author has been ready to criticize and has offered much that can be criticized, and if the reader is left with doubts he did not have before, this book will have served him well.

1

Nature's Unseen World

There are innumerable niceties concerning notions, relations, instants, formalities, quiddities and haecceities, which no one can pry into, unless he has eyes that can penetrate the thickest darkness, and there can see things that have no existence whatever.

ERASMUS, *Moriae Encomium*, 1509

Erasmus preceded Galileo, Descartes and Newton, men who founded new disciplines leading us to classical physics, the physics of an era of unquestioned belief in the existence of an aether. This era passed at the beginning of the twentieth century. The ideas of Einstein, Heisenberg and Pauli have changed our physics. We have reverted to principles, concepts which to Erasmus would be notions, relations and formalities. Our physics are now founded upon abstract philosophical dogma, whereas physical phenomena are still governed by an all-pervading environmental influence which, as it must have a source, signifies the existence of an aether. Because his eyes cannot penetrate the thickest darkness, the scientist of today cannot see what exists in apparently empty space, but he feels its effect and should be ever-conscious of its existence. The cosmos is linked by space and so space must be examined to find the links between the phenomena of our universe.

Understanding the cosmos provides an exacting challenge. But it is easy to find a starting point. Let us review some words quoted from the book by Lincoln Barnett entitled *The Universe and Dr. Einstein*:*

Today most newspaper readers know vaguely that Einstein had something to do with the atomic bomb; beyond that his name is simply a synonym for the abstruse. While his theories form part of

* Page 12 of second revised edition, Harper and Row, New York, 1957.

the body of modern science, many of them are not yet part of the modern curriculum. It is not surprising therefore that many a college graduate still thinks of Einstein as a kind of mathematical surrealist rather than as the discoverer of certain cosmic laws of immense importance in man's slow struggle to understand physical reality. He may not realise that Relativity, over and above its scientific import, comprises a major philosophical system which augments and illumines the reflections of the great epistemologists—Locke, Berkeley, and Hume. Consequently he has very little notion of the vast, arcane, and mysteriously ordered universe in which he dwells.

Clearly, we must start with Einstein's Relativity. Yet, where will this lead us? Will we follow like sheep into the complexity of a philosophical system and be hopelessly lost in a world of confusion? Let us avoid indoctrination which may cause us to make our scientific evaluations on the basis of aesthetic appreciation. It is not uncommon for scientists to describe Relativity by the use of the term 'elegant', but the truths of Nature are all too often inelegant and if we are to be objective we should favour simplicity rather than complexity. Disorder may come from order. Complexity may come from simplicity. The fundamental structure from which we are formed may therefore be simple, and should be assumed so in our initial enquiries. The world we experience is one of three dimensions. It is, in its structural geometrical concept, rather simple. It can be visualized. It is experienced and, in this sense, it must be real. Yet, Relativity would have us believe in a different world, a world of four space dimensions interlinked by time. Relativity concerns 'notions, relations, instants . . . which no one can pry into, unless he . . . can see things that have no existence whatever.' These may seem to be words of a heretic but, in the spirit of Erasmus, we will forge ahead with this assertion as a challenge to the existing disorder of things.

Do we have any allies in this pursuit? A recently published book by Harald Nordenson has critized the fundamental foundations of Einstein's theory.* In the final reflections in this work Nordenson writes:

As I have criticized Einstein very heavily in this book I am anxious to point out that my criticism applies to his philosophical reasonings

* *Relativity Time and Reality*, Allen and Unwin, London, 1969.

and especially those of epistemological character. On the other hand I have the greatest respect for his eminent contributions in other domains of mathematics and physics.

I have often met persons, especially outside Sweden, who have expressed their astonishment that Einstein was not awarded the Nobel Prize for his Theory of Relativity, which many people consider as one of the most outstanding achievements of this century. As a member of the Swedish Academy of Science which distributes the Nobel Prizes of physics I am on the other hand very glad that this was not done, since the Theory of Relativity is not physics but philosophy and in my opinion poor philosophy.

Nordenson has attacked the logical foundations of Einstein's theory. He has presented persuasive reasons, which we need not review here. Our object is to portray reality and replace the abstract, a point which is singularly pertinent if we look at the review which Nordenson's book attracted from the *British Journal for the Philosophy of Science* (August 1970):

The author of the book under review is led to the drastic conclusion that Relativity Theory is logically incoherent, contains inconsistencies and must be rejected, even though he admits we have nothing to put in its place.

It seems appropriate to mention that in September 1970 the Review Editor of this very journal wrote to the publishers of the present writer's book *Physics without Einstein* explaining the difficulty of finding a reviewer. About the book he wrote:

We noted its unusual interest and decided that we should like to review it in our columns. Unfortunately we cannot do this if we cannot find a reviewer, and so far all the five persons approached have been unable to review the book for us.

It would seem that the modern physicist is so specialized in the physics of today that he has lost the aptitude to adapt to new ideas. Perhaps, however, we should be referring only to the philosophers of science. Unable to adapt to new concepts but unwilling to reject the old unless we have something to substitute, the philosophers appears locked in a state of mental stagnation. Relativity is sacrosanct.

The relativistic method is so entrenched that few writers are able to secure publication for their alternative ideas. Few readers can assimilate what is presented to them in texts on Relativity, but the establishment has ordained that Relativity shall be the accepted doctrine. To quote from a publisher's summary of a recent work on gravitation:

> This book is a review of recent research developments pertaining to the theory of gravitation. After consultation with many scientists throughout the world working in relativity theory, the most important topics being worked on today were selected for inclusion in the book.*

Someone has decided, it seems, that only Relativity can lead us to understanding gravitation.

Our challenge, therefore, is not merely presented by the cosmos. Mankind has inertia just as does mass. The challenge in the quest for ultimate truths is to confront this barrier presented by man himself. Later in this work we will consider the nature of gravitation. Leading professors have expressed themselves on this subject. Hoyle (1964) wrote:†

> There is no such thing as gravitation apart from geometry . . . the geometrical relationship between different localities is the phenomenon of gravitation.

On the same subject, Bondi (1963) wrote:‡

> Gravity is a peculiar force and thus rightly described in a very special way.

Our starting point could be Relativity, but what prospect of lasting success? Perhaps that path will lead us to dispose of the cosmos as some mathematical concept devoid of real form and essentially peculiar. It seems better to retrace some of the ideas of antiquity and examine how our basic ideas of the cosmos developed. We must look at the problem of the void in which we are immersed. Either there is some physical substance filling all space or there is not. If there is, then it must yield its secrets if we pry into this unseen world with enough

* *Gravitation: An Introduction to Current Research*, Wiley.

† 'A New Theory of Gravitation' by Hoyle, pp. 19–26 in 1964 BBC Publication entitled *A New Kind of Physics*.

‡ 'Acceleration and Gravity' by Bondi, pp. 5–12 in 1963 BBC Publication entitled *Relativity Today*.

imagination and conviction. Eventually, we must discover the elements of its structure and have enough verification from the methods of physical science. If the void has no substance, it has no existence. It can provide no links, no metric structure, nothing by which the coherent properties of physical science can be related. We are left to philosophize. Mathematical formulations are the creation of our minds. They cannot provide an aether in themselves. They can describe an aether if one exists in Nature. In this work, therefore, our starting point must be a firm belief in the existence of a medium filling the heavenly void. The aether has to be real. If we fail to succeed then we leave the task to others in the future who may have more luck in fathoming this vital secret of Nature. We can pacify ourselves by diverting to philosophy. We can embark on the Relativity journey and eventually be drugged by notions which cause us to lose all sense of time. But let us see where we arrive in this pursuit.

Modern science has presented many facts to us which we can understand in terms of our physics, but many of the problems with which the ancients wrestled are unsolved to this day. It is these problems which are important in any effort to understand the cosmic world.

2

'The Flight of Thunderbolts'

This was the title of a book written just a few years ago by Sir Basil Schonland.* It tells of the thunderbolts, a phenomenon which is as much a part of our cosmic world today as it was when our forebears saw it as a weapon of their Gods.

Ignorance of the scientific foundation of lightning did for a period, it seems, enhance one's chances of death. Schonland describes how in early times in Europe, man, aware that lightning was an act of God, sought to protect himself by prayer. It was usual to supplement prayer by the violent ringing of church bells and, accordingly, bell ringing became a practice during thunderstorms. Lightning has such an affinity for church steeples that this custom resulted in tragedy. Schonland quotes a book published in Munich in 1784 giving the data that in 33 years, 103 bell-ringers had been killed in this way. This was, of course, before the implementation of the remedy which Benjamin Franklin had found for protecting buildings from the effects of lightning. He discovered that lightning was merely a flash of electricity which could be diverted harmlessly to ground by the use of a lightning conductor.

Lack of true knowledge of the physical world can be a source of unnecessary hardship to mankind. It is interesting to quote from Schonland thus:

> Between 1926 and 1930 three accusations against witch-doctors concerning crimes . . . which involved the control of lightning as a guided missile, were brought before the native courts of the Kgatta tribe in the Bechuanaland Protectorate. One was a charge of actual murder by lightning; the accused pleaded guilty and admitted that he had successfully directed a lightning flash to kill another man. The other two cases were charges of malicious damage to property, both

* *The Flight of Thunderbolts*, Clarendon Press, 1964, p. 4.

of the accused having set huts alight by directed lightning. All were found guilty and punished; the confessed lightning murderer (to make the punishment fit the crime) was, by order of the presiding chief, severely branded in the mouth with a piece of burning wood.

We can discount this as ignorance or lack of civilization, but surely ignorance is relative and we too will be judged ignorant by future generations. Our modern knowledge of these destructive phenomena of Nature is not as great as many may believe. The subject of thunderballs, an apparent by-product of thunderbolts, has been under scrutiny in the journal *Nature** in 1970:

In some parts of the world, earthquakes are often accompanied by ball lightning, stroke lightning and sheet lightning. The only causal connection that seems possible is that seismic strains of the earthquakes cause an electric field in the air, which in turn produces ball lightning and stroke and sheet lightning.

It would seem that we do not yet understand the processes by which the electric origins of lightning are explained. Lightning is electricity, but how is lightning generated? There are conventional explanations, but it seems that they are inadequate to explain what happens in earthquake conditions. More will be said about this later, but here we are confronted with the problem of ball lightning, and this may not simply be dismissed as electricity.

We have several reports of ball lightning floating for several seconds down the aisles of metallic passenger aircraft, as well as into homes.

This is quoted from a paper by Altschuler and his colleagues, writing from the High Altitude Observatory, National Center for Atmospheric Research, Boulder in USA.† The authors also mentioned observations of lightning balls which glow red, one which measured about 60 cm in diameter, moved into the ground and dug a trench, and another which moved into the water in a rain barrel and dispersed itself heating the water. Analysis of data showed that the balls have a very large energy density which defies explanation. Their energy is released non-explosively. They can move into objects carrying their energy into the core of the substance. They appear able to float without inducing convection effects, as if buoyantly supported in space. They are

* *Nature*, Vol. 228, p. 759, 1970. † *Nature*, Vol. 228, p. 545, 1970.

stable and display certain electrical effects as well as generating acoustic, visible, infrared and ultraviolet radiation. It is evident that if they were to move into the human body there could be fatal consequences, but what are they?

Seven years earlier, in 1963, D. J. Ritchie of the Bendix Corporation in the United States wrote a paper* concluding:

No matter what may prove ultimately to be the proper explanation of the phenomenon in nature, the manifold directions of research into ball lightning are opening new possibilities for the service of mankind.

His paper was prefaced with the statement:

As with unidentified flying objects, the origins as well as the existence of ball lightning have, in the past, been extremely controversial, with some authorities insisting that such a phenomenon did not exist. However, not only has recent work corroborated the existence of ball lightning, but many data, both analytical and experimental, have been produced.

Ritchie was experimenting on the assumption that the thunderball is an ionized sphere of gas energized by the induction of short-wave electromagnetic oscillations produced in a thunderstorm.

In his 1964 book Sir Basil Schonland commented:

A significant number of earlier reports on ball lightning has likened their behaviour to that of soap bubbles.

Referring to theories advanced to explain them he says:

Some of these suppose that part of the highly ionized channel of a flash is detached (for reasons not understood). But for this detached portion to continue to glow for a few seconds is inexplicable unless some other outside agency supplies it with energy and . . . there is no evidence at all for any such source, which would have to be prodigious.

After dismissing all prospective explanations, the 1970 Altschuler paper resorted to the suggestion that the energy source might be nuclear in origin, but concluded also that there were numerous and difficult theoretical objections to this nuclear hypothesis.

Dare one suggest that they are nothing more than simply a

* *Journal of the Institution of Electrical Engineers*, 1963, p. 202.

phenomenon of the unseen aether medium? A rotating sphere of aether would have all the properties evidenced by the thunderball. The writer, having a firm belief in the aether, showed that the energy content of the thunderball can also be explained easily and in perfect relation with other theory he has presented elsewhere.* However, the journal *Nature* declined to publish such an account for the reason that 'it is not of sufficiently wide significance'.

It is curious to see what man does regard as significant. The writer well remembers his flight from London to New York on June 15, 1970 (BOAC flight No. 591), when the pilot announced the sighting of 'an unidentified flying object' crossing above our flightpath ahead—a spinning object. The passengers were invited to view it. I heard no more of it after the flight. Presumably this is not an unusual occurrence and therefore not particularly significant, but I wonder what might have happened had we flown into it. An event of some personal significance may well have occurred. Would perhaps we have had a rather large thunderball floating down the aisle of the aircraft?

If the thunderball is to become a nuclear phenomenon instead of simply a turbulence, eddy or whirlpool in the aether, this is in line with history. We do not know what it is for certain. If we like to believe it to be nuclear then that is our open choice. It is probably the same with our understanding of the heat source which sustains our lives, the sun. We have not known of nuclear energy for that many years, but we are now assured that the sun is one massive nuclear furnace. We do not know quite why it does not blow up in one large bang, but, for want of a better explanation, it keeps us content to imagine that the sun's energy is of nuclear origin. At the risk of appearing cynical, dare it be suggested that perhaps it is a very large thunderball, or rather a very large ball of the kind we associate with the thunder and lightning phenomena.

One might wonder if the men of ancient times ever perceived these thunderballs as miniature suns, after noticing their bouyancy in space and witnessing them dipping into water and dispersing energy.

* *Physics without Einstein*, Sabberton Publications, Southampton, 1969.

In *The Story of the Heavens*, Sir Robert Stawell Ball* relates:

The old mythology asserted that after the sun had dipped in the western ocean at sunset (the Iberians, and other ancient nations, actually imagined that they could hear the hissing of the waters when the glowing globe was plunged therein), it was seized by Vulcan† and placed in a golden goblet. This strange craft with its astonishing cargo navigated the ocean by a northerly course so as to reach the east again in time for sunrise the following morning. Among the more sober physicists of old, as we are told by Aristotle, it was believed that in some manner the sun was conveyed by night across northern regions, and that the darkness was due to lofty mountains which screened off the sunbeams during the voyage.

The object of these early ideas was to explain, not the nature, but the apparent motion of the sun. Nevertheless, it was conceived as a ball of fire, the origins of which were beyond speculation. It is of interest to wonder how the physicist contrived to explain the source of the sun's heat before the advent of nuclear theory. One viewpoint attributed to Sir William Herschel in a book published in 1852‡ is expressed in the words:

In order to account for the various appearances of the spots (on the sun), he supposed the sun to be surrounded by a transparent atmosphere, in which are suspended two distinct strata of clouds at different elevations. The upper stratum is composed of self-luminous clouds which constitute the source of solar light. The lower stratum is composed of opaque clouds, which shine only by the reflexion of the luminous regions above them.

The fact is that the centres of the sunspots expose lower regions within the sun and, by the physics we accept, these inner central regions are darker and therefore at lower temperature than the outer regions. Herschel's argument that the energy source is a shell enveloping the sun can have some truth in it. Furthermore, there are still some voices left to argue that the sun's energy is not direct nuclear radiation. For many years a scientist named Bruce has been urging a theory that the solar radiation comes from continuous lightning discharges at the

* Published by Cassell, London, 1897.
† The Roman god of fire, son of Zeus.
‡ *History of Physical Astronomy*, by Robert Grant, Bohn, London, 1852.

surface of the sun. Sir Basil Schonland mentioned this in the last words of his book. He writes:

Many hot stars, including our own sun, emit radio waves of high frequency which penetrate our ionosphere; their sources are hot plasmas in stellar magnetic fields and hardly qualifying for description as thunderstorms. But whether any of the dying stars have relatively cold atmospheres in which thunderstorms could be created is an interesting speculation. Bruce has developed ingenious theories to explain in this way the periodic bursts of light from the long-period variable stars which make them on the average 100 times and sometimes 10,000 times brighter at maximum than at minimum. It is too early to form a judgment on his many remarkable proposals which extend to lightning discharges in nebulae with channels 1,000,000 light years long.

To the writer, the idea of a shell of the solar atmosphere being the source of radiation by electric discharges has appeal. The reason is that, as such, it would not be at a uniform temperature and would appear hotter from observations assuming uniform temperature. Thus, the inner parts of sunspots could be at the same temperature, or nearly at the same temperature, and yet appear darker. The problem envisaged by Schonland of the sun being too hot to sustain the mechanism by which thunderstorms are created can be swept aside, as we shall see in Chapter 5. We have reason to see that the cosmos provides a powerful mechanism by which electric fields and consequent electric discharges are produced. If the modern scientist cannot yet be sure how breakdown level electrical charges can be produced in our own atmosphere, then he should think seriously about Bruce's claims that this fundamental mechanism is at work at the surface of our sun.

If progress can be made along a new track for explaining the origins of solar radiation, we may yet explain the origin of the solar system and the primordial energy source of our universe.

Taking note that rotating glowing spheres can be produced from lightning discharges, the thunderballs seen on the earth, is it not possible that Bruce's theories about cosmic lightning discharges might spell for us the origins of our own sun? The sun could be a rotating sphere of aether evidenced by its electrical action in ionizing co-extensive gaseous matter. The sceptical reader might say that it could equally be explained by many other notional concepts. However, that is negative thinking and what is proposed here is constructive.

Let us risk a little speculation. If a spherical volume of the unseen aether medium rotates, it may result in an electric displacement effect radial from its axis of rotation. It is well known from Maxwell's work that a vacuum exhibits electric displacement properties so we are not making an unreasonable proposition. Rotation of a sphere of aether would then develop a magnetic field. It is easy then to say that if such a sphere housed an ionized plasma rotating with it, then both the radial electric field and the magnetic field would be cancelled. However, we know that the sun has a magnetic field and we also know that 'lightning balls have been known highly to magnetize metallic objects such as gun-barrels'.* Therefore, the cancellation may only be partial and we can examine with justified curiosity the properties of the rotating aether medium.

Furthermore, the association of earthquakes and lightning implies a link between gravitation and lightning. The form of this link may be the aether medium. The prospect that cosmic electricity can produce tremendous electric discharges which may induce aether rotation and the formation of bodies like the sun is an exciting thought. The problem is how to proceed with these ideas. In the next chapter we will follow the early background of gravitational theory in the hope that this may help us to forge the links we seek.

* Quoted from the Ritchie paper referenced on page 10. Also note that since the Altschuler paper referenced on page 9 was published, A. A. Mills writing in *Nature Physical Science*, October 18, 1971, p. 131, has questioned the nuclear hypothesis. Mills tested a piece of church masonry known to be struck by ball lightning, looking for radiation dosage. He concluded tentatively that 'the incident at St. George's provides no evidence to support a ball lightning mechanism involving a strong source of radiation'.

3

Discovering Gravitation

The nature of gravitation was accounted for by Aristotle (383–322 BC). Bodies comprised four elements: fire, air, water, earth. These elements could interchange, one being transmuted into the other. Each one sought an 'end'. This accounted for its tendency to move. Thus, fire moves upwards, whereas other elements move downwards. Everything seeks an end and has a final cause. Bodies gravitate because they seek to reach the centre of the earth.

Aristotle's philosophical notion about the nature of the force of gravity prevailed for eighteen centuries. Then man's understanding of the behaviour of bodies under the action of gravitation developed rapidly. The techniques of experimental research began to develop. The concepts of vectors, both force vectors and velocity vectors, and new mathematical skills emerged alongside the discovery of the telescope. The motions of heavenly bodies could be analysed in detail and found to be subject to behaviour patterns indicating compliance with Nature's laws, the laws of physics.

A Dutch military engineer Stevinus (1548–1620) is credited with the discovery that a uniform chain laid over a double incline must rest in equilibrium if its ends are in the same horizontal plane. What the long part gains in weight it loses in that only a part or component of it is effective downwards. Hence emerged the difficult idea of what we call a vector component. About the same time Galileo (1564–1642) discovered the vector properties of velocity. The prevailing notion was that a body could have but one velocity at once. Galileo established that a body could have two separate components of velocity which varied independently. Galileo also helped to correct the idea that all bodies slowed down when not acted upon by force.

It was erroneously believed that a constant force on a body would produce a constant motion. Hence the need to demonstrate that bodies of different weight fall at the same rates. Stevinus reports such an experiment:

> . . . The experiment against Aristotle is this: let us take (as I have done in company with the learned H. Jan Cornets de Groot, most diligent investigator of Nature's mysteries) two leaden balls, one ten times greater in weight than the other, which allow to fall together from the height of thirty feet upon a board or something from which a sound is clearly given out, and it shall appear that the lightest does not take ten times longer to fall than the heaviest, but that they fall so equally upon the board that both noises appear as a single sensation of sound. The same, in fact, also occurs with two bodies of equal size, but in the ten-fold ratio of weight.
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> *De Beghinselen des Waterwichts*, Simon Stevin, 1586*

Galileo used a pendulum to show that the time of swing does not depend upon the amplitude of the swing and then argued mathematically that this implies that gravity is increasing the speed of the bob by equal amounts in equal times, the discovery of the acceleration of the earth's gravity.

When some Dutchmen discovered the telescope, Galileo quickly made a series of revolutionary discoveries in astronomy. Then Kepler (1571–1630) formulated his laws of planetary motion, demonstrating that their orbits are elliptical. To account for the force acting on the planets governing their motion, Kepler chose magnetism. It was Newton (1642–1727), several years later, who was to introduce the concept of universal gravitation. His idea was that there is a single universal force, the force of gravity. Gravity acts between all elements of matter in proportion to the product of their masses and in inverse proportion to the square of the distance between them. This relationship introduces the Constant of Gravitation G, a universal constant, verified as such by Newton by comparisons made for three systems:

(*a*) The actions between the sun and a planet, treated mathematically as two point bodies with the planet moving in an elliptical orbit about the sun as focus,

* Quoted from *Science Past and Present*, by F. Sherwood Taylor, Heinemann, London, 1945, p. 82.

(*b*) The actions between the moon and the earth, as two finite spheres, and
(*c*) The actions between the earth and a small body close to its surface, treated as a point body close to a large sphere.

Newton had to apply then-complex mathematical principles to verify his law for the general case, and his law of gravitation stands as one of the cardinal achievements in the history of science.

Although Newton succeeded in relating the various effects and associating them all with one phenomenon, he did not explain the nature of this phenomenon. Newton did not claim to understand the origins of the force of gravity. He studied its effects on the motions of bodies. His discovery was the Constant of Gravitation G and its universal character, but he could not understand why G was a constant, nor, indeed, could he evaluate G in his time. Its evaluation depended upon knowledge of both of the interacting mass quantities. Astronomical masses could not be measured. They are estimated today from our knowledge of G.

G was estimated in about 1740 by the mountain measurements of Bouguer. In the experiment the deflection of a plumb-line from the vertical due to the side-ways gravitational attraction of the mountain was observed. The difficulty was to evaluate the size and density of the mountain. Later, in 1797–8, Cavendish, using the torsion balance, was able to measure the force of attraction between two small bodies in the laboratory and thereby determine G.

Still the nature of the force of gravity was not understood. Then in 1836 Mossotti proposed a theory of some interest. He suggested that there existed electrical charge which was mutually repulsive and that mass was also mutually repulsive. Further, mass and charge had an affinity for one another. This attraction effect between mass and charge was assumed to be somewhat greater than the repulsive force, giving an overall attraction which represented gravity. Weber and Zollner later developed this idea. They regarded molecules of mass as associations of positive and negative electricity and imposed the condition that the force of attraction between charge of opposite polarity is somewhat greater than the force of repulsion between charge of like polarity.

Such was the speculative state of man's understanding of gravitation, when things began to go wrong with the basic law of gravity. The cosmos was withholding its secrets and the laws governing the motions of heavenly bodies evidently had some finer points which needed examining. This we will come to presently in Chapter 6 when we discuss Einstein's theory of gravitation. For the moment, it is appropriate for us to take stock of how physical science had really been developing since the end of the sixteenth century. Gravitation had captured the scene in the astronomical field, but essentially there are three other important scientific topics to follow in our quest to understand cosmology. The unseen aether medium is one of prime importance. The development of electrical science is probably even more important than the progress in mechanical science. Then there is the question of the source of energy sustaining the universe. Besides these, gravitation is merely a secondary issue, and not a foundation on which to build an understanding of the physical nature of the cosmos.

Descartes (1596–1650) published in 1644 his *Principles of Philosophy*, which contained his expositions on mechanics, on what he termed the 'visible world', and also the subject 'of the Earth'. Descartes advocated belief in an aether medium of which all parts are in motion. He envisaged a plenum composed of eddies, whirlpools or any kind of turbulent motion. Gravitation was attributed to some special substance which entered a body and had the property of seeking to reach the centre of the earth. The sun's energy source posed a more difficult problem. He likened the sun to a flame but could not understand how the sun was sustained in the absence of surrounding air and a source of fuel. At the end of the 22nd section of part 3 of his work he writes:

> We do not see that the sun is dissipated by the surrounding substance; this is why we have no way of judging whether it needs sustenance like the flame; and at all times I hope I may come to see in the future that it is still similar in that constantly material enters it in one form and leaves it in another form.

Given an aether medium one might wonder why Descartes could not have looked to this for his source of solar energy. This would have raised the difficulty that all astronomical bodies might need to be fiery infernos as well, but answers to this difficulty may be there to be found if one accepts the aether medium.

Naturally, ideas about the aether were based on mechanical analogies. Electricity, as the really fundamental property, could not be countenanced. With the development of Newtonian mechanics there was scope to analyse models of the aether medium. The progress made in understanding optical phenomena and the properties of solid and fluid substances was such that the mechanical aether was to the fore. Therefore, as electrical science developed and particularly as magnetic phenomena were discovered, it seems that every effort was made to explain the aether's electrical phenomena in terms of mechanics.

At the end of the nineteenth century the concept of mass stood alongside the concept of electric charge. They were used jointly in explaining physical phenomena. The idea of Weber and Zollner about the uneven interactions of charge and mass as an account of gravitation is typical of this intermixing of properties to explain fundamentals. Rather than explaining gravitation, it would be more direct to explain mass itself in terms of electric charge. Alternatively, the object should have been to explain electric charge in terms of mass properties. However, not knowing what either is in terms of the other, and not knowing what gravitation is either, the undaunted physicist goes on in his attempts to relate phenomena. He runs the risk of explaining a cause in terms of its effect rather than solving his problems the right way around. But to achieve any logical relation is progress. This brings us to the work of Helmholtz, who took note of the fact that gravitation itself could be a source of energy. He propounded the theory that the contraction of matter forming the sun releases energy and is the source of the sun's heat. This idea has now captured the imagination of the astrophysicist. It has taken on a different form in the concept of 'gravitational collapse' and leads to the fantasies of 'black holes' in space. We will come to this later. In the meantime, we examine the beginnings on which this concept is founded.

At this stage, the writer interjects the thought that at a time when the aether was accepted by physicists the logical energy source was the aether itself. Otherwise, we merely assume the existence of matter, derive energy from its coalescence, and are left with the ultimate problem of still explaining the origins of matter and the energy needed to set it apart in the first place.

Also, it is appropriate to interject another observation addressed to those readers who remain sceptical about the aether medium and treasure their thoughts about four-dimensional space. The point concerns the stability of motion under Newton's law of gravitation. I quote from the work of a science historian:*

Laplace (1749–1827) was the supreme mathematician of Newton's planetary theory. The greatest single missing link—and a great one it was—which he supplied in Newton's work was his partial proof that the system would be a stable one; but it was his prodigious power in dealing with both the detail and the general features of the subject which gave him his characteristic place in scientific history.

Laplace died 100 years after Newton. Newton's theory, it seems, needed confirmation on a point of stability and it took so long a time before someone realized and resolved the difficulty. Now, one may wonder whether anyone has bothered to check the stability of the near-elliptical orbits of the planets in Einstein's four-dimensional space using Einstein's modification of Newton's law of gravitation. The passage of time since the inception of Einstein's Theory is no warranty that this point has been checked. On the contrary, one can begin to wonder all the more on reading the following:

Have you ever wondered why ordinary space is three-dimensional? Although this may seem to be a ludicrous question, it has been the subject of considerable thought by scientists and philosophers since the time of Aristotle. . . . However, you do not need to worry that space has been five dimensions without you knowing because general physical arguments have revealed that three is the only combination that works.

Dr. Ira Freeman has recapitulated the reasoning in a translation of W. Büchel's article 'Warum hat der Raum drei Dimensionen?'

* *Science Since 1500*, by T. Pledge, H.M. Stationery Office, London, 1939, p. 71.

(*American Journal of Physics*, Vol. 37, p. 1222). Dimensions larger than three can be discounted if we accept that the gravitational force varies as the inverse square of the distance between two masses. This law, originally derived by Newton, will only allow for stable elliptical planetary orbits if spatial dimensions are three or less.*

It is difficult to imagine how Relativity's very small change in the law of gravitation from the form postulated by Newton could permit the remarkable step of introducing a new fourth space dimension. Perhaps a Laplace is needed to rescue Relativity.

Laplace proposed a nebular hypothesis in 1796. Quoting from a 1835 edition of his work:

> . . . the atmosphere of the Sun originally extended beyond the orbits of all the planets, and . . . it has gradually contracted itself to its present limits.†

Laplace was, of course, concerned with the formation of the planets, but that is not our immediate interest here. It is the application of Laplace's idea by Helmholtz which is of concern. Helmholtz's work dates from 1854:

> When the nebulous chaos first separated itself from other fixed star masses . . . an immense dower was bestowed in the shape of the general attraction of all the particles for each other. The force, which on the earth exerts itself as gravity, acts in the heavenly spaces as gravitation. As terrestrial gravity when it draws a weight downwards performs work and generates kinetic energy so also the heavenly bodies do the same when they draw two portions of matter from distant regions of space towards each other. . . . When, through condensation of the masses, their particles came into collision and clung to each other, the kinetic energy of their motion would be thereby annihilated, and must reappear as heat. . . . Calculations show that, assuming the thermal capacity of the sun to be the same as that of water, the temperature might be raised to 28,000,000 of degrees, if this quantity of heat could ever have been present in the sun at one time. This cannot be assumed, for such an increase of temperature would offer the greatest hindrance to condensation. It is probable rather that a great part of this heat, which was produced by condensation, began to radiate into space before the condensation was complete. But the heat which the sun could have previously developed

* *New Scientist*, February 19, 1970, p. 343.

† Quoted from *Science Past and Present*, by F. Sherwood Taylor, Heinemann, London, 1945, p. 195.

by its condensation, would have been sufficient to cover its present expenditure for not less than 22,000,000 of years of the past.*

We well know, today, that the earth is older than this by a factor measured in hundreds. Hence, Helmholtz's theory has no place in modern opinion. One may, nevertheless, wonder what Descartes' whirlpools in the aether would make of the chaos of all this energy coming together to form the sun. Might, perhaps, the aether contrive to form itself into a rotating unit, a whirlpool, co-extensive with the form of the sun and absorb some of the energy released by the gravitational compaction of matter?

The Constant of Gravitation has only been measured on this our earth. Newton has shown it to be a universal constant in this our solar system. We assume that the self-same value of the constant applies throughout the universe. We make this assumption even though it leads us to believe that some stars are so dense that tons per cubic inch are inadequate units for convenient expression. In the solar system we are dealing with bodies whose densities fall within the densities of the substances used by Cavendish in his experiment to measure G. What if G is different when the density becomes really high? Then, our ideas about the white dwarf stars, for example, will need drastic revision. We do not know exactly what gravitation is and so we assume G to be a universal constant throughout the whole universe and apply it to all matter concentrations however dense. With a very dense star we are then led to realize a problem. As the energy of the star is spent by radiation it will eventually have to cool down. Then its matter must regain a more normal density because the temperature will have originally stripped electrons from its atoms and permitted the tight compaction and the recovery process must lead to its physical expansion. As Eddington puts the problem:

> An intolerable situation—the star could not stop losing heat, but it would have insufficient energy to be able to cool down!†

* Quoted from *Science Past and Present*, by F. Sherwood Taylor, Heinemann, London, 1945, p. 196.

† *The Nature of the Physical World*, by A. S. Eddington, Cambridge University Press, 1929, p. 204.

Work has to be done against the force of gravity in the expansion process. It does seem so absurd that a star could find itself in such a plight. Eddington said that the answer to the difficulty came from the development of new statistical mechanics. Another answer could be that the ever-present aether, being an energy source itself, helps the star out of its difficulty. If there is an aether it seems likely that it will play a role in communicating gravitational force. Force is measured in terms of an energy gradient. If there is no energy available, then there can be no energy gradient and so no force. Gravitation is not guaranteed by Newton's law. If gravitation is a secondary property of the aether medium, the lack of energy will rule out the action of any force. The star will expand and the aether will react to assert gravitation, drawing upon whatever energy sources it has available to feed the energy requirements.

This may lead us to the thought that changes in the gravitational compaction of matter and the deployment of the energy involving the prospective aether may occur with earthquakes. With the overall compaction of a large body of stellar dimensions the energy density may become so great that the aether may be able to absorb the energy. For the earth, however, we may expect not so much an energy exchange, but an angular momentum exchange. Conservation of angular momentum is a consequence of a central law of force such as Newton's Law of Gravitation. Thus if the effect of the earthquake is to decrease the effective radius of the earth and reduce its moment of inertia, the earth will begin to rotate faster. If the earth is permeated by an aether medium which rotates at the same angular velocity, then this too will rotate faster.

This chapter has not taken us much further in our quest. It has served its purpose in bringing us to wonder whether gravitational potential energy has an exchange relationship of some kind with energy stored in the aether medium and possibly with energy associated with aether rotation.

This idea will be turned to good account in the next two chapters.

4

The Lodestone

A true understanding of Nature can only come from the correct interpretation of reliable facts. Experimental science is the source of an ever-increasing number of facts, more or less reliable, depending upon the degree of success of the experiment and the assumptions implicit in the technique or the analysis of the results. We have a vast amount of data but progress towards certainty is still rather slow. One would think, however, that in modern times we can depend less upon imagination and hypothesis than did our forebears. We should be living in an age of empirical certainty coupled with a clear insight into the reasons for Nature's mysteries as presented by Nature herself. We should have real confidence in the certainty of our knowledge if we are to feel proud masters of mysteries of our physical environment when we look back to the amusing ignorance of the philosophers of the past. Unfortunately this is not true. Anyone looking at physics as an outsider would think that everything had been revealed to the discerning scientist of today. It is so complex and it is founded upon careful research and enquiry by so many workers all over the world. It must be founded well and present a truthful picture of the inner workings of Nature. Yet it does not. Nor do we see an elimination of hypothesis and an account logically founded on factual beginnings. Sometimes one cannot trace the facts which the mathematics are supposed to be explaining. Most published accounts of the physical features of Nature, except, of course, the elementary texts for the school reader, tell their story as if the universe would not exist were it not for certain hypotheses such as the Uncertainty Principle of Heisenberg, the Exclusion Principle of Pauli and the Principle of Relativity of Einstein. Hypothesis and theory dominate all the experimental data. Is it really so different from four centuries ago? Man's ego is such that he has to explain his knowledge with conviction. He is reluctant to appear weak and insecure, even when he is trying to develop interest in that vast environment in which we all exist and which will, as a matter of mere logic, never yield to complete understanding by mere mankind.

In this book we are treading our path confident only that there is uncertainty about many if not all of our current scientific beliefs. We stand ready to change our minds, and if someone expresses certainty we will question. How otherwise can we be any more knowledgeable than Aristotle? If we superimpose our imagined convictions upon our quest to understand Nature, we will have theorized about ourselves, rather than about Nature alone. I believe that there is an aether. I cannot be certain but I can show stronger reason for believing in the aether than is afforded to the contrary by the counter-arguments in the literature. I want to understand the portrayals of Nature found in so many textbooks, but I am unhappy about their foundations. They do not seem strong enough to support the grand edifice built upon them. What is mass? What is gravity? Why are all electrons alike? Why does light travel at a definite speed? What is magnetism? If you appeal to a principle, have you explained anything until you eventually explain the principle itself? We know so much more today, but relate our knowledge in such a complicated way that one wonders if we really understand any better.

Comparisons to judge man's progress in his intrinsic ability to understand cannot be made by measuring our knowledge of new experimental facts. Effective comparison can only be made from a consideration of the progress of our knowledge in understanding the results of the earliest scientific experiments. It was towards the end of the sixteenth century that experimental science began to develop as an accepted method of enquiry. Much credit in this pioneer effort must go to William Gilbert (1540–1603), who devoted his life to the study of the properties of the magnet. His treatise *De Magnete* was published in 1600. Gilbert's contemporaries well knew of the magnetic properties of the mineral iron oxide, called by the name lodestone. The concept of poles and their properties of mutual attraction or repulsion were also known. The tendency of the lodestone to set itself in a preferred North–South direction was one of Nature's recognized mysteries usefully applied in compasses for navigation. Hypothesis had it that the lodestone tended to align itself with some northerly star or that it was magnetically attracted to point towards a large lodestone mountain in Arctic regions. Experimental verification of such hypotheses was not an easy task for Gilbert to undertake. He did contrive an experiment to verify his own hypothesis that the earth was a very large magnet and that this could account for the observed behaviour of the compass. Using a lathe, he machined a sphere of lodestone and by using tiny magnets at different positions on its surface he demonstrated that the orientations of the compasses, including their angles of dip, were analogous to the behaviour of compasses reacting to the earth.

Gilbert can be said to have discovered that the earth is a large magnet and it seems that this discovery will stand as firmly established as any ever made by man, but does the modern physicist understand why the earth is a magnet? He thinks he does because he has, in recent times, discovered that a thermally-agitated electrical medium can induce a magnetic field when rotating. We have what is called a theory of hydromagnetism. If the earth has a hot rotating fluid core it is natural to rely on this to account for the earth's magnetism. We do not apparently need any other explanation, even though there is no reasonably certain quantitative verification of the theory.

The physicist constantly discovers new experimental facts. The sun is also a magnet. Its magnetism can be measured by examining the spectrum of solar radiation. But there is a problem here. The sun's magnetism is changing and it appears that it may reverse cyclically over a period of years. Indeed, evidence has been afforded by some stars showing that their magnetic poles exchange positions every few days. Even the earth is now believed to reverse its magnetism every million years or so. Writing about the rapid reversals of the stellar magnetic fields, S. K. Runcorn said in *The Times* (London) of April 26, 1965:

This is one of the most stimulating challenges of cosmic magnetism.

This is no understatement. The star itself, contrary to observation, would have to change its direction of rotation for the existing theory to explain the magnetic reversals. We cannot then assert any reasonably confident knowledge of the nature of cosmic magnetic properties. Certainly, we must doubt the current theory of the earth's magnetism.

Even the nature of the intrinsic ferromagnetism of the lodestone has remained one of the cardinal problems of theoretical physics. There are so many alternative physical models side-by-side in modern texts on magnetism, all purporting to explain the same phenomenon, that no one can assert that we truly understand today the fundamental magnetic nature of the lodestone. Curious though it is, the earliest discoveries—lightning, magnetism, gravitation—are the ones which present the greatest problems, no doubt because they are so fundamental.

There is really nothing sacrosanct about the physicist's present interpretation of Nature. We are all free to think things out for ourselves and we can explore our own ideas without being obliged to conform to the pattern already set by others. If we are to fathom the basic structure of Nature we cannot be timid in the approach we take. Let us explore here a hypothesis of our own, boldly forging a link between gravitation and magnetism. Take the idea of Weber and Zollner already presented and develop it one step further. If gravitation were attributable to a greater force of electrostatic attraction between charge than of repulsion, then possibly charge of different polarity may display a similar inequality in producing a magnetic field. For example, suppose that a small fixed proportion of all positive charge, say, is ineffective in producing any mutual repulsion with its counterpart in other positive charge and that it is ineffective in inducing magnetism as well. Then, given the mass of any element of neutral material, we can associate with it a virtual negative charge, in electrostatic units, given by its mass in grams multiplied by the square root of the Constant of Gravitation G. This follows from the comparison of Coulomb's law of electrostatic interaction and Newton's law of gravitation. If any body of material is rotated it then follows that it will induce magnetism as if this virtual negative charge were set in rotation. Analysis shows that for any such body the ratio of the magnetic moment as expressed in electrostatic units to the angular momentum is simply one half of the square root of G. Hence our hypothesis has something to predict, both qualitatively and quantitatively. It can be tested.

In fact, something very similar to this hypothesis emerged historically and from empirical study, as the subject developed over the years. Schuster (1912) and Wilson (1923) have shown that the magnetic moments and angular momenta of the sun and earth are approximately related by a common ratio. This led to the hypothesis, the so-called Schuster–Wilson hypothesis, that a fundamental property exists which causes any rotating body to have a magnetic moment. A particularly significant result emerged from the quantitative aspects of the hypothesis. It was shown by Wilson that the right order of magnitude for the magnetic fields of the earth and the sun is obtained if it is assumed that a moving mass, measured in gravitational units, has the same effect as a moving negative charge, measured in electrostatic units. It was then realized that the possibly coincidental result of the Schuster–Wilson hypothesis might develop the long-sought link between magnetism and gravitation.

Wilson carried out laboratory experiments. He made magnetic tests on a large swinging iron bar. The magnetic field predicted by using the hypothesis did not exist. The hypothesis stood refuted. Then, two decades later, there was a revival of interest. Babcock (1947) succeeded in measuring the magnetic field of the star 78 Virginis. It now became possible to apply the hypothesis to three bodies instead of two. Coincidental results might stem from a comparison between two astronomical bodies. Coincidence was unlikely if the hypothesis worked on the only three large bodies for which the parameters being compared had been measured. The hypothesis was verified. It was fully applicable to them all, notwithstanding the fact that angular momentum involved in the comparison was for the star 10,000,000,000 times greater than for the earth. Blackett (1947) was quick to draw this to attention.* Seemingly, if we accept Wilson's experiment, there is something special about large bodies. Their

* *Nature*, Vol. 159, pp. 658–66.

ability to induce magnetic fields seems different from that of simple iron bars. Blackett then set about the task of carrying out a much more sophisticated experiment to check the hypothesis in the laboratory. Meanwhile, in this period, unsettling anomalies were being discovered. For example, Babcock (1948), Thiessen (1949) and Von Kluber (1951) were discovering that the solar magnetic field varies. Changing magnetic moment is not consistent with the hypothesis. Blackett (1952) made tests on a large gold cylinder fixed in position in a remote test location. It rotated with the earth. It was of very dense material and, by the Schuster–Wilson hypothesis, this concentration of mass rotating slowly with the earth should be the seat of a magnetic moment. Very delicate and extremely sensitive magnetometer measurements were made. The remote location minimized any ambient interference from noise and vibration or other man-made causes. The instrument was sensitive enough to detect the proverbial needle in a haystack, even at a distance measured in hundreds of yards. But, there was no evidence substantiating the hypothesis. The gold body exhibited no magnetic effects attributable to its rotation with the earth. The hypothesis again stood refuted.

Furthermore, Runcorn and others (1950 and 1951) made measurements on the variation of the earth's magnetic field over a range of depths below the earth's surface and were able to analyse the shape of the earth's field. The magnetism which would arise if the implications of the Schuster–Wilson hypothesis are given meaning has a different field form to that which arises merely if there is, in effect, a large magnet at the centre of the earth.

The principal and clear distinction to be drawn between these two concepts is that for one the horizontal component of the geomagnetic field should increase with increasing depth below the earth's surface, whereas for the other this component should decrease with increasing depth. The result found experimentally went against the Schuster–Wilson hypothesis. It is refuted and it stands refuted. So our own version of the hypothesis is short-lived. We are left with the inevitable challenge of still finding the real answer.

A little reflection here might help. Had the hypothesis been verified, what would that have really told us? Would we not then have confronted just another problem, one still more elusive? What is virtual charge? Why should there be the non-symmetrical behaviour of charge of opposite polarity? Surely, it is just as well that the hypothesis failed. Nature should be simple and never non-symmetrical in its endowment of properties to electric charge of different polarities. We should not invent a pattern of scientific behaviour and expect Nature to conform. We should perceive Nature's own pattern. Our examination of Nature's phenomena will lead us to the answer. The clues to this great mystery are there if only we can see them. Yet, as I write this, I am mindful of a private communication I have just received from a young French scientist presently in North America. Edouard Rocher's thesis is that space–time has a metric composed of two four-dimensional systems interacting in conjunction with an operator *j*, the symbol for the square root of minus one, as used by the electrical theorist. It symbolizes the act of half-reversing a vector, that is a phase change through a right angle. By using it in conjunction with field theory one can make attractive interactions repulsive and vice versa. Rocher's eight-dimensional universe is his starting point in an attempt to relate gravitation and magnetism, and he takes encouragement from the Schuster–Wilson hypothesis, notwithstanding its rejection. Rocher's ideas may gain strength if Einstein's principles survive, but I believe they will collapse alongside Einstein's. Nevertheless, Rocher is undaunted by the rejection of the hypothesis under study. Therefore, let us keep it in mind as we now look for the signs Nature is presenting to us to help us in our quest.

Let us go back in time to that period following Benjamin Franklin's discovery of the electrical nature of lightning. Some years thereafter, in 1774, Joseph Priestley (1733–1804) wrote:

> There is nothing in the history of philosophy more striking than the rapid progress of electricity. Nothing ever appeared more trifling than the first effects which were observed of this agent in nature, as the attraction and repulsion of straws and other light substances. It

excited more attention by the flashes of light which it exhibited. We were more seriously alarmed at the electrical shock, and the effects of the electrical battery; and we were astonished to the highest degree by the discovery of the similarity of electricity with lightning, and the aurora borealis, with the connection it seems to have with water-spouts, hurricanes, and earthquakes, and also with the part that is probably assigned to it in the system of vegetation, and other the most important processes in nature.*

As already noted, we read in *Nature* in 1970 that the lightning accompanying earthquakes is difficult to explain. There seems no link between the two phenomena, and yet the relation has been a feature demonstrated, it seems, for so long and commented on in records two centuries ago. What is the use of theories, such as Einstein's, when we cannot explain those powers of destruction commanded by Nature and called lightning and earthquakes. Surely, we can explain each of them, but it seems that something is lacking if there is a definite link which we cannot explain. What does Einstein have to say about lightning? He does not explain lightning at all. Franklin did that! To Einstein, lightning is merely a flash of light which is signalled at the speed of light. He uses lightning to explain his concept of time, in his discussion of what is and what is not simultaneous.† Given two flashes of lightning Einstein argues that they are simultaneous only if they are seen simultaneously by the observer. Yet, his argument is based upon the acceptance that it takes time for their light to travel to the observer at a finite speed. Therefore, the observer may see them simultaneously and know that they are not simultaneous. The observer may then well wonder why his time measure has to be modified to suit Einstein. Do we really live in a world of makebelief? Time is one of the most basic sense references we have for understanding our environment and as a basic reference its constancy ought really to be taken as 'timeless'. It is so fundamental. We will proceed on this conviction. We will see whether we can come to understand more about phenomena such as lightning, on this foundation, rather than following Einstein and bringing

* Quoted from *Science Past and Present*, by F. Sherwood Taylor, Heinemann, London, 1945, p. 129.

† *Relativity*, by A. Einstein, Crown Publishers, New York, 1961, p. 25.

lightning and other such physical experiences into account to explain variations in the measure of time while yet not explaining the nature of time.

Nordenson (1969)* is highly critical of Einstein's ideas on simultaneity. He writes:

> According to this declaration the concept of simultaneity does not exist *a priori*. It is only by performing certain physical experiments that the concept achieves any sense. This is a most remarkable philosophical proclamation in any context.

However open-minded we are, surely we must believe that an instant in time is universal. No apparition can shatter such belief. It is necessary if only as a matter of definition. If we appeal to definition we can, I suppose, adopt Einstein's definition instead. But why complicate things? Use the natural sense conception of time. It must be right and Nature must be capable of more straightforward interpretation if we stay with this notion. If, after checking the synchronous running of my wristwatch against a clock in my house, I went away on a one-day trip and returned to find these chronometers disagreeing by one hour, and could trace this to no normal cause, I would still believe simultaneity had meaning divorced from signal propagation considerations. Time is fundamental. The chronometers may behave in a queer fashion, evidencing some interesting physical phenomenon, which hopefully would yield to eventual explanation. But if time has to be redefined to provide an explanation one might as well take, as scientific, observations made in one's dreams. To resort to abstract thinking merely to satisfy one's ego that one can find explanation for Nature's elusive behaviour and then to project such ideas is to render science a disservice. It is the universality of time, the sharing of the succession of instants in time by mankind which constitutes the related existence about which man can usefully philosophize. Time has to be fundamental.

Adherents to Einstein's theory talk of 'time dilation'. Some elementary particles are unstable. They have a finite lifetime before they decay into something else. Like man, they die after

* *Relativity Time and Reality*, by H. Nordenson, Allen and Unwin, London, 1969, p. 45.

their due lifespan. Experiment shows that the faster they travel, the longer their expectancy of life. They do not share man's experience in this regard. Scientists attribute this increased lifetime to Einstein's 'time dilation'. In a frame of reference moving faster than ours time passes more quickly—or is it more slowly? Then again, how fast are we moving in space? No, it is the relative velocity which counts, and it is better not to try to explain this in words. Mathematics can extricate us from the confusion. Or do mathematics really obscure the problem? The increase in stability with speed might have been explained before the days of Relativity had the observation been presented. Perhaps the elementary particle, being electrically charged and having all its charge elements mutually repelling according to statistical energy considerations, would find that at speed it has a mutual magnetic attraction between its charge elements which offsets the repulsion and delays the likelihood of disruption to a degree depending upon speed. The experiment supports the idea of time dilation, to be sure, if one merely seeks a metaphysical explanation, but the physicist ought really to look first for a truly physical explanation before abandoning his cause.

Time is measured by the pendulum because, thanks to gravity, the pendulum has the property of relating displaced mass with a restoring force proportional to displacement distance, and because mass, force and distance are appropriately related by the time parameter. Time may be measured by a spring controlled device in which the restoring force is linearly related with displacement by virtue of the elastic properties of the spring. Clocks and watches are useful because they keep time and time keeps constant itself. Since time and its constancy are inherent to Nature as its prime universal property, Nature is not dissimilar from the mechanism of the clock. Our unseen aether medium, if this is the universal clock, has its own harmonious oscillations. It must have a feature by which its distortion is opposed by forces linearly proportional to displacement. If it is a subtle electrical substance, we can imagine a negatively charged system somehow swinging as a whole within a cancelling positive charge. If the unseen aether medium is a plenum of electrical charge and there are, therefore, no voids, then the motion is more likely to be a cyclic rotary motion, with the whole system of negative charges rotating in harmony in balance with the positive charge. Russell (1946)* tells us how the early Greeks believed that there had to be a void as, otherwise, there could be no motion. But Russell contests this by the words:

> 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.

This is quoted not merely to support the argument that the motion of charge in an electrical aether is likely to be cyclic, but also to suggest that if we had to wait for Russell to correct the thinking of the ancient Greeks, we cannot take as certain the present state of rejection of aether ideas by the modern cosmologists. Besides, the modern cosmologists are mere disciples of great thinkers such as Einstein and Dirac, who have both, in their own way, suggested the existence of an aether having a universal harmonious motion. We will come to this specifically later, when we also examine the ideas of a relatively unknown French cosmologist, Véronnet. All three have presented the basis of the idea we are following here, but seem not to have pursued the thought further.

The step forward we are taking is to examine how this aether provides the universal time, and, if the reader has not forgotten, how lightning and earthquakes have possible association. Guided by the time requirement and the restoring force criteria, we note that electric charge distributions are possible, by which to explain the linear restoring force rate using Coulomb's law of electrostatic action. Furthermore, it works out that the system of electric charge which satisfies this criterion, and which is a plenum as well, happens to be the most simple kind of electrical system imaginable. One merely has a uniform continuum of positive charge in which discrete identical negative charges are arrayed in simple cubic formation. These negative charges form a lattice which oscillates relative to the positive continuum. Seemingly, we are immersed in speculation,

* *History of Western Philosophy*, by Bertrand Russell, Allen and Unwin, London, 1961 edition, p. 86.

but we are not lost with this idea, and it can now take us to a new explanation of the earth's magnetism.

All we have to ask is what happens if a large spherical section of this universal aether medium has its own rotation. Remember, time has to be universal in spite of rotation and our time measure has to stay constant. In other words, the cyclic oscillations of the system will retain their synchronism. Simple analysis readily shows that the superimposed rotation will permit the stable relative motion of the discrete negative charges provided there is a small radial displacement of the mean position of the charge. In effect, the rotation of the large sphere of aether within surrounding aether will cause a radial electric field to be established, as the sphere effectively acquires a uniform distribution of charge balanced by a shell of charge transferred to its surface.

A mechanical analogy is seen if one imagines a boy standing anywhere on a rotating turntable and swinging a weight at the end of a spring around in a circle in a plane parallel with the turntable. We presume an arrangement by which the spring force is linearly proportional to the radius of this circle. The time of rotation of this weight will not depend upon the speed of rotation of the turntable, but the faster the turntable goes, the more eccentric will the orbit of the weight become relative to the end of the spring held by the boy. Time as measured by this rotating weight will remain universal, but the disposition of mass contained by the turntable system has changed. There has been an outward displacement of mass from its centre if the turntable rotates in the same direction as the weight in its orbit.

The first observation we make from this concept of a rotation of electrical aether is that a magnetic field should be established which is attributable partly to a distributed charge and partly to an opposing effect due to a charge at the outer surface of the sphere. The magnetic field distribution for such a system will be more like that of a magnetic dipole located at the centre of the aether sphere. Hence the Runcorn mine experiments would support rather than negate the theory for the earth's magnetism to be adduced from this. Secondly, the implication that the magnetism of a body like the earth is due solely to the aether, to a medium which is not affected in its concentration by the density of matter, means that the gold cylinder tests of Blackett would give a negative result, as was found. The magnetic moment has become an aether property and, though the Schuster–Wilson hypothesis is incorrect, some modification of the hypothesis now looks feasible. Thirdly, there is charge displacement if the aether changes its speed of rotation, as we presume it would if the large astronomical body associated with it were also to alter speed. Charge displacement is a flow of current and could induce lightning. An alteration in speed of rotation could come from a redeployment of the earth's mass, as in an earthquake. Hence, the possible linking of earthquakes and lightning. All this comes from a willingness to recognize the ever-present aether medium. It is not a nothing that we see only by following mere notions and principles. It is a reality we perceive by taking note of Nature's own manifestations.

Of course, there is so much more to scientific theory than might appear from this casual treatment. Nothing can be certain about the conclusions just presented. Much more thought and analysis are needed even to begin to have a viable theory. There are still many problems to put on the list needing attention if we are to take this effort seriously. One problem is that if the earth developed a charge due to its rotation and sufficient to account for the earth's magnetic field, then the electric fields within the earth would be so high that conduction effects would obliterate them. This point was well recognized by Augenheister (1925).* However, this is not a problem but a clue to the content of the unseen aether medium. We know there is a magnetic field associated with the earth's rotation. We have been led to the idea that the rotation of an aether enveloping the earth induces this magnetic field. Consequently, we must look to this aether to have properties which cancel the electric field set up by rotation. If the cancellation does not affect the magnetic field, then the charge giving the cancellation cannot be rotating with the earth's aether. It is a direct self-evident conclusion which we have to accept. What does this mean? Simply, that there is free charge beside that contained in the lattice system. Why should

* Augenheister, *Phys. Zeit.*, 26, p. 307, 1925.

there be such free charge? Well, the Earth moves linearly in space as well as rotating on its own axis. It can hardly sweep its aether through other aether and retain its harmony. There would be all kinds of turbulence, drag and disturbance, not at all consistent with the existence of a medium which sets universal constants and puts order into the physical universe. No, the sphere of positive aether continuum can rotate smoothly with the earth, wherever the earth is located, but this charge cannot be carried forward with the earth as it moves around the sun. Consequently, the charge of the system of discrete negative charges cannot do other than remain also effectively undisplaced, save for rotation with the earth.

Now, since this system of negative charge tends to form into a cubic array, what happens is that such an array is formed by the vast majority of the discrete negative charges within the earth's aether but some very small proportion of them are free and move in the direction opposite to the earth's translational motion. Thus the array itself can move forward with the earth and, indeed, rotate with the earth, but the free charge does not share this rotation with the earth. The result is the production of a magnetic field but a compensation of the radial electric field effects set up by the rotation of the aether enveloping the earth. This compensation is possible because there will be a uniform distribution of free charge within the earth as long as the earth moves at a steady speed. The lattice displacement develops a uniform displacement charge density determined by its speed of rotation about its axis. There will also be charge compensation at the boundaries of the aether because the total bounded aether charge sums to zero and balance inside the boundaries assures also a balance at the boundaries.

Nevertheless, should the angular speed of the earth change or should its translational speed change, there will be transient electrical field disturbances developed in the aether itself. In earthquakes there is a rapid but small change in the angular speed of the earth and an induction of lightning could well occur as an aether phenomenon. Also, due to the ellipticity of the earth's orbit around the sun, we have a slow continuous change in the earth's translational speed. This could well explain other sporadic electrical disturbances in the earth's atmosphere.

What is being presented could also explain a concentrated ionization effect at the spherical boundary of a rotating aether sphere. The earth's ionosphere may then evidence aether boundaries. Also, if the thunderball is, as suggested in Chapter 2, nothing more than a rotating aether sphere, it would exhibit similar ionization effects, explaining its glow. Presumably the thunderball having little forward motion through the earth's aether and rotating at a very much higher speed could not command any more free charge concentration than is available in the earth's aether. Substantial ionization effects deriving energy from the rotational inertia of the aether forming the thunderball must then result.

In addition, the origins of the thunderball become easy to explain. A lightning discharge will ionize the air and the discharge current will be carried essentially by a filamentary core of electrons subjected to an inward electromagnetic pinch action. The positive ions, being relatively inert because of their higher mass, will form a cylindrical plasma around this negatively charged core. As a result there will be a radial electric field developed about the axis of the lightning discharge. It seems likely that the aether may be disturbed to react so as to oppose this radial electric field. We have argued that rotating aether develops a radial electric field provided, of course, the axis of rotation is parallel to the axial direction about which the aether charges are moving in their harmonious time-determining orbits. Therefore, provided the lightning discharge has the right direction it may induce aether rotation which would outlive the discharge itself and in some instances consolidate into a spherical form optimizing its electric energy, to create the thunderball.

Is this outrageous speculation? Possibly it is. It seems rather odd to predict that thunderballs formed from lightning discharges will favour those flashes having a certain direction in space. The earth's magnetism can be attributed to rotation of the earth's aether about the preferred space direction. So we reach the peculiar prediction that, roughly speaking, lightning discharges parallel to the earth's axis will produce thunderballs and those at right-angles to the axis will not. Thus vertical lightning to ground in equatorial regions will not induce the thunderball phenomena. Horizontal lightning should produce thunderballs in these regions but such lightning would be high in the atmosphere and the thunderballs would be dissipated before reaching the ground.

In polar regions we have the inverse situation. Accordingly, thunderballs should occur in thunderstorms in polar regions where there happen to be few observers and thunderballs are unlikely to occur in thunderstorms in equatorial regions where there are many potential observers. It is no wonder then that the existence of thunderballs has been doubted.

In mountainous regions midway between the equator and the poles thunderballs should appear relatively prolifically because of the higher incidence of ground flashes which can have the optimum direction. But do we have any evidence?

Thunderballs are not just a ground phenomenon. Quoting from Ritchie*

> One large ball was observed to hang near the base of a cloud for 15 minutes.

But more pertinent to the above analysis is the quotation from Sir Basil Schonland's book:†

> There are no reliable reports of ball lightning from Africa, in spite of the high frequency of occurrence of lightning to ground. The American meteorologist, Humphreys, has examined 280 specially collected reports of ball lightning and found himself able to accept only two or three at most as possible, but not necessarily authentic, fire-balls. The residue of reports from the Alps, which alone must be taken seriously, prompt one to enquire whether there are any circumstances peculiar to this region which could create such unusual effects.

We introduced this chapter by reference to the ferromagnetic properties of the lodestone and have considered the earth's magnetism. The nature of ferromagnetism itself remains an enigma in physical theory. Even the nature of magnetism is problematic. What is apparent is the spontaneous tendency possessed by a ferromagnetic material favouring the magnetic

* See footnote on page 10. † *The Flight of Thunderbolts*, pp. 55 and 56.

state. It is as if some natural urge exists which ensures magnetism unless accompanying constraints impose energy requirements which cannot be met. If the aether likes to adopt a magnetic state and yields energy readily in adopting this state we can imagine materials being ferromagnetic if only the strains in them resulting from the condition do not require more elastic energy than is available from magnetic sources. Similarly, the aether itself might tend to be magnetized, as it can be if it rotates. However, its own magnetic energy yielded thus will not, it seems, sustain the other kinetic energy needed to permit rotation. Rotation of aether, given a liberal source of energy, can be expected. This now takes us to the problem of the creation of the solar system, but we will return to ferromagnetism in Chapter 12.

As a small addendum to this chapter reference is made to a report in the December 24, 1971, issue of *Nature*. At page 465 there is an analysis of experimental evidence showing that the earth has a solid core. It is concluded that 'solidity of the inner core represents the only solution consistent with the observations'. Such a discovery invalidates the accepted theory of geomagnetism and should enhance interest in the theory of an aether-based geomagnetic field discussed above.

5

The Origin of the Solar System

Many treatises on physics present the same theories in the same way and do not admit any of the weaknesses in the matter which the student is thus required to accept. Seldom does one see encouragement to compare the accepted theory with those many theories which have neither become accepted nor have really been rejected. We may read of the contributions of the eminent physicists but we are not exposed to the many sound ideas of those of lesser standing. If these lesser contributions have been published they are there in the masses of scientific literature to be found when we go searching. It has to be so, but the modern textbook would have the reader believe that the best has been sifted out and what is hidden is for the historian rather than the forward thinker.

It is not unusual for a scientific theory to be developed over a period of many years after its initial conception. The task is a labour of love for the creator. Few physicists are ready to take an incomplete theory and project it themselves. Thus, by the nature of things there must be in the literature many sound ideas which have been presented in their initial form only and which, for some reason, their originator has been unable to develop in his own remaining lifetime. There is no convincing physical explanation of the creation of the solar system in any modern textbook. The Bible is probably as authoritative as any account of the subject. Therefore, there is all the more reason for exploring the ideas of scientists of the past who had lesser standing than those whose names appear in the textbooks.

In seeking to understand the origin of the solar system, we will begin by extending some recognition to a French astronomer named Véronnet. On December 16, 1929 the French Académie des Sciences conferred the Henry Poincaré medal on Louis de

Broglie for his work on wave mechanics. On the same occasion Alexandre Véronnet (astronome adjoint à l'Observatoire de Strasbourg) was presented with the Prix Lalande for his works in astronomy. Véronnet's work is particularly interesting because he did not turn away from the idea of the aether, and was ready to call it into account in furthering his theories. He wrote prolifically in *Comptes Rendus* for several years but seems to have had little published after the 1929 period when he proposed an electrical structure for the aether medium. His particular concern was the question of the origins of the angular momenta of stellar systems. Angular momentum is the key problem confronting any theorist endeavouring to understand the creation of the solar system.

We note here that one of the consequences of any central law of force such as Coulomb's law of electrostatic interaction and Newton's law of gravitation is that if particles are in motion subject only to their mutual action the sum of their moments of rotation, termed angular momentum, is constant. The planets in the solar system all travel around the sun in the same orbital direction, which is also the direction in which the sun itself rotates about its axis. Therefore, the solar system has quite substantial angular momentum. One would expect that if the planets were produced from substance ejected from the sun, then the sun would rotate oppositely to the planets and their angular momenta would compensate that of the sun, at least partly if not exactly. The solar system has a net angular momentum and it is an important cosmological question to know where it came from.

There are really three primary aspects of the solar system which need explanation. These are:

1. How was the sun itself created?
2. How did the sun acquire angular momentum?
3. What caused the formation of the planets?

Ideas on this are much as they were in 1929. In that year Eddington's book *The Nature of the Physical World* was published. Here are some excerpts:*

* Published by Cambridge University Press, pp. 175–7.

At least one star in three is double—a pair of self-luminous globes both comparable in dimensions with the sun. . . We may probably rule out the possibility of planets in double stars. . . . The most obvious cause of division is excessive rotation. As the gaseous globe contracts it spins faster and faster until a time may come when it can no longer hold together, and some kind of relief must be found. . . . We know of myriads of double stars and of only one planetary system; but in any case it is beyond our power to detect other planetary systems if they exist. We can only appeal to the results of theoretical study of rotating masses of gas; the work presents many complications and the results may not be final; but the researches of Sir J. H. Jeans lead to the conclusion that rotational break-up produces a double star and never a system of planets. The solar system is not the typical product of development of a star; it is not even a common variety of development; it is a freak. By elimination of alternatives it appears that a configuration resembling the solar system would only be formed if at a certain stage of condensation an unusual accident occurred. According to Jeans the accident was the close approach of another star casually pursuing its way through space. . . . By tidal distortion it raised big protuberances on the sun, and caused it to spurt out filaments of matter which have condensed to form the planets.

Eddington goes on to discuss how small the chances are of this occurring. He says that perhaps not one in one hundred million stars can have undergone this experience and then argues that this makes Earth the privileged place in the universe habited by mankind. He writes:

I do not think that the whole purpose of the Creation has been staked on the one planet where we live; and in the long run we cannot deem ourselves the only race that has been or will be gifted with the mystery of consciousness. But I feel inclined to claim at the present time our race is supreme; and not one of the profusion of stars in their myriad clusters looks down on scenes comparable to those which are passing beneath the rays of the sun.

Hence, we are told that the solar system is unique. Man on earth has the privileged place in the universe today and life as we know it cannot exist anywhere else in the whole of the cosmos. Such are the questions at issue. Such are the answers if we exist because of the chance close passage of another star.

At page 550 of the first semester issue of *Comptes Rendus* in 1929, Véronnet presents a paper entitled: 'On the origin of planets and the formation of the earth'. On the origin of the moment of rotation of the solar system he says:

Tous les auteurs de cosmogonie depuis Laplace ont pris ce moment comme donné. Ils sont partis d'une nebuleuse qui tournait déjà. C'était supposer le problème resolu.

Then he asserts a theorem according to which, the kinematic moment of an isolated system, being invariable, the moment of rotation of the solar system can only be explained by the perturbing action of exterior systems. External action of some kind was the inevitable conclusion, whether in the form of the wandering star or some other influence. The earlier ideas of Laplace about the solar system being formed from the condensation of a swirling gaseous medium lacked something because we are left to explain how this medium acquires its own angular momentum in the first place.

Dauvillier* writing in 1963 emphasized the same point. After referring to the ideas of several contemporary writers he said:

Mais ces auteurs ont éludé l'une des principales difficultés du problème, en se donnant, à l'avance, le moment orbital du système.

Considering all possible theories, there seemed no way of avoiding the basic idea that the planets were formed by a stellar approach. Dauvillier notes how Poincaré, Arrhenius and Jeans all were aware of the very small likelihood of the stellar approach. It seems that a stellar approach within the distance of Mars is only likely in 10^{15} years, a chance which makes the sun quasi-unique. Star collisions, the basis of rival theories, seem even less likely. Several authors have used the notion of the expanding universe to argue that collisions were much more likely when the universe was more concentrated. The result is, however, an impasse. There seems no satisfactory theory by which to explain with some assurance the origins of our solar system.

Véronnet, in examining these questions appears to have studied some of the dynamics of a dispersed medium. His analysis led him to consider criteria of stability and apportionment of energy in its different forms. At page 894 of the first

* Les Hypothèses Cosmogoniques', A. Dauvillier, Chapter 8, *Collection Evolution des Sciences*, Masson et Cie., Paris, 1963.

semester issue of *Comptes Rendus* he was writing about the limited possibilities of forms of space, Euclidean, Riemann and Cartesian. By page 1143 he was commenting on the dynamics of these spaces and deducing that the laws of physics have to be expressed by tensors. Then, by page 1380 he was presenting an 'Electronic Theory of Aether and Light'. He sought to extend electron theory to the aether with a view to explaining the aether, not mechanically, but electrically. He spoke of an aether composed of electrons or sub-electrons, which he called 'etherons'. He envisaged displacement against a restoring force proportional to displacement, which we were led to in discussing the universality of time. He pictures the etherons moving in synchronism. An electric field is their displacement; a magnetic field their motion. He argues that these particles are in a turbulent motion and that there is equipartition of energy and conservation of moments. The common value of their moments determines the Planck constant, which is also related to the energy stored by these elements of the aether medium. In a later paper at page 1488 he goes on to say how he derives Maxwell's laws and the law of Laplace. His ideas are essentially the ones which we came to in Chapter 4. In the paper just mentioned he writes:

> Si notre charge électrique, un électron par exemple, se déplace, toutes les particules d'éther environnantes décrivent des trajectoires fermées, toutes en phase sur le mouvement de la charge. Ces tourbillons des particules d'éther possèdent chacun un moment magnétique parfaitement défini par la surface décrite et la vitesse du déplacement.

We have used such an aether to explain the earth's magnetism, but it seems that Véronnet saw the same model as an explanation for magnetism generally. Hence we should be encouraged to take our aether studies further. It is surprising that Véronnet does not appear to have invoked this aether medium as the external agency which could explain his problem of the angular momentum of the solar system. It seems so obvious. Yet, that is the way of things. We will embark upon this task here to see whether the fundamental cosmological question about our unique existence can be probed further.

We will start with the belief that the aether can be set in rotation with an astronomical body, such as the sun, and that this aether will then store angular momentum and absorb kinetic energy. In the context of rotation both angular momentum and energy can be exchanged with matter because the rotary motion is superimposed on the motion of elements of this aether. This differs from the case where there is translational motion of aether through surrounding aether. In this case the kinetic energy and angular momentum of the aether itself is merely redeployed and so there is no similar interaction between aether and matter with translational motion.

Our aether is real and not at all like the aether which the modern physicist occasionally mentions in a half-apologetic way. We are not speaking of the aether Watson has in mind when he writes:*

> The aether is an imagined world of atomic connections between the real things and processes that the physicist controls and observes.

Such an aether could hardly have played any role in the creation of our solar system. Our sun exists and did not come from man's imagination; it came before man.

When we come to ask how a star is created from an imagined nothingness, the physicist is confronted with a problem. He has no answer. But he can tell you how a star dies, assuming its pre-existence. His theories enable him to speak about gravitational collapse. The star goes suddenly into a never-ending state of contraction. It shrinks in size into the tiniest point imaginable and yet it retains much of its mass. It becomes a so-called 'black hole', whatever that is. The physicist does not know how a star gets its angular momentum when it is created, but says he can work out that angular momentum can be dispersed. Thus, when the star collapses he can investigate how it releases its angular momentum. Silk and Wright (1969)† show that the Newtonian angular momentum of a star is dissipated during the final stages of collapse. Presumably, this dissipated angular

* *Understanding Physics Today*, W. H. Watson, Cambridge University Press, 1967, p. 167.

† 'Gravitational Collapse of a Relativistic Star', J. Silk and J. P. Wright, *Mon. Not. Roy. Ast. Soc.*, 143, 1969, p. 55.

momentum is transported away by the imagined aether. The field medium we call the aether can transport energy and angular momentum. If it can convey these away from a star surely it can, by similar token, deliver them when the star is born, and our theories should be adapted accordingly.

Ideally the solar system would have a total angular momentum summing to zero. If this were the case we could be happy in thinking that we do not live in a freak world. We could look out at the millions of stars in the sky and feel reasonably confident that many of them are solar systems like ours, possibly having planets like the earth and, physics being universal, people not too different from us. After all, physics leads us into chemistry and so to biochemistry. If we assert that our ideal self-contained solar system does exist we have to accept that there is something in the solar system which has been ignored in the angular momentum calculations. Newton's laws of mechanics work for complete systems, not partially complete systems. There is rotating aether in the sun itself, and some, of course, in each of the planets. But this is hypothesis and we seek proof. Our task is not difficult, once having started with the idea.

The stars may have condensed out of a uniform distribution of dust-like substance or from a gas. Matter may be created continuously throughout space, or may have been created once when everything began. Matter may be being created from the aether even today and the processes localized, say, at the surfaces of stars. None of this is of much concern provided we accept the creation of matter which condenses to form stars, thanks to the ever-present forces of gravitation. Given this starting point, as propounded by the philosopher Kant who proposed the accretion of cosmic dust, we are ready to explain the solar system.

When this dust came together the gravitational energy released by its compaction became available for deployment. It did not all go into the thermal excitation of the substance. Had it done so, the kinetic energy of the particles would have been so high as to oppose the gravitational forces and the system formed would have tended to remain a very dispersed gaseous system. Instead, the aether, as we showed in Chapter 4, is ever ready to rotate, and given a liberal source of energy, does exactly that. The magnetic state favours rotation. There has to be balance of angular momentum, and so a sphere of aether rotates one way and a surrounding shell of aether rotates the other way. For maximum acceptance of kinetic energy it works out that the inner sphere and the outer shell must share the kinetic energy equally. They must have equal and opposite angular velocities. This is simple Newtonian dynamics. The maximum kinetic energy condition is imposed by the recognition of minimum potential energy and the fact that one, gravitational energy, is converting into the other. We assume that the inner sphere of aether in rotation has an outer form co-extensive with the matter which has condensed into a spherical form in releasing its gravitational energy and rotates with it. This may sound complicated but it leads directly to a very simple mathematical relationship between the speed of rotation, the Constant of Gravitation, the mass density of the aether and the mass density of the accreted matter, if the latter is assumed uniform.

The mathematics are just a little more complicated if the accreted matter remains gaseous. The physical size of the system formed is not relevant to this relationship.

We know the density of the sun. It must have been about the same before it ejected the planets, because it still contains nearly 99·9% of the total mass in the solar system. We know the Constant of Gravitation. If we know the density of the aether we can then deduce the angular momentum which the matter in the sun had when it was created. Conversely, since we do know the total angular momentum of the solar system we can, by accepting that this is that possessed by the matter form of the sun when created, deduce the density of the aether. Such a figure might seem to be useless except that the figure obtained happens to check very nicely with a value deduced from other considerations in a full analysis of the aether.* For our purposes here, it is better not to invoke this aether density. An account

* *Physics without Einstein*, H. Aspden, Sabberton Publications, Southampton, 1969.

has been given showing that recognition of the aether medium can explain the initial rotation of the sun when its gravitational energy was absorbed by the aether. By taking the whole angular momentum of the solar system and assuming that it was concentrated in the sun at the time of its creation we may show that the sun probably rotated at one revolution every 12 hours. Now, at the end of Chapter 2, it was argued that the rotation of aether developed an electric charge displacement which effectively developed a uniformly distributed charge within the aether.

Ionization effects occur to cancel the resulting electric fields but the fact remains that displacement or charge is a characteristic of the rotating aether medium. The magnetic fields of astronomical bodies afford an indication of the magnitude of this displaced charge. The observations relating to the Schuster–Wilson hypothesis mentioned in Chapter 4 tell us that the electric charge for a body like the sun is roughly of the order of its mass measured in gravitational units. Thus the sun would have an electrostatic charge of the order of its mass of 2.10^{33} gm multiplied by the square root of G. Since G is $6{\cdot}66.10^{-8}$, we obtain a solar charge of about $5{\cdot}2.10^{29}$ electrostatic units. Its field is partially cancelled by ionization effects and partially by free aether charge, of course, but the fact remains that an electric charge of this magnitude is displaced in the sun to balance the aether induction effects. For example, depending upon the polarity we can imagine a concentration of protons in the body of the sun and the grouping of the electrons they would normally pair with located at the surface of the sun.

Next, let us picture an occasional disruption on the sun which is so energetic that it ejects vast quantities of charged particles in the form we know as cosmic radiation, but the event contemplated is on a much more powerful scale. Heavy positive charges and electrons will be ejected but probably a preponderance of electrons because of the surplus electron form at the solar surface. The sun is left with a positive charge for a period until the electric and gravitational potential gradient can work on the ejected particles to call them back.

The maximum possible residual charge from any such disruption in the early life of the sun would be of the order of $5{\cdot}2.10^{29}$ esu.

Now, following these occasional periods when the sun has its residual charge we have a sun which is not stable. The highly energetic ejected matter in the close vicinity of the sun will find that a transiently stable state can develop by which this matter rotates about the sun with the electrostatic restoring force being in balance with centrifugal force. Collisions will be minimal for plasma charge moving in the same sense.

This transiently stable atmosphere can accumulate angular momentum from the sun during this process totalling to a value of the order given by the relation

$$\frac{(\text{solar charge})^2}{(\text{solar radius})^2} = \frac{(\text{angular momentum})^2}{(\text{mass})\ (\text{solar radius})^3}$$

This is merely the electrostatic attractive force set in balance with centrifugal force corresponding to the angular momentum of the related mass of the transiently stable atmosphere.

Now, this transiently stable state may be followed by a further disruption. Although the ionized state of the atmosphere may become less activated as electrons re-assert their more specific positions to cancel the aether boundary charge, the atmosphere may have by then acquired a much higher velocity than the normal gravitational escape velocity. It will then be ejected from the sun to move to an orbit position around the sun where it is kept in balance by gravitation.

It follows then that the equation above tells us something about the formation of the planets. For example, given the initial solar charge of $5{\cdot}2.10^{29}$ esu and the solar radius of 7.10^{10} cm, we can relate the angular momentum and mass of a planet ejected as a result of the maximum initial disturbance. The quantity angular momentum^2/mass would be $1{\cdot}9.10^{70}$.

The value of this quantity for Jupiter, the largest planet in the solar system, is, in fact, $1{\cdot}95.10^{70}$.

It may seem remarkable that this result should come out so well. It is all the more surprising to the author because the electric charge induced in rotating aether should, according to his theory, be dependent upon the angular velocity of rotation and the charge envisaged by the Schuster–Wilson hypothesis does not take due account of the higher rotational speed when the sun was formed.

However, it is important to note that if a charge could develop in matter, in excess of that predicted by the above application of the Schuster–Wilson hypothesis, the mutual repulsive effect of the charge would have an action greater than the mutual attractive effect of gravity. This assumes that the density of matter is uniform. Clearly, then, the maximum effective charge which can be developed to act in disrupting matter is that given by the Schuster–Wilson notation and it is most enlightening to see this operate to give with near exactitude the situation in which we find Jupiter in our solar system.

Of course, we should not be misled by the numbers. The angular momentum of the solar atmosphere during the transiently stable period is not all effective in producing the planetary motion. Not all of the motion is at the maximum solar radius. At other positions of solar latitude the angular momentum comes out somewhat higher in relation to the solar electric charge. This is just as well because it seems probable that the planets were created in pairs as atmospheric bulges developed on opposite sides of the sun.

Thus we could expect Saturn to be formed with Jupiter. Thereafter the sun would rotate at a much slower speed. Note that Nature first determined the mass which would come together to form the sun. Then as this mass came together under gravity there came a time when it was possible for the gravitational energy to deploy to cause aether rotation. The basic sun would continue forming in this way until it reached the physical size governed by its gaseous state. In this condition it was little different than it is today save that it rotated rapidly about once every 12 hours. Then at some time thereafter it ejected Jupiter and Saturn, accounting, as indicated above, for the maximum angular momentum it could shed. This was followed at the next eruption by the ejection of very nearly the rest of its angular momentum in forming two planets Uranus and Neptune.

Note that in earth units the total angular momentum of the solar system is about 1200. Jupiter accounts for 722 units and

Saturn for 293, leaving 185 units. Uranus at 64 and Neptune at 94 took 158 units of the whole, leaving 27 units. Note that just as Jupiter and Saturn are of similar physical size (about 10 times the diameter of the earth), Uranus and Neptune are also of similar physical size (about 4 times the diameter of the earth). Then it would seem that the sun, as a creator of planets, was effectively a spent force. Earth and Venus were ejected accounting for 1 unit and 0·7 respectively. Venus has a diameter 0·95 that of Earth. Pluto and Mars probably came next and then Mercury and the moon. Today the sun is left with some 23 earth angular momentum units. This does not take account of the very small planets, the thousands of tiny planets of relatively negligible angular momentum in the system known as the asteroids. Estimations indicate that probably 50,000 such minor planets exist.

Enough has been said to show that the accepted problem of the angular momentum of the solar system can be overcome if only we recognize the existence of the aether. However, we are left with the question of whether the small planets are being created even today. The asteroids move generally in orbits located between the orbits of Mars and Jupiter. Accordingly, the angular momentum about the sun per unit mass is probably about 1·5 times that of the earth for the average asteroid. Thus at the solar surface the asteroid would form from an atmospheric disturbance rotating at a frequency measured on a per year basis as 1·5 times the square of the ratio of the earth's orbital radius and the sun's radius. This is about 70,000 revolutions per year or 8 revolutions per hour. We may therefore expect some kind of solar pulsation at this frequency to be seen if the sun is generating a new planet which will eventually be ejected to add to the collection of asteroids. Then we may read from the February 4, 1971 issue of *New Scientist and Science Journal* at page 231:

> According to a large body of evidence amassed over the past ten years, it is now established that the solar photosphere has a steady vertical oscillation with a period of 300 seconds.

This may well be evidence supporting the theory offered here for the creation of the solar system. Furthermore, when we come to explain why the earth's magnetism reverses in Chapter 16, it may be evident that the electrostatic balance of the solar atmosphere will be disturbed for the same reason. Possibly, therefore, the events of reversing the earth's magnetic field are linked with the creation of a pair of asteroids. Numerically, if the earth's magnetism reverses, say, every 200,000 years, then a solar system dating back 4,000,000,000 years would have produced 40,000 such planets.

6

The Perturbation of Venus

In Chapter 3 it was mentioned that Einstein had proposed a small modification to Newton's law of gravitation. There were problems confronting the simple law of gravitation which Newton bequeathed to science. Close study of the motions of the planets had indicated that whilst they were moving approximately in elliptical orbits, their orbits as a whole were moving very slowly themselves. On Newtonian theory such progression will arise from the perturbing effects of other planets. Indeed, it was by using Newton's law that Leverrier (1811–1877) predicted the existence of the planet Neptune from observations of perturbations of the planet Uranus. J. G. Galle at Berlin then discovered the planet Neptune within one degree of the place Leverrier predicted (1846). From observations on the orbit of the planet Mercury, Leverrier also predicted the existence of another perturbing body. It was named Vulcan. Sir Robert Stawell Ball writing in his *The Story of the Heavens*, 1897, calls it 'the planet of romance'. He comments:*

> The existence of a planet much closer to the sun than those hitherto known has been asserted by competent authority. The question is still unsettled, and the planet cannot with certainty be pointed out.

For Mercury there is an unaccountable rate of advance of the perihelion. The discrepancy is as little as an advance of 43 seconds of arc per century, but it exists and cannot be traced to inaccuracies in observation. Now, the laws of planetary motion under perturbation conditions depend upon the assumed equivalence of inertial and gravitational mass. Eotvos in 1891 sought to check this assumption. It was established that at least in the laboratory inertial mass and gravitational mass were

* Page 122, book published by Cassell.

exactly equal. Thus it was indicated that the gravitational properties of a body are essentially of the same nature as its inertial properties. At the end of the nineteenth century it was then evident that unless Vulcan could be found we needed a new law of gravitation.

But let us examine the problem more closely. In calculating the perturbation effects it was necessary to know exactly the masses of the various bodies involved, excepting that whose perturbation was under study. Since its inertial mass is the same as its gravitational mass the accelerating forces acting on it develop forces in proportion to its mass and the orbit is therefore substantially independent. The sun is such a large central body as to be effectively fixed for the purpose of these perturbation studies. If a planet has a visible satellite its mass can be calculated. Neither Mercury nor Venus have satellites. Therefore, to find their masses we work backwards from a study of their perturbing effects on other bodies, assuming, of course, that Newton's law is valid. Since there are more orbits to observe than planets with unknown masses this process provides an effective check on the theory. It is the discrepancies which suggest unknown planets as needing recognition.

Let us next examine some of the results of Doolittle (1925)* calculated for the planet Venus. Calculation on Newtonian law gives the following perturbation components of perihelion motion. The assumed masses of the disturbing bodies are tabulated as reciprocal fractions of the solar mass.

Planet	*Secs arc/century*	*Solar mass/Planet mass*
Mercury	− 118·9242	7,500,000
Earth + Moon	− 564·1755	327,000
Mars	+ 74·5865	3,093,500
Jupiter	+ 656·06924	1,047·879
Saturn	+ 7·92070	3,501·6
Uranus	+ 0·277671	22,800
Neptune	+ 0·110304	19,700
	+ 55·86460	

* *Trans. American Phil. Soc.*, 22, p. 37, 1925.

In theory, therefore, the perihelion should be advancing by 55·86 seconds of arc per century, provided our masses are correct. Experimental observation, however, shows an advance of 43·055 seconds of arc per century, according to Doolittle.*

Note that these data were calculated before the later discovery of the planet Pluto in 1930. Pluto is more remote than Neptune and has a mass smaller than that of the earth. Its effect on Doolittle's figures can, therefore, be ignored.

At that time the mass of Venus was known with more assurance than was the mass of Mercury. Also, because Mercury has a highly elliptical orbit and describes its orbit more frequently, being the closest planet to the sun, it provides a better test for Newton's theory than does Venus. For Mercury it was found that the perihelion advanced by 43 seconds of arc per century faster than was calculated. There is an anomalous advance of perihelion. For Venus, Doolittle's data show an anomalous retardation of nearly 13 seconds of arc per century.

These anomalies were, of course, already well known by the men who began to question Newton's laws in the early years of this century. Planck (1907) asserted that all energy must gravitate. Einstein (1911) followed this by contending that since light is a form of energy light must gravitate. Thus a ray of light passing the sun must be curved and the velocity of light must depend upon the gravitational field. Einstein (1915) then presented a new gravitational theory incorporating his concept of a space–time metric in four dimensions. It incorporated a modification of Newton's law. From Einstein's new law of gravitation the planet Mercury would have an added perihelion advance of 43 seconds of arc per century, a remarkable agreement with the observed value. For Venus, Einstein's theory gives about 8 seconds of arc per century as an additional perihelion advance rate to that given by Newton.

Unfortunately, however, Einstein's theory is as inflexible as Newton's. The perihelion advance of Mercury has to be 43 seconds of arc per century plus whatever Newton's theory says it is. The values calculated depend upon the masses of the

* It is merely coincidental that this observed advance for Venus is almost the same as the anomalous advance for Mercury.

perturbing bodies. It is now believed that the oblateness of the sun, not accounted for in these early calculations, can reduce the theoretical perihelion advance by 3 seconds of arc per century. This makes Einstein's result less remarkable. Furthermore, there has been progress in working out the mass of Mercury and the test by Venus looks possible. By analysis of the motion of the minor planet Eros, one of the asteroids which approaches the earth very closely at perihelion and can afford more accurate data, Rabe (1951) has found the mass of Mercury to be one 6,120,000 part of that of the sun. This changes the figure of − 118·9242 in the Doolittle data to one more likely to be − 145·5. The anomalous retardation of 13 seconds of arc per century on Newton's theory becomes an advance of 14 seconds of arc per century instead. This is closer to Einstein's value of 8. But there are difficulties posed by our knowledge of the mass of the earth and moon system relative to that of the sun. Astronomers accept that there are discrepancies in the data they use. Indeed, they use different values for different purposes in order not to add confusion before resolving it. Nevertheless, the sun's mass appears to be about 333,430 times that of the earth, as far as we can judge from the earth's motion about the sun. This is the figure usually seen in most reference works. The mass of the earth is well known to be 81·53 times that of the moon. Therefore, the earth–moon system should be smaller than that of the sun by the factor 329,380. Doolittle's value was only 327,000. Also, many reference works suggest a value of the order of 328,400 as best for some purposes.*

This is not very assuring. If Doolittle's calculations are based on the value of 329,380 a further 4·1 seconds of arc per century have to be added to the theoretical advance, and this cuts the anomaly to 9 seconds of arc, which looks close to Einstein's value. But, did Rabe use Einstein's law in analysing the orbit of Eros? If he used Newton's law he has the wrong mass if Einstein's law is the correct one. Such are the problems!

Einstein's theory reduces gravitation to a geometrical condition; what has been called the curvature of space–time produced by the presence of matter. This compares with a pre-Einstein

* *Science Journal*, H. Aspden, August 1965, p. 28.

concept of Fitzgerald (1894) that gravity is due to a change in the structure of the aether produced by the presence of matter. This question of whether there is or is not an aether has importance even to Einstein's theory. The motion of a planet according to Einstein is not an ellipse even when other perturbing bodies are absent. It is an ellipse modified by progressive rotation as if the radial oscillations of the planet from the sun as centre are at different frequency to that of the planet about the orbit. It is as if the momentum properties of the planet are different for radial motion and the orbital motion. Of course, if we imagine a pendulum with a fixed spherical bob we have exactly this. The momentum properties are different for linear motion and swinging motion. The mass of the bob governs the linear momentum but the physical size of the fixed bob is involved as well, increasing effective momentum, for the swinging action. The planet can be likened to a system with a pivotally mounted bob, since it rotates independently of its orbital motion. The planet should, therefore, have the same effective mass for the two types of motion. But what if there is an aether medium? If the aether in the planet rotates with the planet, then this will not cause any discrepancy. But what about the aether surrounding the planet? We have to add the effect of moving a spherical hole through a fixed medium. This sounds absurd but it has sound physical basis, since we are dividing an argument into two parts. A hole can move through a medium if the medium can transfer itself across the void. Such a hole would have a negative linear momentum exactly balancing that due to the planetary aether. But such a hole could not be moved around in an orbit without changing its effective negative mass, because a hole can be said to move in a line but cannot be said to turn. This means that if there is an aether medium there will be an angular momentum effect to take into account. The angular velocity of the planet in an elliptical orbit changes as the planet traverses the orbit. Thus, the angular momentum of the aether will change as well. This angular momentum will be drawn from the orbital motion of the planet so modifying its orbit. It is then to be expected that the existence of an aether will cause anomalies in the motions of planets. The calculations are straightforward, as the author has shown* elsewhere, and the quantitative results support the thesis in this work that an astronomical body is enveloped in an aether which rotates with it.

* See footnote ref. on page 11.

7

Microcosmic Foundations

All the properties of electron spin, including the proper amount of angular momentum, relativistic fine structure and even the gyromagnetic ratio, flow out of the Dirac formalism in an almost miraculous fashion suggestive of a magician's extraction of rabbits from a silk hat.

Encyclopaedia Britannica, Vol. 18, p. 930, 1970 edition

Modern techniques for understanding the behaviour of the cosmos appear to have rather abstract foundations. The large-scale phenomena of our universe have become the realm of Relativity. The small-scale world of the atom, is the world of wave mechanics. Here we find the physicist using terms such as electron spin, angular momentum, relativistic fine structure and gyromagnetic ratio to portray the properties he can observe by his experiments. Some of these terms are common to the language of the greater world around the atom, suggestive of true unification of our theories across the whole spectrum of our experience. However, in view of the above quotation, suggesting that some of these properties have their origins in the occult magic of Dirac, we need to exercise care before accepting all that modern physics has to teach us. We must be suspicious of mathematical formalism.

An occult-sounding term used by engineers is the word entropy. It is a measure of the thermal energy in a system which is unavailable for turning to good account and performing useful work in man's machines. The concept of entropy is the engineer's contribution to philosophy. Referring to this contribution, and speaking of the philosophy of science in the nineteenth century, Eddington wrote:*

* *The Nature of the Physical World*, A. S. Eddington, Cambridge University Press, 1929, p. 104.

It was in great favour with the engineers. Their sponsorship was the highest testimonial to its good character; because at that time it was the general assumption that the Creation was the work of an engineer (not of a mathematician, as is the fashion nowadays).

Then, later on page 209 of his book Eddington wrote:

Nowadays we do not encourage the engineer to build the world for us out of his material, but we turn to the mathematician to build it out of his material. Doubtless the mathematician is a loftier being than the engineer, but perhaps even he ought not to be entrusted with the Creation unreservedly. We are dealing in physics with a symbolic world, and we can scarcely avoid employing the mathematician who is the professional wielder of symbols.

All this, of course, has given the philosopher food for thought. Dana Scott* writing under the title: 'Existence and Description in Formal Logic', says:

It is curious that in ordinary mathematical practice having undefined functional values, a situation close to using improper description, does not seem to trouble people. A mathematician will often formulate conditionals of the form

if $f(x)$ exists for all $x<a$, then. . . .

and will not give a moment's thought to the problem of the meaning of $f(a)$. More careful authors never use a description or a function unless it has been previously proved that its value exists. . . . More serious is the fact that it is quite natural to employ descriptions *before* they have been proved to be proper.

Scott then goes on to prove something in eighteen pages of mathematical symbology. I could not follow the analysis; it seemed too complicated, though it is surely undoubtedly valid. Jumping to his conclusions I quote one of his results from his page 197:

The operator O is eliminable in a theory T if and only if whenever two models of T are weakly isomorphic by a certain one-one function they are also strongly isomorphic by the same function.

As applied to the physics of crystals, isomorphism is the property of forming in the same or closely related geometrical

* The 16th essay in *Bertrand Russell: Philosopher of the Century*, edited by R. Schoenman, Allen and Unwin, 1967, p. 181.

configurations. In the logical derivation of this result, the operator O is something which has replaced the 'abstraction operator'. I do not confess the slightest understanding of the above conclusion. Nor am I encouraged by the final conclusion on page 199:

> This result on eliminability is not very satisfactory. . . . The author has no idea what kind of model-theoretic conditions would correspond to this uniform eliminability that we have when operators are introduced by contextual definitions. It seems like an interesting problem.

Perhaps an abstraction operator is involved in linking the three-dimensional world of our experience with the four-dimensional world of Relativity. Perhaps then it is difficult for the logician to satisfy himself that the method of Relativity is a valid method by which to reason an understanding of Nature. Or perhaps the logician is just confused by Relativity.

At this stage I wish to give my view that the mathematical theories of our universe, highlighted by Einstein's Relativity, have given too much rein to the mathematician. His skills in providing one of the tools needed by the physicist have been set aside and he has tried to become a philosopher in his own right. His apparent success has so affected the would-be general philosopher that mathematics appear nearly everywhere, superimposing a man-made vision of Nature and confusing us rather than recounting Nature's ordered structure with clear language.

Max Born* in his essay 'Reflections of a Physicist' writes:

> All our instruments consist of ordinary bodies and cannot be discussed but by ordinary language with the help of concepts of Euclidean geometry. It is of course left to the philosopher to analyse this macroscopic domain. But the physicist has enlarged it enormously by using magnifying apparatus: telescopes, microscopes, amplifiers, multipliers, etc. These produce data which, though consisting primarily of ordinary sense perceptions, cannot be conceived as meaningful structures with the help of the experience collected and the language learned in childhood. One has to apply abstract thinking. This is the domain of Russell's theory of empirical knowledge.

* The 11th essay in *Bertrand Russell: Philosopher of the Century*, edited by R. Schoenman, Allen and Unwin, 1967, p. 124.

For the physical world revealed here is a construction of the mind, armed with mathematics, from raw material obtained by the senses, armed by the magnifying tools of science.

Evidently, Born sees both the physicist and the mathematician as mere helpers who carry the brushes and paint to the great philosopher artist, busy at work transforming the visions of his mind on to a canvas which will portray Nature and Creation. But surely, this canvas has already been painted by Nature herself. It only needs the physicist to clean off the paint added for centuries by these many philosopher artists and then to examine, under his microscope of course, the fine detail and true beauty and majesty of what is there to be revealed.

When Eddington referred to the Creation being the province of the mathematician he had in mind the name of Dirac. Dirac graduated Ph.D. at Cambridge in 1926 in mathematics. Six years later in 1932 he was awarded a Nobel Prize along with Schroedinger for 'the discovery of new productive forms of atomic theory'. Yet, Dirac was an engineer turned mathematician. He graduated as a Bachelor of Science in electrical engineering at Bristol in 1921, and his engineering spirit may well account for his frank and objective way of expressing his ideas, thus making his work an easy target for our enquiry. Dirac's contribution to modern scientific outlook on the workings of the cosmic world is so great that he provides the focal point for study in this chapter and also in Chapter 10. Following the theme of our introduction, it will be the objective to question and criticize the reputed 'wizardry' of Dirac. But this attack has broader address. The viewpoints projected here can be levied against the works of numerous less-eminent contributors to the mathematical theories of physics. It is just that Dirac's work provides an exciting stimulus to critical and constructive review and adds to rather than detracts from the magnitude of his great contribution to the scientific thought of this century.

Dirac's main contribution concerns the properties of the electron, that fundamental entity of electric charge which is almost the sole performer in the practical applications of electricity. The history of science is well coloured by the early recognition of the existence of the electron and its eventual discovery when, near the end of the nineteenth century, it became possible to measure its charge/mass ratio, and then its singular charge. After this there seemed little further to be said about the electron. How it kept itself intact, restraining itself from exploding under the action of the mutual repulsive force of its charge, was the real problem. How it behaved in atoms and could be created or annihilated were to become problems. A concept known as 'electron spin' was to be invented by 1925.* Nevertheless, the electron had been discovered by the end of the last century and, thereafter, its properties were merely a matter for experimental investigation to afford the clues as to its origins. But when Dirac came to discover the properties of the electron he was not examining the electron at all. His interest focused upon certain mathematical equations characterizing the new concepts of wave mechanics which were at that time being projected in Continental Europe by de Broglie and others.

It will be remembered that at the beginning of Chapter 5 we mentioned de Broglie's award of the Henry Poincaré medal by the French Académie des Sciences on December 16, 1929, and the honour on the same occasion conferred upon Véronnet. Months previously Véronnet proposed his aether to the Academy, an aether containing 'etherons' whose motion determines the Planck constant. Four days previously, on December 12, 1929, de Broglie had been presented with the Nobel prize 'for his discovery of the wave nature of electrons'. In his Nobel lecture he had said:†

> A purely corpuscular theory does not contain any element permitting the definition of a frequency . . . I thus arrive at the following overall concept . . . for both matter and radiations, light in particular, it is necessary to introduce the corpuscle concept and the wave concept at the same time. In other words the existence of corpuscles accompanied by waves has to be assumed in all cases.

Centuries before, in the time of Newton, it had been recognized that light had a corpuscular nature, and yet that light

* Uhlenbeck and Goudsmit, *Naturwiss*, 13, 1925, p. 953.

† The quotations from the Nobel lectures presented here and elsewhere in this book are taken from *Nobel Lectures (Physics) 1922–1941*, Elsevier Publishing Co., 1965.

was transmitted by waves in the aether. It was a real step forward to discover that corpuscles had an associated wave nature. The inevitable physical constant of such an association is Planck's constant, the quantity relating energy and frequency of light quanta. Véronnet's aether was, therefore, very much in evidence from de Broglie's discoveries. For de Broglie to say that 'a purely corpuscular theory does not contain any element permitting the definition of frequency' and then go on to endow it with its own wave properties is to ignore the aether. Or it may be a way of recognizing the electron and the aether as a co-operative whole. It is a question of one's viewpoint.

Three years later on December 12, 1932, Dirac delivered his Nobel prize lecture under the title 'The Theory of Electrons and Positrons' including the words:

> It is found that an electron which seems to us to be moving slowly, must actually have a very high frequency oscillatory motion of small amplitude superimposed on the regular motion which appears to us. As a result of this oscillatory motion, the velocity of the electron at any time equals the velocity of light. This is a prediction which cannot be directly verified by experiment, since the frequency of the oscillatory motion is so high and its amplitude so small.

Dirac attributed this viewpoint to Schroedinger but Einstein also had proposed an explanation of de Broglie's wave formulations in 1925.* Einstein imagined the electron as belonging to a Galilean reference frame oscillating at a frequency determined from the electron rest mass energy and the Planck relationship, and being everywhere synchronous. Thus Dirac, Schroedinger and Einstein all seem prepared to recognize that particles of matter may have a superimposed cyclic motion, as if belonging to some unseen reference frame which is oscillating at a very high frequency, which for electrons happens to be the frequency at which they are annihilated or created.

One is tempted to argue from this that the aether which we spoke about in Chapter 4 as having a system of negative particles oscillating in harmony in a continuum of opposite charge is exactly in keeping with these wave mechanical ideas. If an

* Paper at p. 3 of *Berlin Sitz.*, 1925, but see also reference by Sir Edmund Whittaker in *History of the Theories of Aether and Electricity, 1900–1926*, Nelson, London, 1953, p. 215.

electron is swept into the negatively charged system and shares its oscillations it can well display wave properties. Certainly, the ideas proposed for the origins of the earth's magnetism must gain support from this link with de Broglie's wave mechanical theories.

However, we must return to the mathematical techniques which led to the bold discoveries of Dirac. We will omit the mathematics in the following quotation from his Nobel prize lecture and capture those words (paraphrasing some) which will show how his argument is developed:

> We begin with the equation connecting kinetic energy and momentum of a particle in relativistic classical mechanics. . . . From this we get a wave equation of quantum mechanics, by letting the left-hand side operate on the wave function. . . . With this understanding the wave equation reads . . . but a wave equation must be linear in certain terms and this is not. . . Let us try a new equation . . . this involves four new variables which we use as operators . . . now assume certain relationships between these variables . . . this is linear and it makes the equations equivalent to a certain extent . . . the new variables which we have to introduce to get a relativistic wave equation linear in . . ., give rise to the spin of the electron . . . the variables also give rise to some rather unexpected phenomena concerning the motion of the electron. These have been fully worked out by Schroedinger. It is found . . .

Here the quotation develops into the one already presented. Dirac invented a mathematical equation, found it could be adapted to fit the observations and then concluded that the terms in his equation actually give rise to physical phenomena. He has provided the mathematics needed to fit the facts. All that remains is for someone to provide the physics which will fit this mathematics. All we need is enough understanding of the aether and we might find what is needed. But, oddly enough, the modern physicist thinks the work is already finished. He is not interested in the physics and is quite content with his mathematics.

Dirac himself had more to say. His eye for symmetry allowed him to extract more from his mathematics. Continuing from his lecture:

We now make the assumptions that in the world as we know it, nearly all the states of negative energy are occupied, with just one electron in each state, and that a uniform filling of all the negative energy states is completely unobservable to us. Further, any unoccupied negative-energy state, being a departure from conformity, is observable and is just a positron.

The positive electron or positron had just been discovered earlier that year by Anderson and Millikan, working in California analysing cosmic radiation. Dirac's mathematical scheme thus explained the positron as well. One might wonder how a physicist or an engineer can come to terms with the idea of negative energy, particularly when it is attributed to the fundamental sub-stratum of our universe and is not merely a change in energy due to displacement from an arbitrary position. However, be that as it may, Dirac's theory commanded attention and was taken as meaningful by those best able to judge. Dirac did, however, not claim that his mathematics could explain the neutral particle, the neutron of the atomic nucleus, which had been discovered by Chadwick that very same year, 1932. It is interesting to note that when Chadwick received his Nobel prize for this very discovery in 1935 he said about the neutron:

A structure of this kind cannot be fitted into the scheme of the quantum mechanics, in which the hydrogen atom represents the only possible combination of the proton and the electron.

This was in spite of the fact that Fermi had been at work suggesting in 1934 that the neutron and the proton were the same particle in two different quantum states. But we have more to quote from Dirac's lecture, and it is particularly important in view of our account of the creation of the solar system as presented in Chapter 5.

If we accept the view of complete symmetry between positive and negative electric charge so far as concerns the fundamental laws of Nature, we must regard it rather as an accident that the earth (and presumably the whole solar system), contains a preponderance of negative electrons and positive protons. It is quite possible that for some of the stars it is the other way about, these stars being built up mainly of positrons and negative protons. In fact, there may be half the stars of each kind. The two kinds of stars would both show exactly the same spectra, and there would be no way of distinguishing them by present astronomical methods.

Now, this is only speculation. Symmetry has meaning in mathematics but we have to be cautious in physics. Dirac's mathematics pertain to an aether as much as they do to the systems of matter we can see. If the aether had regions with polarity of charge inverted, would the boundaries between these regions be stable? Boundary conditions are of vital importance to the physicist. The mathematician can examine his ideal regions, his singularities, and forget the practical boundary problems. This is where Relativity fails, as we shall presently see. The chances are that with the aether of mixed polarity there would be an over-riding tendency towards uniformity rather than symmetry. Aether in which positrons and anti-protons predominate might be squeezed out of existence as the boundaries move to convert it to aether pervaded by electrons and protons. We are speculating, of course, but we are thinking in physical terms, not mere mathematical notions of symmetry. Perhaps, then, it is in the sun and all the other stars that this fight between the aethers is raging. The polarity inversion may be occurring at the spherical boundaries between aether at the solar surface and hence energy may be unleashed from the aether itself as by-products of the basic particles of charge are produced to create and illuminate the universe. It is not our task to pursue this here. We have examined how Dirac approached the problem of explaining the properties of electrons. What he discovered may, or may not, be an answer. It may only be itself a philosophical problem. In any event, Dirac became the man most competent to speak about the origins and the nature of the electron. It is, therefore, of particular interest to see what he has to say about the electron a little later in 1938 when he is examining electron radiation properties. It is the question of energy radiation which is attracting attention at the present time. Hence the importance of this question. But we will come to that in Chapter 10. First, we will digress a little to philosophize about physics. This diversion seems appropriate because ideas of the cosmos have been our prime concern in the previous chapters. Now we are turning away from these grand matters of our direct experience and what we can observe in astronomical telescopes to the uncertain realm of the microcosmos, the physics of what we cannot see. We want neither occult techniques nor fiction, but, instead, experimental techniques and fact. We must be able to distinguish fact from fiction to make certain progress in our endeavour.

For those equipped to understand the language in which the physical nature of our environment is currently portrayed, physics is a most fascinating subject. The secrets of our origins and destiny are undoubtedly contained in the ultimate solution of the fundamental problems of physics. Concepts such as space, time, energy, matter and electric charge all play a prime role in the physicists' world, but the secrets of the reality contained in these concepts will not be discovered merely by thought processes. Man must examine and re-examine the system of Nature which has revealed them and reach his conclusions without adding unnecessary complexities contributed only by his mind. The fundamental nature of things is likely to be simple, just as complex products result from random or selective aggregations of simple constituents. However, although it is said that truth is stranger than fiction, one can but wonder at both the strangeness and the truth of modern physical theory. If the reader who is well versed in physical theory can honestly say that he understands the accepted explanations for the physical nature of phenomena then he will have little interest in this book. But few physicists can really be wholly satisfied with the representative works of modern physical theory. Doubt and uncertainty must confront the majority and this book may provide some appeasement if not inspiration to those interested in thinking about physics.

Perhaps the real measure of our understanding of physics is our ability to convey such understanding to the younger generation. Let us then consider what is perhaps the first physical phenomenon to be introduced to the child without the back up of assured knowledge about its nature and cause. Magnetism should arouse tremendous curiosity, both in our childhood and in later years, if we really care about Nature's properties. The magnet has aethereal powers. It attracts iron and exerts its influence across empty space or even through material bodies. Yet how do we explain magnetism to a child? We cannot. We only demonstrate it. How do we explain magnetism to an adult? If he is conversant with the terminology of physics and he researches in the textbooks on the subject he will find it hard to discover an explanation that can evoke understanding. He will find it has some dependence upon what is termed an 'Exclusion Principle' for which we are indebted to a scientist named Pauli. This principle in its turn can be demonstrated in its application in physical theory. Its use can, therefore, be understood, but how can one understand the physical reason for the applicability of the principle without going deeper into the problem? We must be careful not to translate one problem into another and then think we have explained something. Progress results if we translate two problems into one common one, and then only if the common problem is one of physics and not merely one of mathematics. So-called principles do tend to be more mathematical than physical, and one can hardly explain mathematics by physics.

Looking through one of the most significant treatises on magnetism (dated 1966) we find the following statement:*

> About a generation has elapsed since it became recognized that the major agency responsible for ferro- and antiferromagnetic behaviour of materials is the Pauli exclusion principle, which makes the spatial and momentum distributions of a group of electrons dependent on the relative orientations of their spins.

This statement will undoubtedly be endorsed by physicists working in this particular field. They can even explain what it means, but they are unlikely to say more than is said in the rest of this treatise on magnetism. One can understand what they say, but does this mean that one understands magnetism itself? Many words and ideas are used in the explanation and they have no direct connection with what is observed in Nature. By some mental exercise one can forge links between Nature and certain principles and notions of man's own and then apply these to explain something else. But how do we know the

* Page 1, Vol. 4, *Magnetism*, Rado and Suhl, Academic Press, New York, 1966.

links thus forged are sound? Are these links founded in fact or fiction? Perhaps it does not matter, except that man has developed some linking concepts which are, to say the least, rather weird and complex. The nature of magnetism is, hopefully, not as complicated as the above-mentioned treatise suggests. Physics has become so complicated that the future must see attempts to scrap much of the presently accepted work and try again to find something less complex. In the meantime the newcomer to the subject should try to adapt his viewpoint to extract what is of value in recorded physics. The facts of experiment unadulterated by theoretical correction have to be sifted from the data available. Theoretical introductions to the facts of the subject are to be viewed with special caution.

The ultimate understanding of Nature will have to be one which relates natural phenomena to a minimum number of physical concepts. In the days before the discrete particle nature of electric charge it was the object of natural philosophy to portray phenomena in terms of mechanical principles. Before Newton's time there was a more direct reference to basic features of experienced phenomena. Fire, earth, water were typical elements on which physical theory was founded. With the discovery of the electron we could advance to efforts to relate all physics to fundamental electric charges and their mutual interactions. Yet, surprisingly, there has been little of lasting acceptance to emerge from these attempts at physical unification. The object remains as a challenge but inspiration has not matched the task. And yet, Nature should be simple and it should not be difficult to understand its fundamental structure.

In this book we shall forge ahead in this enquiry to the point where we even find a way of explaining mass itself in terms of electrical action. We will arrive there by asking questions and finding simple answers, by not accepting too readily what others have accepted too readily. We will move first to an explanation of the nature of the physical force interaction between two bodies, taking note of some words in Newton's *Principia* (1687):

That one body may act upon another at a distance through a vacuum, without the mediation of anything else, . . . is to me so great an absurdity, that I believe no man, who has in philosophical matters a competent faculty for thinking, can ever fall into.

The reader may be sceptical about what has been said in this chapter. We have criticized the abstract methods of Dirac, made reference to de Broglie's endowment of electrons with a wave property and come to Newton for support in advocating the existence of a real aether. Progress in physics may, indeed, require the physicist to backtrack in his ideas. As recently as March 1971, de Broglie wrote at page 149 of *Physics Bulletin*:

Everything becomes clear if the idea that particles always have a position in space through time is brought back. . . . The movement of the particle is assumed to be the superposition of a regular movement . . . and of a Brownian movement due to random energy exchanges which take place between the wave and a hidden medium, which acts as a subquantum thermostat.

Now, if de Broglie has to appeal to a hidden medium which exchanges energy with matter, and this in 1971, is not there purpose in reviving the aether with real fervour? We are now half way through this text on Modern Aether Science. The role of the aether in large-scale, cosmic phenomena has been presented. More will be said about this in Chapter 16. Now, however, whether prompted by de Broglie or Newton, the role of the aether on the microcosmic scale has been introduced and we are ready to see where this takes us.

8

The Law of Force

In this modern age of science we really should be able to say that we know how to work out the force which one electric particle exerts on another. But can we? We know that like charges repel and that unlike charges attract according to the law named after Coulomb. The force of interaction between charges at rest varies inversely as the square of their distance apart. Do we know the law of interaction for discrete charges which are both in motion? We can hardly explain the physics of diverse phenomena in terms of a common relation with a particle system of electric charge unless we can answer this question with a firm 'yes'. Explaining Nature in terms of electric charge behaviour is physics. The mathematician knows how his symbols interact so he has no problem creating his theories of the universe. The physicist has problems finding the facts and even finding how to express the facts, because we are not quite sure any more what we mean when we talk of a particle in motion. Motion is a relative quantity and requires a reference frame. Do we have to specify a reference frame to develop physics? The answer to this is affirmative for the problem with our two electric charges, unless we expect to find that the interaction force is the same whichever frame we choose. In Nature it might be that the force does not depend upon our choice of reference frame and then we need not confuse our basic question by digressing in this way. Experiment should provide the answer.

Early in the twentieth century Trouton and Noble (1903) relied upon accepted electrodynamic theory in performing a relevant experiment. They found that the interaction forces between opposite charges on the plates of a moving capacitor did not depend, as was expected, upon the orientation of the capacitor in space. The capacitor was carried through space with the earth at a speed which could have resulted in electromagnetic interaction permitting detection but it was evident that the earth's speed did not figure in the electrodynamic interaction. It was as if the reference frame was not important. However, this is like proving experimentally that two plus two is not four. There must have been error in the logic of our deduction. If the reference frame does not matter we can examine a law of electrodynamic interaction between two charges moving at different velocities and choose one which is at rest relative to one of the interacting charges. Then we would have concluded that the force between a charge at rest and one in motion is the same as that between the two charges if an equal velocity component is added to both. Since the interaction force can be divided into components by pairing off the interactions between the original and additional velocity quantities, we see that three interactions have been added to the basic one and that these three must together sum to zero. Since this has to apply for any possible basic system so that there are numerous parameter combinations in the various sets of three interactions, it must be that each of these interaction components is zero. In short, we can argue that only the basic Coulomb interaction force can exist from the findings of the Trouton–Noble experiment. On this argument we deny the existence of electromagnetic interaction between discrete charge and have experimental evidence on which to rely. However, we now have it that two zeros plus two zeros sum to more than four zeros, in effect, and the experiment thus interpreted proves nothing.

On this basis we assert that there is electromagnetic interaction between charges in motion and that this action varies with the velocities of the charges relative to a common reference frame. Did Trouton and Noble check the effect of moving the capacitor at different velocities relative to this common frame? They did not. In fact, taking the earth itself as a frame they did not move the capacitor at all. They merely assumed that the earth must be moving in space due to its motion with and about the sun. Their experiment showed that two discrete electric charges moving together with the same velocity must have an interaction force acting directly along the line joining the charges, as does the Coulomb force. Trouton and Noble must have used an incorrect law of electrodynamics. Alternatively, we admit but one reference frame to the experiment, the earth frame, and contend that we have proved nothing about electromagnetic interaction save that it adapts to a local reference frame.

Yet, although this is the logical outcome of a study of a famous and accepted experiment in physics, we find that neither of these alternatives is admitted by orthodox teaching. How, then, has history disposed of Trouton and Noble's findings? Perhaps the best answer to this question is to be found in Sir Edmund Whittaker's *History of the Theories of Aether and Electricity*. He notes that shortly before his death in February 1901, Fitzgerald commenced to examine the phenomena exhibited by a charged electrical condenser, as it is carried through space by terrestrial motion. Magnetic theory prevailing at that time indicated the prospect of detecting the earth's motion through space from changes in torque on the condenser resulting from variations of its state of charge. Fitzgerald's pupil Trouton followed through with the experimental work but no effect of any kind could be detected. Whittaker then dismisses the subject by saying that the explanation of the result 'was rightly surmised by P. Langevin to belong to the same order of ideas as Fitzgerald's hypothesis of contraction'. The impossibility of determining the motion of the earth relative to the so-called aether then emerges as a principle of physics. Whittaker reports that Poincaré, lecturing in St. Louis, USA in September 1904 named this principle 'The Principle of Relativity'. Applying this principle, one has to override one's expectations of results from the Trouton and Noble experiment. No torque can occur, as a matter of 'principle'. We need not, it seems, worry about our conclusions concerning the interaction of electric charges in motion.

Thus history shows us that this important experiment was swept aside with daring abandon as the theory of physics succumbed to invasion by Relativity. Sterile physical principles became the foundation stones for a new kind of physics, which, being Man's own fabrication rather than a replica discovered from Nature's own structure, is subject to erosion with the passage of time.

The Trouton–Noble experiment reappears from time to time in the scientific literature. Writing in 1970, Strnad* demonstrates how there are difficulties in applying the Special Theory of Relativity to explain the null result of the experiment, and how it may be necessary to accept the added complication of a principle of virtual work suggested recently by Fremlin (1969).† It seems that there are doubts in applying the Principle of Relativity to a system at rest in our earth frame. Nothing happens by which we can detect our motion, so why should there be a problem to answer? Yet, those versed in Relativity do not seem ready to accept the basic principle. They go into all kinds of mathematics to explain their difficulties in working with Relativity. Page and Adams (1945)‡ dealt with the paradox of the Trouton–Noble experiment rather differently. They merely asserted that according to Relativity there should be no torque, consistent with the experimental result. Hence, without analysis, they were led to assert that the dielectric structure holding the charged capacitor plates apart must transmit some balancing torque.

The writer here submits the proposal that we really do not know what force exists between two electric charges due to their magnetic interaction. Physicists are lost. They need to take a fresh look at the problems and work out a new law of electrodynamics.

Where do we stand in our effort to unify physics in terms of interaction between electric charge? We still have not reached an answer to our question: do we know the law of interaction force for discrete charges which are both in motion? The Trouton–Noble experiment should have at least suggested action along the line of separation for charges in parallel motion, but this prospect went adrift since the purpose of the experiment was not to pronounce on electrodynamic law but to

* J. Strnad, *Contemporary Physics*, p. 59, 1970.

† J. H. Fremlin, *Contemporary Physics*, p. 179, 1969.

‡ L. Page and N. I. Adams, *Electrodynamics*, Dover, p. 278, in 1965 version of 1945 edition.

detect motion in the aether. What is curious is that the theory leading to the experiment was never questioned to its classical foundations as a result of the null findings. The theory should have been rechecked. Even more curious is the fact that the accepted versions of electrodynamic interaction laws between discrete charges in motion all give answers contrary to the findings of the Trouton–Noble experiment. Rather than modifications in the basic equations we have seen attempts to distort the experimental apparatus by the mystic action of the all-important principle.

Let us look back at the origins of electrodynamic theory. We see that discrete charges are not isolated in experimental work to facilitate measurement between two and only two such charges. In fact, we are not even interested in this ourselves since all we need to know is the effective interaction force between pairs of charges in a populated system of charge. This is the additive component of the interaction. But, what we need to know is the interaction where charge in one part of the system is all moving with one velocity and charge in the other part of the system moves with another velocity. Our problem is that the classical law is deduced from experiments in which charge in one of the interacting systems moves in closed circuits and therefore does not possess a unique velocity common to the system. Classical theorists, therefore, made assumptions about the direction of the force interaction between two isolated charges. They formulated many alternative laws of electrodynamics any one of which can explain the observed electrodynamic interaction between electric charge in motion, provided one of the interacting charge systems is effectively a closed circuital current. The most famous of these laws was that of Ampère, but it is seldom used. Today we have turned to the intermediary use of the notion of a magnetic field, and usually combine two electromagnetic rules, the left-hand rule and the right-hand rule, to work out the electrodynamic interaction between separate charges. However, even here we rely on one of the charges being effectively a closed loop of current. Had Ampère, or the others who had to make assumptions to formulate their laws, used the empirical fact later to emerge from the Trouton–

Noble experiment, then they would have obtained a different law of electrodynamics. Necessarily, this law would give electromagnetic interaction along the line joining the interacting charges when both have the same velocity, that is, move parallel relative to the appropriate frame of electro-magnetic reference. The author has presented this law in several publications* but popular attention has not yet been turned to the problem, even though unified physical theory is so much dependent upon knowledge of the interaction between electric charge.

It is startlingly easy to show where the opinions of the past went adrift. What we have to do is to take note of the fact that our two electrons can never exist in isolation. Whittaker seems very briefly to come close to this when he explains how Eddington used Mach's principle to approach the problem of gravitation:†

> Eddington applied Mach's general principle to the interaction between two electric charges. If they are of opposite sign, all their lines of force run from one to the other, and the two together may be regarded as a self-contained system which is independent of the rest of the universe: but if the two charges are of the same sign, then the lines of force from each of them must terminate on other bodies in the universe, and it is natural to expect that these other bodies will have some influence on the nature of the interaction between the charges.

As we shall see in Chapter 11, where Mach's principle is discussed, it is really wrong to try to explain gravitation without first explaining the nature of mass. Our prime concern has to be electric interaction effects. Then, when we understand these we can hope to discover an understanding of the force of gravitation. It is permissible, nevertheless, to use the mathematical techniques developed for gravitational theory in our study of the effects of inverse square law actions between electric charge.

* *The Theory of Gravitation*, H. Aspden, Sabberton Publications, Southampton, 1960; 'The Law of Electrodynamics', H. Aspden, *Journal of the Franklin Institute*, 287, p. 179, 1969; *Physics without Einstein*, H. Aspden, Sabberton Publications, Southampton, 1969.

† *History of the Theories of Aether and Electricity, 1900–1926*, E. Whittaker, Nelson, London, 1953, p. 151.

It is a well known and easily-proved fact of particle dynamics that external forces will act on a system of two particles as a single force through the common centre of gravity and that any motion of the particles relative to this centre of gravity is completely independent of these external forces. Therefore, we have to be open to the possibility that, in analysing a two electron system in isolation, we can have a force communicated by the environment so as not to exert any turning moment on the system.

This is the simple, logical and straightforward starting point to an analysis of the problem. It has apparently eluded recognition in the past. Indeed, some theorists have gone out of their way to make it an absolute condition that no external out-of-balance force should act on the system as a whole. They have lived with Newton's maxim that action should balance reaction but forgotten the rider that this only applies to a complete system. They have assessed an incomplete system and found that their results do not have utility in explaining the behaviour of Nature, which evidently will not let itself be fragmented to suit the theoretical whims of the physicist.

The force communicated by the field environment will divide into two equal components X acting separately on each electron, as depicted in Fig. 1. The centre of gravity of the system is midway between the two electrons because of their equal charges and masses and so the force components need to be equal to provide no turning action and need to sum to the total force exerted from outside.

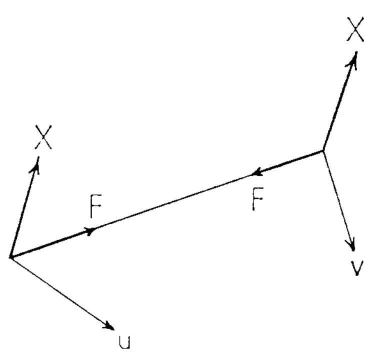

Fig. 1

Next, note that electrodynamic theory concerns actions additional to the Coulomb effects between charges. Usually we are dealing with current elements, that is charge moving in association with other local charge which provides an electrostatic field cancellation. The result is that there can be Coulomb forces on the electrons in these circumstances, as when they are flowing in a conductor, but they must be embraced exclusively by the two vector forces X depicted in Fig. 1.

We are then left to consider the mutual magnetic effects of the two electrons. By working out the interaction of their magnetic fields and analysing how the interaction energy component changes with separation distance between the charges, we find that a direct force acts between them. This is denoted F in Fig. 1. The history books show that some workers, notably Helmholtz, worked along these lines and proposed F as the complete law of electrodynamics.* It was inadequate, of course, because it took no account of the forces X. To find X is quite simple. We merely consider energy deployment at each particle. The force components, the energy supplied and the energy absorbed by the electrons must be compatible. The result presented in the Appendix at page 161 is a new general law of electrodynamics which differs from those derived historically and based on other assumptions. But it is a law which not only gives all the right answers when adapted for use for studying interaction involving a closed circuital current; it additionally reduces to a form for which the forces X are zero when the current elements represented by the electrons move in parallel directions. The two velocities u and v in Fig. 1 then are parallel. The result of the Trouton–Noble experiment clearly conforms. Hence, in electrodynamic terms we arrive at a law of attraction conforming exactly with the form of Newton's law of gravitation for a common condition of all interacting elements. This condition is satisfied if all mass is associated with a related electric charge moving harmoniously in synchronous circular orbit. Charge in such motion was the key to Véronnet's aether, as presented in Chapter 4 to explain the earth's magnetism. Hence, we have

* F alone is inadequate to explain the circuital laws but Helmholtz's formulation would have explained the null result of the Trouton–Noble experiment.

our clue to understanding gravitation. It is beyond the scope of this work, but it is possible to derive the Constant of Gravitation in terms of the charge/mass ratio of the electron and thus provide convincing evidence in support of such a theory of gravitation. This is presented in detail in the author's recent book *Physics without Einstein*.

A concluding remark, perhaps needed to dispel some doubts, is that the above views are not refuted because an electrical current will turn a coil in a magnetic field. To develop the turning moment here there are at least three current interactions, two current elements in the coil and one developing the field. No two alone will develop a torque between them. The coil will never turn itself. Nor will the whole system including the source of the field ever turn itself due to its own interactions.

9

Boundaries of Relativity

In the concluding pages of the previous chapter we escaped losing ourselves in the abstract world we entered earlier. We arrived at a conclusion about the law of electrodynamic interaction between electric charge in motion without even defining what we meant by motion. It was a natural result of being satisfied that our theory fitted what we saw. Electrons in motion can be measured. Their velocity is determined from a knowledge of their mass, their charge and their centrifugal behaviour when deflected by an electric or magnetic field. Velocity is measured relative to the earth frame, the frame from which we make most of measurements in physics. It is the frame we have in mind when we speak of motion. Philosophically we may wonder if the same laws of physics would apply if measurements were made on the surface of the moon. It seems quite probable because test apparatus sent to the moon appears to function there much as it does on earth. Therefore, philosophically, we can accept the Principle of Relativity or we can say that both the moon and the earth have their own aether moving with them and all physics are the same relative to this aether medium. Motion of electric charge really means motion relative to a frame of reference in the aether, if our interest centres on magnetic effects. This is hypothesis, but it is a good working hypothesis and it suits the ideas presented in Chapter 4. Nevertheless, we must admit that other ideas can have closer claim on the truth, until there is conclusive evidence determining which is right. So we will be tolerant of Relativity and explore that subject further now.

Let us stay with the problem of the force between two electric charges in motion. The reader may glance at the reference works available to him to find the textbook formulae for the interaction force. But, search as he may, he will not find anything to prove that a formula has been verified by experiment. Therefore, the reader must keep a critical eye on the way the formulae are derived.

It will be found that there is an empirical formula for the force on an electric charge in motion in an electric and in a magnetic field. It is known as the Lorentz force equation. Being empirical, the equation has to be believed, having due regard for the restrictions imposed by the experimental techniques used. For example, we must remember that the magnetic field on which the empirical facts are established is not produced by a single electron but by electric currents in closed circuits or by whatever it is that generates magnetic field inside a ferromagnet.

Writing about this empirical equation, Dingle* said:

> This is not deducible from the general equations of the field according to classical theory, and has therefore to be ranked as an additional postulate. The modifications introduced by Relativity, however, remove the necessity for this, since, when the proper transformation equations are used, the force appears as a consequence of the change of the co-ordinate system.

Now, this is a very powerful statement. To say that an empirical equation of classical physics cannot be deduced from classical field theory is itself a challenging remark, and it certainly is not true today. The force on an electric charge due to an electric field can be derived from classical field energy analysis. The force on the charge due to a magnetic field can also be derived by classical techniques, as was shown at the end of the previous chapter, provided, of course, we know the origins of the magnetic field or assume that it is produced by a circuital current. But, for Dingle to say that the force on an electron can be understood in the mere transformation of a co-ordinate system is unduly provocative. We should be in rebellion at this blatant suggestion that magnetism is an electric field viewed from a different reference system. But how can we rebel without weapons? Words and philosophy are no help against an established doctrine. Well, we do have weapons. We have our experimental facts, and we can disprove what Dingle says. First, note that if we can develop a magnetic field merely by transforming a

* *The Special Theory of Relativity*, H. Dingle, Methuen, 1950, p. 79.

co-ordinate system, we have contrived to do what Nature herself cannot do. We have produced a field which is not characteristically dependent upon a source. We have assumed that all magnetic fields are generated, not by a discrete electric charge, but by some system defined by co-ordinates. We have invoked some kind of infinite electric fluid. It is, of course, the electric charge continuum introduced by Maxwell to explain his displacement currents. Maxwell's equations are the basis of the transformations used in Relativity to derive a magnetic field from an electric field and vice versa. But, of course, if you do this, you are no longer talking of magnetic fields produced by electrons or discrete charges in a system under analysis. You are assuming that all magnetic fields are in effect the same as those developed by a uniform electric charge in the aether medium. Well, they are not the same. To assume that they are the same will merely lead to a result which is correct only for those situations where the magnetic field is developed by a current which is a closed circuit one. The infinite current filaments of the notional charge continuum invoked by transforming Maxwell's equations are, mathematically, closed circuits.

Evidently, Relativity denies the possibility that a magnetic field could develop a force on an electric charge along the direction in which the charge is moving. Lorentz's formula says the magnetic force has to act at right angles to the motion. Yet, if the magnetic effect is produced by a charge following in line behind the first charge, there is no magnetic field along points in this line but there is an electrodynamic force between the charges. Many authors have provided experimental evidence of these forces. They appear as anomalous cathode reaction forces where electric discharges are under study. Furthermore, our understanding of the energy in a magnetic field should tell us that the interaction energy between two electric current elements when aligned is dependent upon their separation distance. If they comprise two electrons moving forward in the same line, they will have an electrodynamic force set against their mutual repulsive force. Also, if gravitation is an electrodynamic force action, as Einstein tried to show without success, we would expect gravitation to act between particles even though they are moving along a common line. All sense points to this result. Therefore, we must, indeed, be careful before accepting the Lorentz formulation. Since Relativity leads to the formula without any reservation, it shows the ineffectiveness of the relativistic method.

Still, there is more criticism to come. If we follow Dingle, we should take the basic force on electric charge as the product of the strength of the charge and the electric field intensity. The transformations come after we have made this assumption. What experiment has ever shown that the force on a unit charge is simply the electric field intensity? The answer is 'none', so we have another questionable assumption on which relativistic argument is founded. The electric field intensity is actually defined as the measure of the force exerted on unit charge. The field is the imaginary connection between two interacting electric charges, themselves defined in terms of force. The definition of force in terms of field-charge interaction must seem valid. It is used so extensively in electrical theory. Yet it is not universally valid. There are hidden implications in the fundamental notions of classical field theory which will not permit the use of this simple basic fact without some reservation. Curiously, the reservations only seem to impact Relativity, because classical theory tends to start out with charge as the source of electric fields, whereas Relativity pulls field out from nowhere by the magic of abstract transformations of reference frames.

The reader who is interested should trace through classical theory to find how the ideas of a field and field energy are reconciled with the forces acting between electric charges. He will find that inevitably the charges involved have to be specified and that inevitably there are boundary conditions to take into account. This is seen immediately if we consider a uniform electric field. An electric particle in this field will have its own symmetrical field and the interaction field energy cannot be calculated without specifying the boundaries. If the boundaries are put at infinity, then the interaction energy is infinite. The force is determined by the change of energy when the particle is displaced. Hence, it is measured by the difference between two infinities, an indeterminate quantity. On the other hand, by symmetry, we see that the particle will not know where it is relative to the field and so cannot be under any force. Now, our problem has come about because we have invented a field. If we specify where the charge producing the field is located, then we have no problem. We can even develop a uniform electric field between two capacitor plates and work through the field energy analysis to find that there is the expected force on a particle of charge located between the plates. In fact, the usual formula for the force only applies because the boundary conditions permit the realization of an actual system of charge. The charge location or equivalent boundary conditions have to be capable of specification.

With Relativity, an electric field can be produced from a magnetic field by transforming co-ordinates. What this means in terms of redistribution of electric charge and charges in boundary conditions defies interpretation. Possibly a planar charge distribution suddenly appears as if we all live between the remote parallel plates of an imaginary capacitor. Possibly this problem is not important. Relativity may only be a convenient symbology by which to relate physical concepts. But it should not then be used to explain the nature of physical phenomena. Boundary conditions cannot be ignored in applying Relativity.

For those readers who remain sceptical and think Einstein's theory inviolate, it is appropriate to note that Einstein himself alerted us to the boundary difficulties. Einstein died in 1955 but, in an appendix he added to the fifth edition of his *Meaning of Relativity* (1956 with preface dated December 1954), he wrote in his concluding remarks at page 164:

> A field theory is not yet completely determined by the system of field equations. . . . Should one postulate boundary conditions? . . . Without such a postulate, the theory is much too vague. In my opinion the answer to the question is that postulation of boundary conditions is indispensable.

He goes on to give support for this argument and thereby points to the need for further research.

It must be accepted that the relativistic derivation of the Lorentz equation is on an inadequate foundation. The empirical law of electrodynamics, as developed by the author with logical theoretical foundations, seems to be the correct law for dealing with interaction between isolated charges in motion. The reader is, therefore, warned to be cautious about believing the theoretical ramifications thrust at him in the textbooks on Relativity. So much of physics depends upon the interaction of electric charge that you just have no way of founding physical theories of Nature if you set out with the wrong law of electrodynamics.

Care is needed because physicists are human and they make mistakes. Everyone makes mistakes, and it is particularly easy in theoretical research. The researcher is setting off on a journey in the dark along an uncharted road. If he gets lost, he has no one to put him back on the right track until someone else comes down the same road, goes back, finds a better road and bothers to come back again to collect the lost soul. All this takes time, centuries of time, and with so many people rushing around, all lost at once, the chances of sorting things out are reducing rather than increasing. But there is an added difficulty. There are those who go along the right road and come back to invite others to follow. Yet they will not follow because someone already out of reach has assured everyone that he has explored that same path and found nothing. There is imperfect recollection of what he really reported but it still daunts the willingness to believe the more favourable reports. Such is the world of the physicist unless he is a recognized explorer of the jungle and can take a large following with him wherever he may go.

I am, incidentally, thinking of certain characters and experiences of my own in putting together the above observations. The man now out of reach is the Reverend Samuel Earnshaw (1805–1888). He left behind him an interesting proposition, generally referred to as Earnshaw's theorem. According to this theorem, an isolated electric charge cannot remain in stable equilibrium under the action of electrostatic forces only. I found my papers being rejected because my discoveries were in conflict with Earnshaw's law. Hence, the question, 'Who was Earnshaw?' Well, this same question had troubled someone else. W. T. Scott had undertaken the task of tracing Earnshaw's work to find the source of this great theorem. He describes his difficulties and his eventual success in a paper published in the *American Journal of Physics* in 1959 under the title 'Who Was Earnshaw?'*

He found a treatise published by Cambridge University Press in 1879 which made reference to the reading of a paper before the Cambridge Philosophical Society in 1839, and later published in their *Transactions* at pp. 97–114 in volume 7 of 1842. Earnshaw's paper was entitled: 'On the Nature of the Molecular Forces which regulate the Constitution of the Luminiferous Ether'. Earnshaw proved that the aether could not constitute electric charges retained in relatively stable configuration, if the forces acting between them are of the usual inverse square form, obeying Coulomb's law. For stability, the law of interaction force between the mutually attracted elements has to differ from that between mutually repelled elements. An inverse square law of gravitation will not hold a particle system stable against electrostatic forces of repulsion also according to the inverse square law. He concluded:

> It is therefore certain that the medium in which luminiferous waves are transmitted to our eyes is not constituted of such particles (acted on by purely inverse-square forces). The coincidence of numerical results, derived from a medium of such particles, with experiment, only shows that numerical results are no certain test of a theory, when limited to a few cases only.

This is quoted to show that over a century ago the basic problems of the aether were being studied with vigour. Conclusions were reached and their effects have echoed along the corridors of science and influenced the development of modern physics. We find that Jeans† has taken up Earnshaw's theorem by arguing that it denies the possibility of a stable union of discrete charge such as protons and electrons to form atomic nuclei. This is interesting, particularly because it is a modern quest to seek the discrete constituent charges deemed to form such nuclei. The search for quarks seems to be an effort mounted in ignorance or defiance of the great work of the Reverend Samuel Earnshaw.

* Volume 27, p. 418.

† Sir James Jeans, *The Mathematical Theory of Electricity and Magnetism*, Cambridge University Press, 5th edition, p. 168.

Now, I wish to explain where the physicist has gone wrong in applying Earnshaw's theorem. Firstly, Earnshaw himself was interested in an aether composed of particles of charge. The inverse square law of force was, logically, his only force relation. He proved that a system of particles could not be stable. Yet stability was a desirable aether property. But then he should have decided that the aether was not exclusively composed of particles. The aether we envisaged in Chapter 4 is a uniform charge continuum which is positive permeated by a system of identical electric charged particles, all negative. The positive charge is dispersed like a gas or fluid and, using the inverse square law, the mutual effects between this positive charge and the negative particles develops a restoring force on each such negative particle proportional to its displacement from a neutral position of stability in the continuum. Therefore, if the negative particles all move harmoniously about their respective neutral positions, we do have a stable system configured to explain the numerical values of the universal physical constants. Centrifugal force is in balance with the restoring force. The cycle time of the particle orbit is constant independent of disturbance, because the system is effectively a linear oscillator. Earnshaw's theorem is not violated because we have force relationships present which vary linearly with separation distance. We have a dynamic aether, but a stable one.

The basis of Earnshaw's theorem seems to be an earlier theorem according to Gauss, and the use of some ideas embodied in what is termed Poisson's equation. Essentially, the argument is that we imagine an isolated electric charge held in stability at a point where we know no charge resides. Then we say that the slightest displacement would be resisted because the potential gradient would be directed away from this point and this means that the electric field has to be directed towards the point. But, since stability implies resistance to movement in any direction, the field acting on the charge has to converge on this point from all directions. This it can only do if there is an external charge at the point itself, which is impossible because that is where our supposedly stable charge is located. Hence the theorem about instability.

The basis of the theorem is that the charge is isolated in free space. If the charge is surrounded by a sea of other charge, then the theorem fails. This has also been noticed by Scott, the man who traced Earnshaw's work. In a book dated 1966 he writes:*

> In a region of continuous charge distribution, a maximum or minimum could exist, but a continuous distribution is an idealization. We have to consider each electron or proton as an isolated charge, so that pure electrostatic equilibrium is impossible.

We live in an age of abstraction but not one of idealization! Why should not the very space substance which permeates us and holds us together be an idealization? The aether should be as near to the ideal substance as our imagination can ever take us. Earnshaw's theorem tells us that if pure electrostatic equilibrium is possible, then space must comprise a plenum of electric charge. Earnshaw's theorem also tells us that if ever we find that an atomic nucleus is a simple stable aggregation of electric charges, then space must comprise a plenum of electric charge and we must believe the real aether exists. We cannot wish away our very existence because of erroneous interpretation of mathematical results. Earnshaw's work did not destroy the aether. It provided another means for recognizing this great medium.

The physicist has tried to build his physics upon the interaction of electric charge but he got himself muddled when he drifted into mathematical arguments without following each stage carefully by physics. The physics can become muddled too if the physicist does not step back regularly to think what he is trying to do. For example, he expected that when the electron finally allowed us to measure its properties it would have an electric charge and a certain mass. Hopefully, all electrons would be the same. If they were not the same then, provided they could be grouped together in some logical order, they would have been given names in some kind of electron family. When success came, the satisfaction centred on the fact that the charge and mass of the electron could be measured and the degree of accuracy attained by the experiments. There should

* W. T. Scott, *The Physics of Electricity and Magnetism*, Wiley, p. 43.

have been satisfaction in greater measure at the discovery that, in fact, the electron was universally the same. This equality of all electrons is itself a physical phenomenon warranting explanation. Electrons can be created and annihilated, coming from and going into the void of space, absorbing or leaving mere energy in this exchange process. They come into being or die in company with the positron. They share their roles equally in this great vanishing trick which Nature performs to tantalize us. But why are they all the same, whether they are those performing in a laboratory in England or those performing in the United States? The simple answer is that there must be something shared by the environment in all the laboratories. This 'something' must be uniform in order that the parameters of the electrons created at different localities should be uniform. The origin of the electron must be a medium which is electrical in character and no amount of abstract thinking can avoid this conclusion. Relativity does not have the power to cross these boundaries either. The language of the aether is not Relativity. It is the physics of the electron, the properties of electric charge, which can reveal the secrets of the aether medium.

We will, therefore, move closer to the problems of charge, mass and energy of the electron. We will ask ourselves why, if all electrons are alike, they contrive to stay alike when our theories tell us that they are radiating their energy all the time they are accelerated. How can they do this when we know they travel through superconductive metals without using any energy at all? Has the phenomenon of the apparently infinite conductivity of certain materials at certain low temperatures been explained by abstraction too? Or can we be naïve enough to suggest that it is atoms which radiate energy, not electrons, so that only when the thermal conditions of the atom allow it to be triggered into radiation by electron impact will we see any generation of the heat which manifests the property of electrical resistance? Let us proceed with the suspicious thought that electrons do not radiate energy and that those who say that mathematics prove otherwise have jumped to the wrong conclusions.

10

Dirac's Electron

Dirac's electron is an abstract product of his mathematical enterprise. The electron I have in mind is a sphere filled by electric charge. It is an electron which Dirac, the authority on electrons, was able to dismiss in 1938* with the words:

> The Lorentz model of the electron as a small sphere charged with electricity, possessing mass on account of the energy of the electric field around it, has proved very valuable in accounting for the motion and radiation of electrons in a certain domain of problems, in which the electromagnetic field does not vary too rapidly and the accelerations are not too great. Beyond this domain it will not go unless supplemented by further assumptions about the forces that hold the charge of an electron together. No natural way of introducing such further assumptions has been discovered and it seems that the Lorentz model has reached the limit of its usefulness and must be abandoned before we can make further progress.

Dirac's criticism is the problem of the forces that hold the electron together. This is an extremely basic question in physics. It defies explanation, until you have seen the very simplicity of the answer. Force and pressure are not primary phenomena. Force does not act instantaneously between electric charge. Force occurs only when energy changes and energy changes only when it can. The primordial parameters are taken here as space and electric charge. Given a volume of space occupied by electric charge, we can say that the mutual repulsion 'forces' in the charge will cause it to adopt spherical form. Yet, the volume and the charge jointly determine the energy and energy determines the form. To explain this, imagine a definite volume of space bounded by fixed walls, as depicted in Fig. 2. Within these walls we presume there to be a medium filling the space except

* 'Classical Theory of Radiating Electrons', P. A. M. Dirac, *Proc. Roy. Soc.*, 167, p. 148, 1938.

for a sphere occupied by a definite quantity of electric charge. Instead of regarding the charge as self-repulsive, assume that it develops energy in the surrounding field. If this field energy can

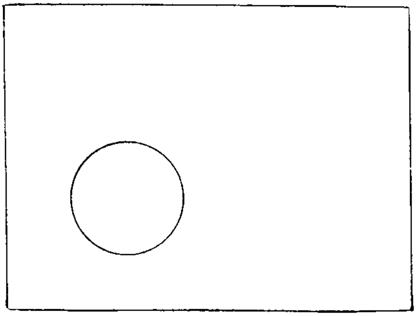

Fig. 2

change, then the charge can redeploy. Reduction of the field energy by transfer of energy to some other form can result in the charge expanding, as we understand by the notion of a repulsive force action. But there has to be reason for energy change. We take it that the charge has the character of preserving itself, of moving to conserve its energy if subject to extraneous influence. This is the subject of the next chapter. However, here we make the point that the charge cannot expand unless the space it occupies, the sphere bounding it, expands first. If it did expand without such assistance, its energy would disperse and there would be no discrete electric charges in the whole of our universe. We must take note of the fact that electrons and many other elementary charged particles are stable. Force arises only when energy changes and this is only when motion can occur to permit the change.

Now, if the walls of the system depicted in Fig. 2 move outwards, it is a different story. The particle of charge will become unstable. It will expand and release energy. Of course, in Nature, the imaginary space is full of charges. They can interact without change of volume. They occupy the same volume whether they are close together or far apart. Hence their interaction energy can change to develop forces between the charges which we measure and from which we reduce Coulomb's law. If the walls of space expand, first one and then another of the charges will expand by a statistical process. As soon as the first one starts to expand it will act to fill the space by displacing the filling medium and so restrain other particles of charge from expanding at the same instant. We are here envisaging a process of expansion of the universe by which more space is constantly created as the plenum of electric charge constantly, but statistically with its transiently stable states, expands to keep voids from forming.

Returning to Dirac, we can say that Nature keeps the electron charge tightly together for our purposes and, while it is useful to have an explanation even coupled with assumptions, the fact does remain that the Lorentz model of the electron can survive as a viable idea. Quoting further from Dirac's paper:

> One of the most attractive ideas in the Lorentz model of the electron, the idea that all mass is of electromagnetic origin, appears at the present time to be wrong, for two separate reasons. First, the discovery of the neutron has provided us with a form of mass which it is very hard to believe could be of electromagnetic nature. Secondly, we have the theory of the positron—a theory in agreement with experiment so far as is known—in which positive and negative values for the mass of an electron play symmetrical roles. This cannot be fitted in with the electromagnetic idea of mass, which insists on all mass being positive, even in abstract theory.

Neutrons are believed by some authorities to be electrically neutral aggregations of discrete electric charges of opposite polarities. This is the basis of what has come to be called quark theory, but we do not have to believe all about quarks to accept this aggregation idea. Furthermore, as we observed in Chapter 9, the current belief was that Earnshaw's theorem denied the possibility of stable aggregations of this kind and this belief is ill-founded. Also, since Dirac wrote the above words it has been discovered that a neutron can be diffracted by a magnetic field and this does suggest that it has an electrical form. Certainly, it is not by any means reasonable to argue today that the mass of the neutron is not characteristic of its electrical nature. Dirac's second point, that the theory of the positron implies an electron of negative mass, is hardly pertinent. It merely sets his theory against the logical and physically founded concepts of the ever-positive mass effect of electromagnetic field energy. It is like saying that his theory conflicts with the other one and is correct solely for this reason.

Then Dirac, whose object is covered by the title of his paper, 'Classical Theory of Radiating Electrons' goes on to say how it is desirable to assume a point model for the electron to avoid the unnecessary complication of not having the field equations he uses 'holding all the way up to the electron's centre'.

At this stage we must pause for reflection. We are examining Dirac's thoughts on the question of energy radiation by the accelerated electron. Dirac wants to use a point charge electron whose mathematical portrayal invokes field equations applicable throughout space. That is, boundary problems are to be put aside. The reader, if he is tuned into the author's viewpoint, may wish to retain the electron as a sphere of electric charge, if only because it is easier to imagine a finite object than a mere point surrounded by mathematical equations. These differences are important if we are to end up with something meaningful.

Dirac then runs into the obvious problem that the energy of the electron would become infinite if Maxwell's theory is to hold. The self-energy of an electric charge is inversely proportional to the spacing between its charge elements. The spacing is zero if the charge is concentrated at a point. So Dirac declares that he does not want to reject Maxwell's theory and that he will try to overcome the difficulty by mathematics. He writes:

> Our aim will be not so much to get a model of the electron as to get a simple scheme of equations which can be used to calculate all the results that can be obtained from experiment.

This seems an appropriate objective, but we are looking at a paper about energy radiation by electrons and it is a fact that no one has ever, even to this day, measured experimentally energy radiated by discrete electrons. Energy transfer associated with radiation, which in its turn is associated with the excitation of electrons in test apparatus, has been observed, but when Dirac speaks of calculation it is not merely energy transfer which has to result from his equations. It is quantitative data of energy transfer which permits verification by experiment and theory on this is an idle pursuit if we have no way of relating this to the specific number of electrons present and contributing.*

Dirac then brings us to the following statement:

> A great deal of work has been done in the past in examining the general implications of Maxwell's theory, but it was nearly all done before the discovery of quantum mechanics in 1925, when people gave all their attention to the question of how an electron could remain in an atomic orbit without radiating—a question we now know can be answered only by going outside classical theory—and were thus not interested in simply looking for the most natural interpretation their equations would allow.

This, indeed, is a statement which evokes comment. If everyone faced the question of how an electron could remain in an atomic orbit without radiating, why is it that this was not taken as the clue to one of the most fundamental questions in physics, the question about the very nature of mass? The mass of the electron could well be that property it exhibits in moving to conserve its intrinsic electric field energy and so its charge. Why go outside classical theory to couple with quantum theory an over-riding restraint on energy radiation? Why bother interpreting equations? If an electron in an atomic orbit does not radiate energy then an electron need not radiate energy whether accelerating by moving steadily in a circular orbit or accelerating in a straight line. This is the simple interpretation and, if equations indicate otherwise, we must question whether they are built upon erroneous assumptions.

However, Dirac did not do this. He was writing about the radiation of energy by electrons according to classical theory and if atomic electrons did not radiate energy quantum radiation assumptions were too easy a way of avoiding the problem. Dirac wanted to stay with the mathematical equations and draw meaning from them. He even added strength to the classical theory by using relativistic principles to derive the usual expression for energy radiation according to Lorentz's theory, and he wrote:

* See discussions of Cerenkov radiation in Chapter 12.

Whereas these equations, as derived from the Lorentz theory, are only approximate, we now see that there is good reason for believing them to be exact, within the limits of classical theory.

Then, on the next page of his paper:

As an interesting special case, let us suppose there is no incident field, so that we have the equations of motion . . .* In general the electron will not now be moving with constant velocity, as it would according to ordinary ideas, since we may suppose it to be started off with a non-zero acceleration and it cannot then suddenly lose its acceleration.

This is a fantastic result to anyone accustomed to Newtonian mechanics. Dirac realizes this when he then writes:

To study the rather unexpected results of the preceding section more closely. . . . It would appear that we have a contradiction with elementary ideas of causality. The electron seems to know about the pulse before it arrives and to get up an acceleration (as the equations of motion allow it to do), just sufficient to balance the effect of the pulse when it does arrive.

Surely this just cannot be believed. Dirac was basing his analysis upon acceptance of an idea presented by Schott in the *Philosophical Magazine* in 1915.† Schott had analysed the problem of the incident electric field and wrote:

This equation shows that the whole of the work done by the external field is converted into kinetic energy of the electron just as if there had been no radiation at all. None of it is radiated. . . . Thus we see that the energy radiated by the electron is derived entirely from its acceleration energy.

Schott's idea was to provide the electron with an energy component he called 'acceleration energy' of which he said:

Its existence is a direct consequence of a mechanical theory of the aether.

So convinced were the physicists involved in these studies that the electrons must radiate energy if accelerated that they had to look to the physical force exerted by a mechanical, as opposed to

* These equations contained acceleration terms even though Dirac specifies no incident field able to exert force on the electron.

† Vol. 29, pp. 49–62.

an electrical, aether to call into account the sources of the energy radiated.

So, here was Dirac in 1938, adopting the notion of an acceleration energy necessitating aether able to exert mechanically the forces needed to feed the energy being radiated and, apparently, missing the obvious fact that the easy way out of all the difficulties is to see that the electron does not radiate energy at all. Dirac was addressing a problem which did not exist, and now see where he was guided by his conclusions:

> The behaviour of our electron can be interpreted in a natural way, however, if we suppose the electron to have a finite size. There is then no need for the pulse to reach the centre of the electron before it starts to accelerate.

Yet he started his paper by saying that the electron should be deemed to be a point charge! Then he wrote:

> Mathematically, the electron has no sharp boundary and must be considered as extending to infinity.

This is puzzling. It depends whether we have charge or energy in mind. If we have stayed with the model of the electron as a sphere of charge, we can see a finite electron, meaning the charge, and also see a field extending to infinity.

Finally, Dirac concluded:

> In this way a signal can be sent from A to B faster than light. This is a fundamental departure from the ordinary ideas of Relativity and is to be interpreted by saying that it is possible for a signal to be transmitted faster than light through the interior of the electron. The finite size of the electron now reappears in a new sense, the interior of the electron being a region of failure, not of the field equations of electromagnetic theory, but of some elementary properties of space-time.

Space–time has failed. What does this mean? How can space–time fail? If the space–time according to Relativity fails, then Relativity fails. But how can anyone accept the argument presented here by Dirac? It is submitted that the question of the radiation of energy by an electron was clarified by Dirac's paper to the extent that the paper demonstrated the impossible situation into which mathematical formalism can lead the physicist. Modern physical theory has become abstract. The starting points of the original papers on the subject are mathematical, the treatment is mathematical and the conclusions are mathematical. In many instances there seems to be no relation whatsoever to the phenomena which make up the world of experimental physics. Dirac has been bold enough to translate his findings into language which can be interpreted in the context of a true understanding of Nature. He has revealed a maze in which so many physicists seem to be wandering, following one another, without having any clear direction in which to go. It is due time that this was realized. This realization is the key to further progress, as we see in the next part of this work.

Whereas Dirac, incidentally, declares that space–time fails within the electron but Maxwell's equations operate, Einstein, in his book *The Meaning of Relativity*, first published in 1922, writes:

We do know, indeed, that electricity consists of elementary particles (electrons, positive nuclei), but from a theoretical point of view we cannot comprehend this. We do not know the energy factors which determine the distribution of electricity in particles of definite size and charge, and all attempts have failed. If then we can build upon Maxwell's equations at all, the energy tensor of the electromagnetic field is known only outside the charged particles. It has been attempted to remedy this lack of knowledge by considering the charged particles as proper singularities. But in my opinion this means giving up a real understanding of the structure of matter. It seems to me much better to admit our present inability rather than to be satisfied by a solution that is only apparent.

It should be mentioned that Dirac himself wrote in *Scientific American* in May, 1963:

I might mention a third picture with which I have been dealing lately. It involves departing from the picture of the electron as a point and thinking of it as a kind of sphere with a finite size . . . the muon should be looked on as an excited electron. If the electron is a point, picturing how it can be excited becomes quite awkward.

11

The Nature of Mass

The Einstein enthusiasts are very patronizing about the 'classical' electromagnetics and its ether, which they have abolished. But they will come back to it by and by. Though it leaves gravity out in the cold, as I remarked about 1901 (I think), gravity may be brought in by changes in the circuital laws, of practically no significance save in some very minute effects of doubtful interpretation (so far). But you must work fairly with the Ether, and Forces, and Momentum, etc. *They* are the realities, without Einstein's distorted nothingness.

Unpublished notes of Heaviside, March 1920*

The modern idea of the nature of mass dates back to 1904, when Mach put forward the principle now named after him. It is still only an idea. The nature of mass, like its great property gravitation, is still a mystery to the physicist, the philosopher and the mathematician.

Let us examine a few authorities on the subject. First, what is Mach's principle? Sir Edmund Whittaker explains it thus:†

According to Mach's principle as adopted by Einstein, the curvature of space is governed by physical phenomena, and we have to ask whether the metric of space–time may not be determined wholly by the masses and energy present in the universe, so that space–time cannot exist at all except in so far as it is due to the existence of matter.

Whittaker was writing in April 1953. Mass, space–time and energy stand or fall together as the basic elements of this fabric

* The author is indebted to H. J. Josephs for his kindness in providing the above quotation from Heaviside's unpublished work as kept in the archives of the library of the Institution of Electrical Engineers in London. Mr. Josephs wrote about Heaviside's manuscripts in 'Postscript to the work of Heaviside', at p. 511 of the December 1963 issue of the *Journal of the Institution of Electrical Engineers*.

† *History of the Theories of Aether and Electricity, 1900–1926*, E. Whittaker, Nelson, 1953, p. 168.

which is us and our environment. The inertia of mass is due to the interaction of mass with all other mass in the universe. At about this time Sciama was writing his Ph.D. thesis at Cambridge 'On the Origin of Inertia':*

Einstein's work . . . shows that inertia is connected with gravitation. However, as Einstein himself was the first to point out, general relativity does not fully account for inertia. Thus a new theory of gravitation is needed.

Ten years later, in 1963, we find Bondi writing:†

What is gravity? . . . We are more familiar with its effects than with perhaps the effects of any other force. Nevertheless, science finds it rather difficult to digest gravity, and our best modern theory of gravitation, Einstein's theory, is a very complete and beautiful theory that yet does not quite fit in with the rest of physics . . . we do hope to gain much more insight once this great difficulty, this gap between the theory of gravitation and the rest of physics, has been closed.

This was followed in 1964 by Hoyle:‡

Einstein's mathematics has always been a complete unit in itself. It has remained an isolated corner of physics which nobody has succeeded in relating in a really fruitful way to the rest of physics.

Is this progress? Surely we should heed Heaviside. We must come back to the aether, to classical ideas, to the circuital laws of electromagnetism. We must cast Einstein's 'distorted nothingness' aside, and our prejudice as well, and think again. We must heed Dirac's conclusions in 1938 that the boundaries of the electron extend to infinity and that space–time fails in the 'interior' of the electron. We must think again about the nature of this electron, and stop talking about signals travelling faster than light and particles being accelerated without accompanying force.

At the Kelvin lecture of the Institution of Electrical Engineers delivered by Hoyle in 1970 he spoke of signals from the future. In a report published by the Institution we read:§

* *Abstracts of Dissertations, 1953–1954*, Cambridge University Press, 1956, p. 276.

† See footnote reference on page 6.

‡ See footnote reference on page 6.

§ *IEE News*, p. 16, May 11, 1970.

Such signals would affect the form of the laws of physics, whereas signals from the past merely give information. The basis of such speculation is an analogy with the familiar 'action and reaction' concept in classical mechanics. To be able to 'signal' to a distant object, something must be propagating from the object to the signaller—a signal from the future. The backwards propagation has never been observed because it is impossible to 'waggle' a charge in isolation; the rest of the universe is always present. In 1945 Wheeler and Feynman calculated that the effects of all 'backwards' signals from all the particles in the universe cancel exactly. Conversely the future completely absorbs electromagnetic radiation.

I cannot understand all this. I know that we still read about the difficulties of explaining how an electron sustains the energy it is supposed to radiate when accelerated. I suppose the distant universe has to feed in, by some kind of signalling system, the energy needed by the electron to sustain radiation. But is this not just another way of saying that the electron interacts with the aether so as not to radiate its energy? Why go about in such a roundabout fashion to say this simple thing?

We should not explain gravitation without first finding the explanation for mass itself. We should not try to explain mass in terms of interaction with other mass, because that is to probe gravitation before we understand mass. We should, instead, explain mass in terms of electric charge, discarding Mach's principle for a new one, the principle we see in such clear evidence, the principle that an electric charge will move to preserve itself. It will react to electric disturbances in just such a way as to conserve its charge and its intrinsic energy. That is the principle revealed to us by Nature herself. All we have to do is to show that it accounts for the properties of inertia. It is easy to prove by mathematics* but, in view of the strong criticism levied against the mathematical approach in the previous chapters, we will proceed using pure physics.

Surrounding an electric charge there is supposed to be what we call an electric field. Electric energy of the charge is determined by multiplying the strength of this field by itself at every point and summing the resulting quantity over all surrounding

* *Physics without Einstein*, H. Aspden, Sabberton Publications, Southampton, 1969, pp. 11–13.

space. Energy and charge are the fundamental quantities, not field, but it does appear that the energy associated with electric charge has a spatial distribution which fits the above concept when taken with a vector field radiating uniformly from the charge. Also, the field apparently moves as an integral system with the charge when the latter is not accelerating. The system is depicted in Fig. 3. The field idea is useful when the interaction between two charges separated by a fixed distance is analysed. Then, by combining the field components of both charges before squaring and summing, the change of energy with separation distance can be calculated. Coulomb's law can be derived in this way.

When the charge in Fig. 3 is accelerated a disturbance in the field is propagated outwards. We assume that the propagation is at the fixed speed of light. This is logical because we have specified charge and energy and need a third dimensional constant involving time. All physics can be linked by the use of three dimensional quantities. Mass, length and time are the familiar dimensions used, but, fundamentally, we can take electric charge, energy and a velocity parameter, if we prefer. The algebra of physics will take us from one system to the other, but given energy, the universal character of the velocity of light and the fundamental role of electric charge, it seems best not to stay with mass, length and time in an endeavour to explain the nature of mass.

Fig. 4 shows how the field of the charge in Fig. 3 is distorted by an infinitesimal pulse of acceleration in the direction V. The field depicted shows the position of the radiated field disturbance as it speeds outwards to its infinite destiny. When an electric charge is accelerated it emits field disturbances which set up waves in space. There are two imaginary spheres bounding the disturbance zone. The outer one is centred on a position the charge had immediately before receiving the acceleration pulse. The inner one is centred on a new related position to which the charge had moved at the incremental velocity during the period taken for the disturbance to spread to the zone under study. The radial distance between the two imaginary spheres is equal to the distance travelled at the propagation speed in the small

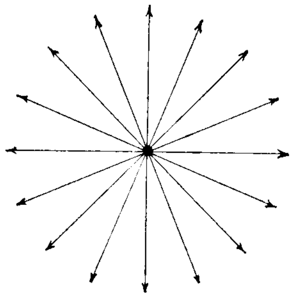

Fig. 3

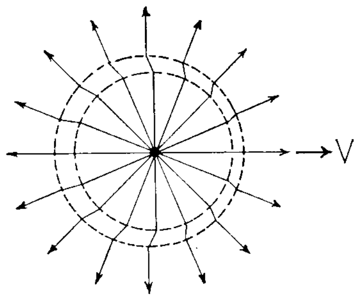

Fig. 4

interval during which the acceleration occurs. We can ignore the non-concentricity of the spheres because the acceleration pulse would have to increase the velocity of the charge by an amount equal to the propagation velocity itself to make the eccentricity distance equal to the radial separation of the spheres. We are dealing with the effect of a small acceleration pulse, productive of small changes in velocity as we experience in Newtonian mechanics.

The field lines in Fig. 4 radiate from the centres of the two spheres and are accordingly distorted, as shown, in the disturbance zone. Now, in effect we can separate the field into two systems, one of the form of Fig. 5 and another of the form shown in Fig. 6. The field directions of these two systems are orthogonal at all points. Thus, considering energy, we can square and add components separately using Pythagoras' Theorem. We then see how the disturbance has its own added energy in a wave zone. The total field energy of Fig. 5 must be the same as that of the non-accelerated charge, by comparison with Fig. 3. We have the added field components of Fig. 6 to consider, and these must, it would seem, add energy which is radiated outwards as the zone goes off to infinity.

Since we are portraying the process of energy radiation, we can easily see that deceleration will still send energy outwards. The radiation process is irreversible. Using mathematics this model can also yield the accepted formula for energy radiation. The method presented here has been attributed to J. J. Thom-

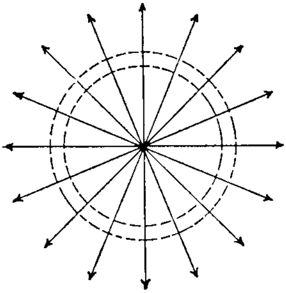

Fig. 5

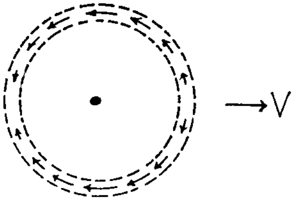

Fig. 6

son. Hence, the reader may ask how we can retain the assertion that the electric charge does not radiate energy. Well, the answer is so obvious once you see it. The business of squaring and adding only works to give energy correctly if there are no other electric fields present. We really can never say that our charge exists in complete isolation in a universe devoid of other electric field-producing charge, particularly if we wish to give it a little pulse of acceleration.

Let us assume that our charge has decided to move in the direction of the ambient electric field, seeking to conserve itself and being unwilling to radiate its energy as we have described. There is then an electric field in the direction V. This field is in the direction V because like charges repel and there is repulsion of the charge in the V direction. This ambient field itself does not move with the field disturbance radiating from the accelerated charge. Now, as is known, where we have two field components which act in opposition and which are not orthogonal but are directly opposed, we obtain three energy density components when we square the result. We have two quantities found by squaring each component independently and we have a negative energy density component due to the interaction of the components. The self combination of the components of the ambient field adds nothing to our energy radiation problem because the field itself is not moving. The energy radiation terms deduced from Fig. 6 do remain as positive radiation. However, the interaction with the field in Fig. 6 will introduce negative energy radiation as well. Now, the overall field energy at any point can never be negative. A component can be negative if we have another component which is adequately positive. The negative energy component under review will appear in the wave zone as the disturbance travels outwards to infinity. This negative quantity can cancel the zone energy exactly. This is seen if we resolve the ambient field at each point in the zone into a component in line with the disturbance field components of Fig. 6 and other components in orthogonal directions. The component in opposition with the disturbance field component increases from zero to a maximum around the wave zone exactly as does the disturbance component. Now, if two terms separated by a minus sign are squared and added so that the interaction component cancels the square of one of the terms alone, this term is exactly double the other term. It follows, therefore, that for zero energy in the disturbance zone due to the acceleration pulse the ambient field must be exactly half of the maximum field component shown in the disturbance zone in Fig. 6.

Hence, if we have an electric charge in an electric field and it reacts to avoid energy radiation it will move so that it produces a distorted field satisfying this criterion. The field which produces the acceleration actually prevents energy radiation. An accelerated charge does not radiate its energy and thereby it derives its property of inertia.

Why has this been missed by the great thinkers of the classical period in physics? Probably because they were convinced that light conveyed its energy by waves in the aether. The discovery of the photon and the quantum features of energy transfer had not daunted their belief in wave theory and the clear mathematics of energy radiation by accelerated charge. They could take the disturbance zone of Fig. 6 out beyond the range of the local field producing the acceleration. Radio waves travel far from the electric circuits producing the electron oscillations in the transmitter. However, this is assuming that the energy ever gets away from the electron in the first place.* If there is an aether a wave might come along and merely ripple the energy already present in the aether itself. Field energy cannot be con-

* See later discussion in Chapter 12.

veyed by waves, as is so clearly evident from quantum behaviour in energy transfer. It is also evident from our illustrated analysis, because as the disturbance field components are propagated away from the charge they become weaker. The related components of the ambient electric field do not weaken in this way. Therefore, the passage of the wave causes a ripple of negative energy in the field-permeated surrounding space. This only means that the local energy is deployed into other forms, but it tells us something very important about the electric charge emitting the disturbance. The zero net energy condition has to apply at the surface of this charge.

If the charge is contained, say, in a hollow spherical shell containing a void and surrounded by the aether medium, there is nothing inside it to store any energy. It, the charge, is a mere spherical shell. It moves so as not to radiate any energy or even deploy any of its energy at the location of its charge. Hence, the condition for the half field response applies exactly at its outer surface. This means that given a unit strength ambient field acting on a unit strength charge, the charge will accelerate to develop a double unit field at its surface at positions lateral to the acceleration direction. The field which is developed here is found as the radial field of the charge as distorted by a deflection equivalent to multiplying it by the ratio of the eccentricity distance of the spheres already mentioned to the radial distance between the spheres. This ratio works out to be the acceleration times the time it takes for the disturbance to develop at the surface divided by the propagation velocity of the disturbance. This is simply the acceleration times the radius of the charge divided by the square of the propagation velocity. The radial electric field is simply the unit strength charge divided by the square of the radius, using the simple inverse square law of field. Thus, the disturbance field developed is the acceleration divided by the charge radius and by the square of the propagation velocity. For unit spherical charge, the charge radius is one half of the reciprocal of the energy stored by the charge. The disturbance field then becomes double the acceleration times the energy divided by the square of the propagation velocity, and we know that the acceleration is such that this field is two units in strength. It follows that unit force developed by unit ambient field on unit charge will produce an acceleration inversely proportional to the energy divided by the propagation velocity squared. In other words, the electric charge, in responding so as not to radiate its energy, will display the property we term mass. Its mass will be equal to its energy divided by the square of the velocity of propagation of the aether medium. Thus, its energy will equal its mass multiplied by the square of the velocity of light.

We have now accomplished our task. Mass is explained as the property of an electric charge in contriving to avoid energy exchanges at its surface. It emits waves when it is accelerated by an electric field. It causes oscillations in the aether when it is oscillated itself. The energy in the aether is disturbed, but at the very boundary surface of the electric charge there is no disturbance. The charge has found a way of moving which brings a calm unruffled field condition to its surface form. Meanwhile the accelerating electric field puts some of its energy into another form in recognition of the acceleration imparted to the charge. This is the kinetic energy of the charge. It is stored in the field without disturbing the field remote from the surface of the charge and this can only be true if in fact the charge sphere shrinks a little to create more space for field energy. Kinetic energy is stored by the charge reducing its radius.

In explaining the nature of mass we have come to the well-known relationship between energy and mass, on which much of Einstein's recognition is founded. We do not see inertia as a property dependent upon gravitation. Mass is a mere property of electricity. Inertia is synonymous with mass. One implies the other.

It is to be noted that the above argument has been applied to a spherical shell of charge. It applies equally to a solid sphere of charge. The latter is merely an aggregation of spherical charge shells. There is no energy transfer at the surface of each shell due to acceleration of its own charge. Further, if we consider interaction field effects between any two such shells, since there is no interaction energy within the outermost shell, we can have no energy transfer in this regard at the surface of the outermost shell. It works out that the mass property is linked to energy by the same relationship.

It remains to ask what happens if the electric charge moves at a very high speed approaching the speed of light itself. Increase in mass with speed has been observed. The answer is given already. The charge does not change but in shrinking to store the kinetic energy the electric field energy has increased. Thus, since mass is proportional to this energy for a constant speed of light, mass increases. As speed increases with increasing mass the effect is compounded and, mathematically, it may be shown that the speed of light is limiting. Mass would be infinite at this speed.

12

The Aether in Evidence

In the previous chapter we were able to explain mass as a property of electric charge in motion through space. The nature of kinetic energy was explained in terms of the physical contraction of the charge in reacting in an electric field to prevent radiation of field energy. Thus, the history of the motion of an electric charge from its instant of creation is partially recorded in terms of its physical size. Its state of motion relative to a basic reference frame is implicit. There must be some kind of reference frame in which matter is created. Furthermore, an electric charge in motion induces certain effects. It acquires kinetic energy, but it is also known to develop magnetic fields. One may wonder then if the reference frame for matter creation is the frame of reference for electromagnetism. This means that we are considering something other than the charge, its energy and its so-called field. A frame implies the existence of something else, an orderly structure interacting with electric charge in motion. We are considering the aether.

The fundamental ingredients of our study are electric charge, energy and a time parameter. Logically, our aether will be composed of an orderly array of electric charges in an organized state of motion. Such charges will react to the electric field of a moving electric particle. We will depict the action in the field vector diagram in Fig. 7. Consider a charge at Q moving with a velocity proportional to OQ. Imagine an element of aether charge normally at P but having a new home position at R because of the direct electric field of our charge at Q. This aether element is, however, reacting to our charge as if it were at O, because it has taken time for the action to be propagated. In fact, the vector OP represents the propagation velocity. Therefore the aether charge will not be at R. It will be displaced from R and somehow reacting to the propagated effect from O. The diagram assumes that the displacement vector RS is a minimum, making RSP a right angle. As was suggested in

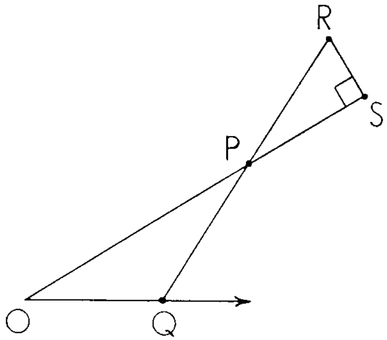

Fig. 7

Chapter 4, aether charge will tend to move in harmony in circular orbits. Any displacement involving oscillation about a new centre will not affect the basic natural frequency of the motion. Thus, in Fig. 7, the charge is portrayed at S but in reality it will be oscillating about S. Also, we could argue that the charge at Q and the positions O and P share such an oscillation in the inertial frame of reference. The aether charge is subject to restoring force proportional to displacement. This is why the oscillation frequency is universal. The aether is a natural clock. The distance PR is a measure of the electric field at P due to the charge at Q. The distance PS signifies the strength of the field absorbed by the displacement to S. Some energy is transferred locally from the main electric field of the charge at Q but this does not affect the inertial behaviour of the charge. The criteria accounting for mass effects explained in Chapter 11 are not affected.

The action described is reversible. As the charge at Q passes and recedes into the distance the aether charge at S will return to P. Note that the displacement RS is less than PR but that when OQ exceeds OP some positions of P do allow RS to equal PS, a condition corresponding to a charge velocity in excess of the speed of light in free space.

Let us now consider electric induction effects in matter rather than in free space. To explain the velocity of light in an optical medium, that is, to derive the refractive index, a standard method is to use electron theory and suppose the wave disturbances to be simply periodic in time and space. Energy is not considered. The analysis concerns fields, disturbances, displacements and the natural frequencies of the different systems present. Convincing results emerge from the analysis. Dispersion and absorption are explained in wave theory, the predecessor of quantum theory and the photon. But, remember that energy is not considered. Indeed, go further than this and begin to wonder whether the propagating medium really needs any special energy stimuli. There is the reversible deployment of energy from the direct electric field actions of disturbing charge, but electromagnetic waves may be sufficiently nourished by these disturbing actions and may rely more on the energy already contained in the medium. Electromagnetic waves may merely cause a local oscillation of the existing store of energy in the medium itself. Waves may travel through the aether or through matter without conveying any energy as part of the wave action.

If we now regard matter as having properties such as were assumed in Fig. 7, we can expect the passage of an electron through matter to develop disturbances merely deploying energy locally. The electron will retain its kinetic energy. However, this would be to ignore the interaction effects of other electrons, which can lead to energy dispersion amongst them. Also, of course, there are quantum phenomena, events involving interaction between the electron and what are probably localized disturbances of the lattice-like array of charges which must constitute an important metric of the aether. These actions give rise to Bremsstrahlung and photon phenomena, but it is the non-quantum interaction between matter and aether which is important to the present argument. We can have no duality of wave theory and quantum theory unless we mean that both phenomena coexist in reality. Then we need waves without energy transfer and look to quantum mechanisms to explain energy migration.

The aether is merely disturbed by its interaction with charge in motion. But the aether acts as a catalyst. It is essential to the system. It has energy and it holds this energy in a state of equilibrium with the charged matter present. There are energy interchanges continuously but it is an exchange process which ensures that the aether retains its store of energy however much it is buffeted by the electric forces of passing charges. Magnetic forces too will promote, we assume, similar effects. They will promote actions or displacements, but always subject to the overriding equilibrium tendency of the aether energy. The result of all this is that if energy is fed to the aether transiently by a charge in motion and the aether reacts to reject it, the aether will not discriminate between any such charge present. Accordingly, the disturbing charge will only receive its energy back as a co-operative action involving other charge. Some kind of statistical process is at work. There are mutual induction effects with the ever-present environment of other charges of matter, as the aether plays its catalytic role.

This has two important consequences which help to provide some very significant evidence of the existence of the real aether medium. One is magnetism itself, but firstly let us consider our problem of electric induction in matter.

The process described by reference to Fig. 7 will be somewhat thwarted if the propagation velocity is retarded by the presence of other matter and the charge displaced from P experiences the direct action of the charge at Q before the propagated disturbance arrives from O. In free space this cannot happen. However, high velocity electrons moving close to the speed of light could be injected into a refractive medium in which the velocity of light is lower than the speed of these electrons. In simple terms, there is field action but the propagated aether charge displacement cannot occur quickly enough to assure the equilibrium state of Fig. 7. The energy deployment process at points within the field involves a time delay. Reaction is rapid and almost instantaneous if the rapid oscillatory motion of the aether lattice has adapted to the disturbing charge by experiencing the gradual effects of the propagated disturbance. However, what comes in the case under study is a shock wave which disturbs the equilibrium in the aether itself. Even displacement effects due to direct field action in the refractive medium are subject to substantial time delay when reacting to really high speed electrons. This medium has hardly time to participate in energy deployment in the field. The aether, therefore, takes the brunt of the shock wave effect.

As the charge recedes the effect of the shock cannot subside fast enough. The equilibrium has been disturbed and some energy is left behind in the field. This energy has not been fed back to the disturbing charge via the interaction forces between the lattice charge and the charge of the electron. It is retarded, losing its kinetic energy until its speed comes below the propagation velocity within the medium. Then its further retardation will depend solely upon its interactions with other matter and photon emission. Note that the physical displacement of charge in the aether is essential to this argument. It is not possible to contemplate solely displacement in the refractive medium itself because this cannot react quickly enough to the direct action of the electron field. The electron is moving at a velocity much higher than any prevailing in the atomic systems it is disturbing. In effect, we have said that the aether preserves an energy equilibrium and in so doing it acts as an unseen catalyst under normal circumstances. However, it can be taken by surprise and its equilibrium processes, at least in respect of the wave propagation role they play, are just not fast enough in the singular situation described. The aether can be left holding energy after the electron has passed on, and this energy will be spilled out to any other charge in the medium in a manner unrelated to processes normally observed at speeds below the propagation velocity.

The experiment has been performed by Nobel Prize winner Pavel A. Cerenkov. It was reported in 1937. Quoting from his 1958 prize lecture entitled: 'Radiation of particles moving at a velocity exceeding that of light', we read:

> In 1904 to 1905, shortly before the theory of Relativity came into being, Sommerfeld submitted the hypothetical case of the movement of an electron at a speed greater than that of light in a vacuum to a theoretical study. But the coming of the theory of Relativity which affirms that material bodies are unable to move at the speed of light,

still less to exceed it, overshadowed Sommerfeld's conclusions which seemed less to the purpose. It is, seemingly, to this circumstance that we may to some extent ascribe the complete neglect of the problem of the movement of electrically charged particles in a substance, because it could not be reconciled with the theory of Relativity.

Cerenkov discovered that when electrons travelling at a speed higher than the speed of light in a substance are injected into that substance there is emission of radiation having no spectral structure. The quantum we associate with Planck is missing. The photon mechanism seems to be supplanted by something else. Electric particles can interact to exchange energy and a dispersal of energy known as Bremsstrahlung occurs. However, with Cerenkov radiation it seems that the aether characteristic of energy conservation is at work until the particle moves slower than the speed of light in the medium.

We now turn to the problem of a magnetic field. It would, it seems, involve extreme speculation to explain the physical nature of a magnetic field. To attempt this one would have to take note of the efforts of the nineteenth century and remember that a formal physical account of magnetism could lead to the analysis of the motions of an aether fluid. Magnetism is as fundamental as electricity itself since the most minute element of charge, even an element of a discrete charge, exerts a magnetic effect. Electrons have the fundamental discrete electric charge we recognize as the basic quantum in accepted physics. Yet, electrons can develop a magnetic effect attributed to spin. The explanation of the nature of a magnetic field does not fall amongst the same order of things as other fundamental physical phenomena. In this work we are treating what may be termed the macroscopic properties of the aether medium. The nature of an electric field, of electric charge, and of magnetic field actions probably depends upon the microscopic behaviour of an aether more fundamental than the electrical model presumed so far in this work. Accordingly, for the present purpose, let us rely on the analogy between electricity and magnetism. The aether has been found to react to a disturbing electric field merely by deploying energy locally from the field to the balancing electric state of charge displacement in the aether medium. For the magnetic field we will suppose a displacement state of some form but accept, by analogy, that no energy attributed to the motion of the disturbing charge is, in fact, fed to localities in the field region, taking due note of the possibility of transient exchanges which assure equilibrium conditions.

On this hypothesis what, then, is magnetic energy? It could be regarded as a component of energy stored in the aether but, if so regarded, its presence should be melded with that of what we might term 'dynamic electric energy' associated with the displacement vector RS in Fig. 7. It so happens that the field vector RS is equal in magnitude to the magnetic field vector developed at P by the motion of the charge at Q. Then the magnetic energy at P would need to be taken as a negative component compensated by the positive dynamic electric energy component and we must not imagine deployment of the intrinsic static field energy of the electric charge at Q. Such a concept was helpful in developing the main analytical work of the author* but it can best be avoided by simply ignoring magnetic field energy as such. It may have no real existence. Magnetism may be a state providing its own microscopic catalytic action between charged electric particles in motion, but somehow referenced on an electromagnetic frame provided by the dominant role of the lattice array of aether charge already mentioned.

Remember that the aether will not discriminate between charge when it feeds back any energy accepted from a particular charge in motion. We must then expect that when a charge is set in motion it will have to find its own equilibrium via the catalytic action of the aether, exchanging energy with other free charge present. It will experience a retarding electromotive force (a back-EMF in the terms of the electrical engineer). Other charges present may see this electromotive force as an accelerating force and absorb energy to augment their kinetic energy. Then they too contribute to the magnetic disturbance, but the net effect is that the catalytic action can transfer kinetic energy between the charges, a phenomenon we well know from the behaviour of the electric transformer.

We will now develop this argument in detail, coming to the

* *Physics without Einstein.*

thesis that magnetic energy supposedly stored in the field really takes the form of kinetic energy imparted to the reacting system of charge, whether in matter or in free space. This will afford some clear indicators of the existence of a real aether medium.

The law of force action between electric current elements can be worked out by evaluating the interaction magnetic field energy components and examining how these change with separation distance between the elements. This was discussed in Chapter 8. However, it has just been said that a magnetic field is merely a disturbance condition in the aether and that energy is conserved in the aether field. All we have is kinetic energy of the charges generating the current elements and we cannot reasonably expect an interaction energy from these terms. It seems then that we have a problem. But this is a problem which takes us to convincing evidence that the aether medium does exist. It leads us to some remarkably easy answers to other problems as well, problems which have turned physical theory upside down for many decades.

We are talking of currents which produce magnetic fields and the effect of these fields upon electric charges in motion. Our physics tell us that any reacting charge will describe helical paths and develop an opposing magnetic field effect resisting the magnetic field applied by the action of primary currents. But do all the charges behave the same way? Do all free electrons in a lump of copper, for example, really react to oppose the applied magnetic field? If so, we would find it difficult to put a steady magnetic field into copper. There should be very strong diamagnetism substantially cancelling the whole field effect. But there is no such reaction, certainly not of the magnitude our physics would imply. History provides some very remarkable answers: they discredit the contribution which scientists have made to progress in this century.

The authority on diamagnetic susceptibilities is the treatise by Van Vleck.* After referring to the statistical theorems by which earlier workers reconciled their minds on this problem, Van Vleck writes at page 101:

* *The Theory of Electric and Magnetic Susceptibilities*, Oxford University Press, 1932.

This absence of a diamagnetic susceptibility from free electrons at first thought appears quite paradoxical. If each electron describes a circle about the field, it certainly possesses angular momentum about the centre of the orbit, and the sense of the rotation is such that the attendant magnetic moment is opposite to the field, apparently giving diamagnetism. However, . . . in case the body containing the electrons is bounded in extent, the electrons near the boundary cannot describe complete circles but are reflected from the boundary. . . . These boundary electrons are very vital, as without them there would be diamagnetism. . . . A potential barrier is also required at the boundary to reflect the electrons. Of course, on true theory, quantum modifications must be taken into account. . . . Thus the theorem on the absence of diamagnetism is valid only in classical theory.

We know before we start any theoretical enquiry that a lump of copper does not suppress a magnetic field which is not alternating. We know that there is no apparent diamagnetism. Our physics applied to the electrons individually say that there is diamagnetism. How does Van Vleck explain the difficulty? Electrons bounce off the inside boundaries of the copper. But if an electron collides with an atom it will hit one of the outer guardians of the atom, another electron. Newton tells us that when two identical bodies collide they merely exchange momenta. So the electrons change places. Such a collision will not constitute any change in the diamagnetic argument. No, Van Vleck says that there has to be a potential barrier causing the electron to bounce back. Van Vleck draws the bounce as in

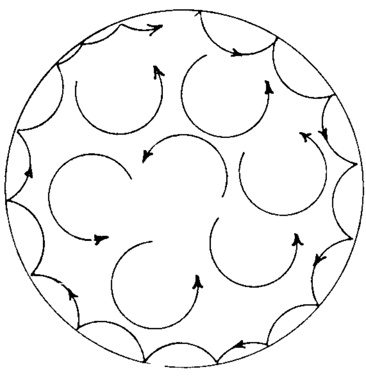

Fig. 8

Fig. 8 so that the electron migrates around the inside boundary to develop a magnetic field compensating the orbital motions of the other free electrons. There is also a reserve position. Van Vleck falls back with confidence upon quantum theory for a supporting explanation. He imparts a statistical distribution to the angular momentum. Negative angular momentum is as likely in mathematics as is positive angular momentum, when there is no magnetic field. When we apply a field we know that magnetic force acts at right angles to the electron motion. It does no work. Therefore no energy is added by applying the field and so, if there is no magnetism due to the electron motion when no field is applied, there is none when the field is applied. The argument is clarity itself. But it is wrong: not because the quantum statistics are wrong, but because we have applied with confidence a law of electrodynamics according to Lorentz, and completely forgotten that fundamental discovery made in 1831 by Michael Faraday. An electric current is generated in a closed circuit when a magnet in its neighbourhood is moved. This discovery still has to survive all quantum treatment by the physicist. If you apply a magnetic field to a system of electrons in motion you must supply energy. There is an experiment which shows that induction applies to the current element, and so to the discrete charge in motion.

It is an experimental fact that the electromotive force and potential drop can differ in a circuit element. This has been shown by apparatus of the kind shown in Fig. 9. Here, a magnetic core M is excited by an alternating magnetizing field to produce magnetic flux changes linking a circular current circuit C. Two diametrically-opposite points on the circuit are connected by symmetrically disposed leads to a voltage detector G. These leads are flexibly connected so that the circular current circuit can be pivoted about an axis through the two points of connection. The axis of the magnetic core passes through the centre of the circular current circuit. The experiment consists in pivoting the circular current circuit with the magnet excited. It is found that, whereas the potential drop in the two halves of the circular circuit must be the same since they carry the same current, the measured signal changes from zero as the circuit

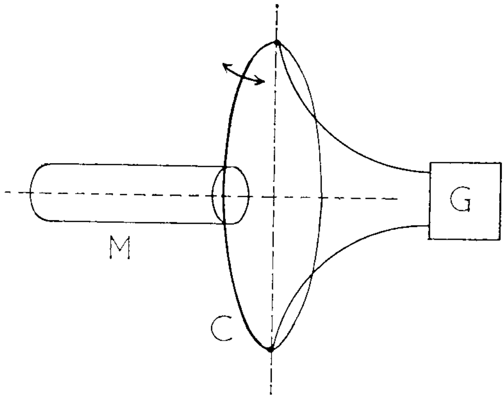

Fig. 9

is turned from a position normal to the axis of the magnetic core. This clearly shows that the electromotive force in the two halves of the circuit are not equal. There must be a force induced in a circuit element, that is, on a single charge in motion, acting along the direction of the current or motion. This force is supplementary to the lateral force set up by the operation of the law of electrodynamics. It is a force existing transiently when a magnetic field is changing.

There is therefore a fundamental error in physical reasoning in the theorems purporting to explain why the free electrons in any material are of negligible effect in resisting the applied magnetic field. From energy considerations, diamagnetism is the inevitable result and we do have to face this fact and see how we can reconcile it with the apparent non-existence of substantial diamagnetism.

Our starting point is obvious. Some substances exhibit ferromagnetism. They contain electric charge in motion, both free electrons and electrons in their atomic systems. Somehow, the statistics of their behaviour, whether classical or quantum, allow them to develop a magnetic field without any help from outside. Effects such as this come from deployment of energy. It suits the electrons in the ferromagnet to assume a state where they develop a magnetic field. They pay attention to the alternative states open to them and accept the one involving minimum potential energy. They seem to ignore the statistical rules which Van Vleck would impose upon them to deny them the ability to contribute some magnetic field of their own. So, we look to energy. We minimize potential energy, which implies maximization of energy due to the dynamic state, such as magnetic energy or kinetic energy. And we turn back to our diamagnetic problem.

If a magnetic field acts on an electron, the interaction with the transverse velocity component of the electron drives the electron into a circular orbit at this velocity. There is balance of magnetic force and centrifugal force. It works out that the electron develops a reaction magnetic moment equal to the kinetic energy due to this velocity component divided by the strength of the magnetic field. It is the same if we merely assert a 'spin' magnetic moment since the magnetic field times the magnetic moment is a measure of the energy involved. Analysis then shows that if a magnetic field is applied to a system of electrons in motion, the total reaction magnetic moment will be the total of these energy components divided by the effective magnetic field. This effective magnetic field is the applied field less that due to the reaction magnetic moment. There is an optimum reaction for maximum kinetic energy or minimum potential energy. This is when reaction field is exactly half of the applied field. This, in turn, means that, apart from small atomic reaction effects, all substances are diamagnetic to this same extent. The magnetic field is invariably halved by the reaction of charge. Accordingly, what really happens is that any electric charge in motion sets up twice the magnetic field we measure. Half of this is cancelled by reaction. Then we see that the kinetic energy deployed to develop the reaction is exactly equal to the conventional magnetic field energy.

We have solved our problem with remarkable ease and confirmed the theoretical aether field result deduced above. The free charges in a substance have a statistical distribution of their kinetic energy and produce no magnetism due to this but they receive extra energy, in measure equal to the so-called magnetic energy, and this they deploy exclusively to sustain the reaction.

All magnetic fields are halved, whether in material substances or in the aether itself. Therefore there has to be free charge in space capable of reacting. This itself proves the existence of the aether as a real medium. It is needed to keep our physics coherent on this awkward problem of diamagnetism.

The reader might be suspicious of the above argument and be inclined to accept the assurances of Van Vleck that statistics can eliminate diamagnetism. It may help, therefore, to draw attention to some comments made by 1970 Nobel prizewinner Professor Alfvén. After deriving the result that the diamagnetic reaction moment of a charged particle is equal to its kinetic energy divided by the magnetic field but noting the theorems based on Fig. 8, he writes:*

> On the other hand, as a single spiralling particle produces a diamagnetic moment, it seems reasonable that a gas consisting of an aggregate of such particles should be diamagnetic when it is not in thermodynamic equilibrium. The importance of this is evident in view of the fact that discharges are in a state very far from equilibrium. . . . Our discussion of an electron gas is of interest because it shows that under certain conditions a charged particle gas may be diamagnetic. In cosmic physics a gas always contains about the same number of positive and negative particles. . . .

Alfvén is saying that if there is free charge in space it should react to exhibit diamagnetism and that it will so react if it is not in thermodynamic equilibrium. Therefore, if the aether is an electric plasma and it has the form envisaged in this book, a form in which there are no collisions able to develop the boundary reactions according to thermodynamic statistical processes, then the aether too will display diamagnetism.

Ferromagnetism is a natural phenomenon because the atomic electrons in certain states in certain materials find that energetically there is an advantage in aligning their orbits. Their intrinsic energy is deployed to set up a magnetic field. The reason is interesting. Firstly, note that any electron in motion in an atom is like the charge at Q in Fig. 7 discussed above. Associated with its motion there is reaction kinetic energy in the aether or in the electrons in surrounding substance.

* *Cosmical Electrodynamics*, Clarendon Press, Oxford, 1950, pp. 58 and 61.

The process of energy deployment is as follows. When the charge at Q moves it develops a disturbance we recognize as a magnetic field. Free charge in the environment is affected. An electric inductive reaction is involved due to this and a force exists on Q absorbing some of its kinetic energy. This energy is transferred via the same inductive mechanism to the free charge just mentioned. Ferromagnetism occurs because the atoms can release some of their potential energy to come to a more favoured energy state. In the energy equilibrium process there is ample kinetic energy in the free electron system present to sustain the mutual effects of the magnetic field. An appropriate statistical contribution can be made by just enough such free electrons reacting to the main magnetic field polarization to keep the energy balance. Magnetic polarization and alignment of the electron orbits in the atoms correspond to the preferred energy state. This action is, however, regulated by the overriding condition that the alignment of orbits does not itself require more potential energy than is freed. For example, let us suppose that one electron orbit in each atom in a ferromagnetic crystal decides to align itself with some direction in the crystal. Because of the orbital quantization of the electron its magnetic moment is fixed and a certain amount of potential energy has to be stored because we have induced new strains in the crystal. The electrodynamic interactions have been altered. The orbits are no longer randomly orientated. It follows that ferromagnetism will occur if the potential energy accompanying the change in elastic strain is less than the reaction kinetic energy, because this latter quantity is not just a measure of the magnetic energy usually recognized but is equal to the energy sustaining the induction processes. At the onset of ferromagnetism the potential energy from the atom spills out to feed the strain energy. Meanwhile the reaction field energy is tapped from the thermodynamic energy of the free charge moving in the substance. Any surplus energy goes into kinetic energy and increases the thermal condition.

There is some evidence that the kinetic energy imparted to electrons by magnetic induction is limited by the related magnetic energy. If a strong current pulse is induced in a semi-conductor, one would expect the kinetic energy of the electrons and so the current itself to have a critical relationship with the magnetic energy within the conductor. This presupposes that the energy imparted by applied or induced fields exceeds by far the initial kinetic energy of the electrons, an unlikely possibility in ordinary metals but a distinct possibility in semi-conductors. The result will be an apparent failure of Ohm's law because a current saturation effect may occur. Also, since the magnetic field relates to current in dependence upon the physical size of the conductor, this saturation effect should depend upon the conductor cross-section.

In a paper at page 941 of *Helvetica Physica Acta*, 1969, Jaggi has drawn attention to the experimental evidence of the size-dependent non-ohmic behaviour of germanium and silicon. Jaggi also mentions the curious saturation condition that magnetic energy equates with the kinetic energy within the conductor at saturation. This helps to confirm the thesis about the disposition of the so-called magnetic energy in reacting current systems, but we must stay with the problem of ferromagnetism to see if we can account for the saturation magnetism evidenced by iron and other ferromagnetic materials.

We know that in a crystal the minimum strain energy is stored when there is symmetrical strain. The strain due to ferromagnetism is not symmetrical. It depends upon the axis in which the polarization lies. However, strain energy is a function of stress and strain. It depends upon the time it takes for the crystal to react to the stress. The minimum energy condition is then one where the magnetic polarization reasserts itself repeatedly in each of the possible directions of magnetization. If this happens fast enough the energy deployed as crystal kinetic energy will be small. Overall, therefore, minimum potential energy is a state for which the polarization is repeatedly quenched and reasserted so as to allow the magnetization vector to spend the same period of time in each of the possible crystal directions. There are no problems here due to thermal losses. The changes in magnetization involve repeated exchanges of energy with the kinetic energy stored in the free charge system. However, each time magnetism is lost there is adiabatic cooling and each time it is re-established there is adiabatic heating. This means that the temperature stays unchanged.

Of course, if a magnetic field is applied to a ferromagnetic it will favour a magnetization direction in its sequence of interchanging its magnetism between the different axes, and so it will develop an apparent polarization in one direction and form into the domain systems familiar to the expert on ferromagnetic properties. The strain energy does not depend upon which direction in a given axis the magnetism has chosen. Ideally, the polarization will be along each axis for equal portions of any time interval, but this will be modified very slightly by the effects of an external field and its direction. This will endow the ferromagnetic material with some strain sensitive properties and magnetostriction is to be expected. Our object here is really only to show how the aether leads us to an understanding of ferromagnetism and how ferromagnetic properties give convincing evidence in support of the aether concept.

The first real evidence comes from the fact that we have shown that in a ferromagnet there will be a half-field reaction. The magnetic moment set up by an orbital electron is exactly double that predicted by conventional theory but it is half cancelled by reacting charge which also has its own orbital motion. In a ferromagnetic substance the reaction will be caused by electrons and so if we measure the ratio of the total magnetic moment change and the total of the accompanying angular momentum change when we reverse the magnetism in a ferromagnetic specimen it will be double the value expected on normal theory.

This was observed experimentally by Sucksmith and Bates (1923).* The anomalous factor of two, known as the gyromagnetic ratio, has sustained Dirac's formalism, because this mysterious factor is supposedly due to a primary property called 'electron spin'. The Dirac theory has, however, been a great handicap to the theory of ferromagnetism. It has prevented the true source, the orbital motion of the electron, from being accepted as the origin of the ferromagnetic field. This we have rectified in the above account.

With the new theory of ferromagnetism developed above it

* *Proc. Roy. Soc.*, 104A, p. 499, 1923.

becomes possible to attribute ferromagnetism to electrons which decide to come out of their wave mechanical motions and lock into a simple orbital state. Analysis shows that two electrons in the second Bohr orbit produce the observed magnetic polarization in iron. It is noted that the quantization of each atom in iron is known to contribute 2·221 Bohr magnetons. The Bohr magneton is the quantum measure of magnetic moment. It is a real challenge to any theory to explain a quantity such as 2·221 when ideally one would think it should be an integer. Let us see where our theory takes us.

The force on an electric charge moving in a magnetic field arises because the energy conditions involving reaction effects optimize that way. Thus, energy optimization is more basic than force. Consequently in considering how a charge reacts in a magnetic field it is the deployment of energy in reacting to the effective field which matters. An iron crystal has a body centred cubic structure and if its magnetism shares each of the three cube directions equally, being bi-directional in two axes and uni-directional in the third, we have one third of the total instantaneous magnetic field as the effective polarization. This will develop a reaction effect of one half this, determining the energy to be deployed to provide the reaction field. Since this reaction is shared between the three axes as well, we have a polarization of one third the instantaneous action less one half of one ninth of the instantaneous action. This is five eighteenths of the primary quantization.

The energy analysis can be used to show that iron is ferromagnetic due to the contribution of electrons in the second Bohr orbit.* It appears that two electrons contribute to the ferromagnetic state, because this gives eight Bohr magnetons when the double action is allowed for. Five eighteenths of this is 2·222 Bohr magnetons. Allowing a little time for the magnetism to move from one direction to another we would expect the actual value to be slightly less than this, comparing well with the measured value of 2·221. Similar analysis can be used with success for cobalt and nickel, allowing for different crystal structures and taking two electrons per atom in half the lattice

* See Chapter 3 in the author's book *Physics without Einstein.*

structure for face-centred nickel and two electrons for each atom in the close-packed hexagonal structure of cobalt.*

The evidence of reaction effects in ferromagnetic material is strong and the evidence points to the corollary, a reacting aether. Magnetic phenomena are therefore particularly important in judging whether or not the aether should be recognized by the modern physicist.

Before ending this chapter something should be said about gravitation. Gravitation is a magnetic phenomenon. It is readily explained and is seated in a magnetic disturbance at the universal frequency of the aether. It can have certain steady state characteristics in respect of interactions between gravitating elements but will not interact with a magnetic field unless, of course, it is at this very high frequency of the aether. The frequency is that of photons developed when electrons are annihilated. The constant of gravitation G can also be derived in terms of the charge/mass ratio of the electron, based on a straightforward analysis of the aether. The reader is referred to the comprehensive analysis elsewhere.† However, it is appropriate to note that the state of magnetism in space corresponding with a gravitational field means energy deployment from the joint orbital motion shared by matter and aether charge. The aether is found to undergo charge displacement due to the out-of-balance effects otherwise arising from the presence of matter. The harmonious orbital motions of this displaced charge are like the orbital motions of the electrons contributing to ferromagnetism. Energy is deployed from this motion and converted to the kinetic energy released to matter when a body moves under a gravitational force.

* H. Aspden, lecture at meeting of Magnetics Group of German Physical Society, Salzburg, March 29, 1971.

† *Physics without Einstein.*

13

Action at a Distance

In explaining the effects of an electric charge in motion by reference to Fig 7, it has been tacitly assumed that there is action at a distance in the aether. Coulomb's law of electrostatic interaction between electric charge has been the basis of the whole argument even though a case has been declared favouring energy action as more fundamental than the force effect. Force arises when motion permits energy to develop what it is that we experience as a force.

Now, there are those who think that field theory excuses us from the need to worry about action at a distance. Also, there are advocates of mechanical aether theory who just cannot accept such a thing as action at a distance. The energy argument developed in this work and as used by reference to Fig. 2 may or may not give a satisfactory alternative to these sceptics. It seems that the orthodox scientific community accepts 'field theory' as the convenient alternative, without quite understanding the physical reality of the 'field'. Action at a distance still bothers the realist element in scientific thought. It is authoritatively dismissed by abstraction in a paper by Hoyle and Narlikar* with the words:

The success of field theory has overshadowed the action at a distance theories, although, ironically, we nowadays need have no difficulty with the problem that seemed so worrying to Newton and his followers, namely the mystery of how particles manage to act on each other when they are at a distance apart. We now know that particle couplings are propagated along null geodesics—i.e. at no distance in the four dimensional sense. Strictly, the phrase 'action at a distance' should be changed to 'action at no distance'.

* 'A new theory of gravitation', *Proc. Roy. Soc., A*, Vol. 282, pp. 191–207, 1964.

This is peculiar thinking. It seems that Einstein's theory can be used to transform words as well as frames of reference. We are simply concerned with the question of how two electric charges relatively at rest act upon one another, somehow exerting their mutual effects across the space separating them, and we are told they are both at the same point in space–time. Two electric charges can be separated by a distance in a three-dimensional world and since we are concerned with Coulomb's law, a law derived from experiment in an assumedly three-dimensional reference frame, we had better restrict ourselves to this real world if we expect to achieve anything meaningful. Are two spaced electric charges constantly subjected to the mutual interaction force? Are they in a state of jitter due to pulsations in the actions and delays in propagating their interactions? These questions may offend the physicist who lives by abstraction. The offence, however, may well arise because it is irritating to have a problem and not to have any clear answers. It is easier to argue that all that matters is what can be measured. If one cannot make measurements to determine the truth it probably will not matter to our physics how abstract our thoughts, as long as they link at least somewhere with the reality of observation. Is it not better to acknowledge our difficulties and let the students of physics wrestle with them, as problems of real physics, rather than as abstract riddles purportedly connected with the true nature of things?

Stedman,* writing recently on 'Broken Symmetry' in *Science Progress*, gave perspective to the philosophical implications of abstract physical principles when he referred to a reported conversation involving Heisenberg:

> Someone asked Heisenberg in the discussion time: 'Why then did God create the world with asymmetry in it?' Heisenberg's reply: 'Only nothingness is absolutely symmetrical, and there would be no point in creating that.'

Stedman then went on to write:

> Perhaps the rambling account above is reminiscent of the endless debates of the schoolmen of the Middle Ages, on such questions as:

* G. E. Stedman, *Science Progress*, Vol. 58, pp. 507–23, 1970.

'When a fish swims, which moves first, the water or the fish?' If such apparently futile questions form the warp and woof of modern physical theory, it would appear that we are not much better off than the schoolmen.

A question may seem futile if we do not know the answer, but it is better to keep in mind such futile questions than to offer to others futile answers. In many matters in physics we have progressed remarkably little from the state of knowledge in the Middle Ages.

When we contemplate the problem of action at a distance perhaps we are in a poor state of mind. It is the present author's contention that there is a real aether medium. Such is the subject of this book. But this belief has arisen from the discovery that much of the accepted physics of electromagnetic theory is inconsistent and that the weaknesses can be remedied by involving the electrified aether medium. Coulomb's law has been the foundation of all the author's analysis. It is the most fundamental physical law relied upon by the author in building the theory published in his earlier works.* Certainty has come from the quantitative derivation of the universal physical constants. These are the features which give the theory its real meaning. The universal constants of physics are somehow determined by Nature; they are determined quantitatively, and, of course, qualitatively. However, it is easier to contrive qualitative arguments purporting to explain what is observed than it is to couple with a qualitative picture a derivation of the observed numerical features. Quantitative support does exist for the simple qualitative physics given in this work. The form of the aether under discussion can be analysed in depth by applying classical electrical theory with some corrections. By discovering that if an electron does not radiate its energy when accelerated it must possess the property of inertia, the aether, as an energy containing medium in its own right, has come in evidence and also mass properties have become a consequence of the electrical properties of the aether.

The author has therefore been content to brush aside the

* *The Theory of Gravitation*, 1st edition 1960, 2nd edition 1966 and *Physics without Einstein*, 1969.

concepts of those advocating an aether based on mechanical foundations and, of course, the author's ideas, along with any favouring an aether, are set aside by those scientists of our time who are happy with life as a matrix of mathematical equations in a void.

One staunch advocate of aether theory is Oscar N. R. Potier, who has questioned the lack of definition of energy in the author's work, pointing out that energy is really force times distance. He writes:*

> You suggest that gravitation is a magnetic phenomenon. This means that action at a distance and tractive, tensile, or attractive forces are accepted, against the teaching of the sacrosanct laws of mechanics—contiguity and push or compression as the only possible forms of reality where physical forces are concerned.

Potier's own theory† is based upon an ever-accelerating universal expansion by which all elements of matter are forced further and further apart by forces transmitted by a space substance forming the aether. The inertial restraint appears as a gravitational attraction if this accelerated expansion is not appreciated. This idea can be disputed on quantitative grounds but it does, in principle, show how an unwillingness to give in to the doctrines of established physics and accept the inexplicable action at a distance forces can provoke new thoughts about the fundamental mechanics of our universe.

Now, it is not particularly worthwhile to argue that energy is force acting through a distance when, in fact, force may be a measure of energy change when whatever is associated with the energy undergoes a change of spatial configuration, that is, change of distance. Given energy and distance we need have little difficulty with the concept of force. Given force and distance we can understand energy, but energy can be something existing in its own right, whereas force implies something else. Energy is a scalar quantity whereas force is a vector. Energy is the more basic parameter. The example from the human frame

* Private communication dated Lisbon, January 9, 1971.

† Oscar N. R. Potier, 'The Fundamental Mechanism', paper read before Portuguese-Spanish Congress for the Progress of Science, Seville, November 23, 1960.

is that a lifeless unenergized body can exert no force because it can expend no energy. An electric car battery needs energy before it can be applied to develop a force. So it may be in Nature, at the really fundamental level. Energy is a primary quantity and force a secondary effect. Therefore, it is not to be expected that we can ever fathom the very nature of energy.

The question we can approach is the problem of electric charge. Energy and space (distance) imply force and we need not invoke mass from these parameters, as did Newton. Instead, given energy and space, can we develop the notion of electric charge and from that then come to understand Coulomb's law and the problems of action at a distance. The author can explain mass from the electric nature of the aether, but the author may still be taught that the aether can yield an even more fundamental truth, possibly exposing the very nature of electricity. It is important to keep an open mind in these matters.

Let us, for the moment, return to Hoyle and Narlikar's 'action at no distance' theory. Their paper is entitled 'A new theory of gravitation' and concerns Hoyle's ideas of signals from the future. The subject is essentially the problem of the accelerated electron already treated by reference to Dirac's abstract ideas on electrons. The Schott energy referred to on page 97, as requiring a mechanical aether to apply the necessary forces, appears to be invoked when Hoyle and Narlikar write:

> An accelerated charge in an otherwise empty space experiences no electromagnetic force, whereas a damping force is actually observed.

It is not clear from this paper how this damping force has been 'observed'. Then, referring to Wheeler and Feynman, Hoyle and Narlikar write:

> They pointed out that the particles we actually observe to radiate are not in an otherwise empty world, so the theoretical result that such particles should not radiate is not necessarily a contradiction with experience.

The paper then talked about a 'static homogeneous universe of charged particles' which produces a reaction equal to half the usual retarded solution due to accelerated charge minus half the advanced solution. Not only do we need an aether, but we need the inevitable signals from the future to reconcile the theoretical problems of energy radiation by electron acceleration. By assuming that an electron can radiate its energy scientists have given themselves a problem which they overcome by assuming that the aether sends energy to the electron anticipating its future movements. The human body is an assembly of electric charge and, on similar lines of thought, we must argue that the aether already contains the data governing our future movements, as if our destiny is ordained by the spiritual control of the aether substance. However much this may conform with religious conviction, it seems so much easier, scientifically speaking, to recognize that an electron will not radiate its energy. We must turn our physics around to satisfy this fundamental observation. The aether exists. This is beyond dispute. How far beyond dispute has been the question at issue since Einstein changed our frame of reference. However, the future does not exist until it happens, at least to those of us who understand what we mean by the word 'simultaneous'.

In Chapter 11 it was implied that the great thinkers in the classical period in physics had missed the fact that an accelerated electron derives its inertia because it does not radiate its energy. They did, however, not miss an important part of this fact, that is that an accelerated electron need not radiate its energy. Rather, they deliberately chose to ignore this possibility when they had the message clearly before them.

Professor G. H. Livens, Fellow of Jesus College, Cambridge, writing in the second edition of his book *The Theory of Electricity*, published by Cambridge University Press in 1926, presented this message quite forcibly. It is appropriate to quote from his work at some length. After deriving Poynting's formula for energy transfer, he writes:

This is Poynting's result and this vector is usually called after him. It is however necessary to emphasize the fact that it represents the flux of energy only on the hypothesis that the kinetic energy is distributed in the medium with a density $\int_0^B H \, dB$ per unit volume; and even then it is uncertain to an additive vector quantity which integrates out when taken all over the surface f. However, following usual practice in physics, it is best to adhere to the simplest hypothesis. The actual phenomena strongly suggest that the flux of energy is correctly represented by this vector and the addition of anything else is merely a gratuitous complication which is not, after all, necessary. There is however no definite and precise reason why we should take the matter this way; we might have adopted some other scheme. The only other one of any importance is obtained by performing the first integration by parts in some other way. We found that. . . . This is the general form of a result which has received very influential support in some quarters and there is something to be said for it. . . . In any case we cannot definitely say that either form is wrong, and the particular form of theory is entirely a matter of preference and not proof. The chief point to be noticed is that we get different distributions of magnetic energy according to the assumptions we make; the differences are, it is true, unimportant in the ordinary statical and dynamical aspects of the theory so far examined, but cases will be examined where the two distributions are of fundamentally different types. In some types of fields, for example, the densities of the magnetic energy on the two theories are equal in magnitude but opposite in sign.

The above appears between pages 242 and 244 of Livens' book. Written, as it was, in the heyday of the quantum theory, when more and more evidence was being discovered of energy transfer by discrete quantum processes, it is surprising that the popular preference did not switch to reject Poynting's ideas and accept the alternative outlined by Livens. Probably, however, the minds of the time were too busy with the new ideas in wave mechanics to be bothered repairing some of the classical theory. Professor Livens reverted to the problem on page 313 of his book writing 'On the flux of energy in radiation fields':

According to the usual conceptions of physical science, when energy travels by radiation the direction of the flux is along the ray, so that the flux vector gives not only the direction but also the intensity of the ray (the intensity of a ray being measured by the energy that passes along it per unit of time). In ordinary propagation in isotropic media the direction of the beam is perpendicular to the wave front, because the electric and magnetic vectors are both in this surface. The energy in this case travels along the beam normally to the wave surfaces. In crystalline media however it is the electric displacement vector that is in the wave front and the electric force is not coincident with the displacement so that the energy flux vector is no longer normal to the wave front. The direction of the ray, that is the path of the energy, is then oblique to the wave front surfaces, but in any case its direction at any point is the same as that of the energy flux vector at that point.

In entering into a more detailed analysis of these phenomena the first difficulty encountered is the ambiguity in the definition of the flux vector. The usual procedure is to base the whole discussion on Poynting's form of the theory, which appears to provide the simplest view of the phenomena, and to ignore the possibility of alternatives. We must not however forget that our view-point may be coloured by a long use of the particular form of the theory as the sole possibility so that its apparent suitability may be at least misleading. It is therefore essential that we bear in mind that Poynting's theory is not the only one which is consistent with the rest of the electromagnetic scheme and we shall therefore follow the usual discussion along the lines laid down by Poynting by a brief review of at least one simple alternative.

After Livens has given the analysis using Poynting's theory he then writes:

The whole of this discussion has been based on Poynting's theory of the processes involved. If we turn to the single alternative theory suggested in paragraph 229 where the radiation vector appears not as the vector product of the force vectors but as the product of the complete vector current by the scalar potential . . . we shall find a remarkably different aspect of the whole of the processes.

He then shows energy transfer perpendicular to the direction of propagation of wave radiation and says:

Of course in a theory where there is to be no transfer of the energy, the whole conception of energy at a point must be different. That this is so in our present case is immediately obvious. According to the general discussion the appropriate formula for the kinetic energy density is . . . that is the kinetic energy now has the same value but the opposite sign to that usually employed in Poynting's theory, so that the total energy is on the modified theory simply the excess of the electric potential energy over the magnetic kinetic energy on the older interpretation. In the case of no absorption these are equal and the present theory does not associate energy at all with the radiation, so that no question of its transference arises. In the case of absorption it will be seen that the new theory identifies as the total energy in the field just that part of the energy which on Poynting's theory is not transferred.

Livens next considers the Hertzian vibrator and goes on:

Thus whereas on Poynting's theory the energy supplied to the field at the vibrator is transferred outwards and radiated away, on the new form of the theory the energy, now however differently interpreted, is stored up in the field surrounding the vibrator and counted there in the kinetic energy. . . . We know without ambiguity the difference of the energies . . ., the Lagrangian function, which is of necessity correct, as it leads to equations which have been proved by experiment to represent the motions of observable electrons. But beyond this the rest is pure conjecture.

Livens says 'beyond this and the rest is pure conjecture', yet we have had half a century of pure conjecture thrust upon us because we favoured the wrong alternative. Professor Livens puts the case for non-radiation of energy and the case for negative field energy. The present author, unaware of Livens' work,* was later to develop these same notions on independent lines and to follow their stimulus in understanding magnetic phenomena.

We may now revert to the problem of action at a distance and the nature of electric charge. Let us proceed, attempting a simple logical approach. Three dimensions are needed to define the parameters of physics. We may choose dimensions which are observed as variable quantities or we may opt to base our physics on dimensions which match the basic physical constants. In the latter case we would need to explain then why a particular quantity could occur as a constant. Therefore, logically, we will choose as primary dimensions quantities which are variable, or rather arbitrary, in the scheme of Nature. Thus electric charge seems to be a fixed quantum and cannot be considered as primary. Hence, we can hope to explain it in terms of more fundamental concepts. Nature somehow keeps the electron charge invariable. It is a determined quantity and is not arbitrarily fixed by some quirk of Nature. Variables we can use as primary dimensions are energy, time and distance. A universe can be constructed in one's imagination which permits the distance between its elements to be set arbitrarily. If the elements move to relate to time then time can be set arbitrarily as well. Also, energy does not come in Nature as a fixed quantum. Even a photon is frequency-dependent. Hence energy, space (or dis-

* I am indebted to Mr. David Eagles for drawing Livens' work to my attention in November 1970.

tance) and time are appropriate primary dimension quantities.

Time, distance and energy may have units set by Nature but all can change. More important is that electric charge can come in positive and negative forms. Now what does this really mean? We only have positive and negative as notional concepts; something we interpret by mathematics in comparing two quantities. In terms of time, distance and energy we cannot conceive negative time or negative space. Negative energy is no better than negative substance. A negative energy component is possible if our measure is relative to a positive reference and negative magnetic field energy as contemplated in Chapter 12 only implies an aether permeated with energy and depleted to become energy in some other form. Negative energy is an impossible notion in any fundamental frame of reference. Nevertheless we can combine space and time to develop opposites. We can conceive opposites which arbitrarily become positive or negative in the choice of direction of movement or rotation of an element of energy.

It follows from this that the logical approach to explaining Coulomb's law and the charge it connects is to try to seek out something which offers motion of energy in a plenum. Vortex theory is the likely candidate. Such speculations will not be pursued here save for a cautionary remark. Vortex theory often presumes the existence of particle forms in a fluid medium and accounts for their interaction in terms of the vortices ever present when they move. This assumption will not advance us to a better solution than was found when vortex theories went out of fashion at the beginning of the twentieth century. The particle form itself must be part of the same fluid form. It could be a cluster of vortex filaments in an all-pervading incompressible fluid medium.

Given a particle concept in terms of motion and an energy substance, mass can be developed from the dimensional relationship between energy and velocity. Perhaps then if the particle form is nothing more than a vortex system it may move to conserve itself and thus display inertial properties and its mass in keeping with the author's theory. To be reasonably content with such an approach Coulomb's law would need to be explained and, consequent upon this, magnetic effects. This was the fundamental object of many of the old aether theories which claimed success in their time. Whittaker* has provided an excellent account of such theories. Also, however, vortex theory is still very much alive in some minds. See, for example, the work of Wilhelm M. Bauer.†

It may seem to the reader that to speak of vortex theories of a fluid aether is to set the clock back a century. It is out of tune with the world of the modern physicist. Yet the eventual truths about the aether will not change with time and the truths of the past will not either. The physicists of the last century may not have had the experimental data we possess today, but equally they could focus their undistracted attention on to the fundamental philosophical implications of the subject. Their conclusions may not be conclusive, but their lines of enquiry deserve respect and should not be rejected without some caution. After all, they did possess some experimental facts which the modern physicist still cannot explain.

It is gratifying to see a report of a lecture in June 1971 presented by Professor Wheeler at the Cambridge Institute of Theoretical Astronomy:‡

> His new discipline describes reality without recourse to either mass or charge. Whereas Einstein described a universe where the curvature of space–time was a product of real masses for which Einstein could not account theoretically, Wheeler's universe accounts for all phenomena without the need to postulate any real mass at all. This is a revolutionary improvement on Einstein. Its full implications are only beginning to be realised. In superspace, Wheeler contends, 'pre-geometry' constructs material out of non-material. This plenteous nothing (not to be confused with antiquated theories of an aether) contains entities of dimensions far too small for direct observation. However, on a scale of the order of 10^{-33} cm the universe is a fabulously rich sea of events, eddies, vortices, and foam.

Let us, therefore, revive vortex theory of the substance permeating empty space, but let us be at pains to avoid anything antiquated. A modern aether is what is needed.

* *History of the Theories of Aether and Electricity, The Classical Theories*, Nelson, London, 1951.

† *Mechanik Elektromagnetischer Vorgänge*, 1965.

‡ *New Scientist and Science Journal*, July 29, 1971, p. 242.

14

The Nuclear Aether

The physics of the aether is to many minds the physics of the nineteenth century. The twentieth century has so far been concerned with the physics of the atom and its quantum behaviour. Physics has assumed importance in industry primarily because electrical technology in the semiconductor field has become the province of the physicist rather than the electrical engineer. Also, physics has now an undeniable place of importance because everyone is all too aware of the energy hidden inside the atomic nucleus. For this reason the minds of many research physicists are technology-orientated. Theoretical physics is complicated, the aether is dead and who has the time anyway to be concerned with such an antiquated topic! The more open-minded may say that if the aether has a place it is in cosmology; it is certainly not in the field of the nucleus. But let us see if we can dispel this belief.

Is there anything about the atomic nucleus we cannot explain? The atomic mass does not increment in proportion to the atomic charge. It seems that over a range of atoms of low atomic mass the number of nucleons is approximately twice that of the number of proton charge units in the nucleus. The nucleons comprise the protons and neutrons believed to form the nucleus. At high mass numbers the ratio of two increases roughly to about two and a half. An explanation of this would help our understanding of nuclear physics. Does the reader already have such an explanation? If not, perhaps the following analysis will have some appeal.

Consider an electric charge surrounded by a concentric uniform spherical distribution of discrete charges of opposite polarity. Now calculate the electrostatic interaction energy of such a system. This quantity will be found to be negative until the spherical charge distribution has a charge exactly double the magnitude of the central charge. Thereafter we would have positive interaction energy signifying instability, because the 'binding' energy associated with the negative polarity has ceased to 'bind'. We may expect, therefore, an entity to form as a stable aggregation in which the central charge acquires an enveloping double charge of opposite polarity, assuming the spherical distribution. If we consider instead a central charge with a uniform spatial charge distribution surrounding it, bounded by a sphere, then instability sets in when the surrounding charge is two and a half times that of the core. Between these two limiting examples, we could have, say, charge distributed in two concentric shells of unit and double unit radius, the charge content being proportional to the area of the spherical shell form. This gives a ratio of 2·166 for stability.

It needs little imagination to recognize the relevance of this to our nuclear problem. The atomic mass number is a measure of the number of negative nucleons clustered around a central core of charge. This charge has negligible mass compared with the nucleon mass contribution but the charge is the positive charge we regularly associate with the atomic nucleus. We need not speak of a combination of neutrons and protons to explain qualitatively the numerical difference between atomic number and atomic mass number. Somehow the charges of the nucleons are not detected, because we well know that the atomic electrons only react to the central charge. They ignore the nucleon charges just as they ignore charges in the aether medium. Indeed, the electrons may see these nucleon charges as they see the aether. In fact, the nucleons may be deemed to be arrayed in a structure and to have displaced negative aether charge so as to substitute themselves in the structured form of the aether itself. Their charge is undetected just as the mass of a buoyant body goes undetected in a fluid of equal mass density.

Hence, we need to invoke our aether. Also, we see support for the cubic lattice distribution of aether charge. An oxygen nucleus can be adequately populated by a single shell of discrete charges. There are 26 charges disposed in a regular cubic system about a central charge and 16 of these are presumably replaced by negative nucleons. The two to one ratio applies, because the oxygen atom has a atomic number of 8. Now take chromium, for example, which has an atomic number of 24. Here, we might expect charge to be distributed over another shell as well. The stability condition, calculated for idealized spherical distributions, requires 2·166 times as many nucleons as units of central charge. Hence an atomic mass number of 52, as is found. Similarly, for heavier atoms we find an appropriate relation between the two quantities conforming with this theory.

It has to be accepted from this that the nucleus consists of a central charge surrounded by a cluster of regularly spaced nucleons of negative charge. As the author has explained in his book *Physics without Einstein*, the nucleons form into a lattice structure with bonds joining the nucleons and, additionally, pions contributing to the energy of the bonds also derive their energy from an interaction with the nucleons. These features of the nucleus modify the mass and add some complication. Different isotopic forms may depend upon alternative structure configurations rendered possible by the different bond positions available. This is a matter for further analysis. When the above-mentioned book was published the author supposed the nucleons to be formed as a system of neutrons and protons, as is conventional. The later realization of the stable charge system introduced in this chapter, however, has led to a revision of the model. All the nucleons are the same. They are negative particles of mass approximating that of the proton.

The central charge itself is the conventional nuclear charge of the atom but it has relatively small mass. The physical size of this charge has been measured by experiment. It is approximately the size of the electron or positron multiplied by the atomic number, as if, for example, the oxygen atom has a charged core formed by the merging of 8 positrons which conserve their charge within their aggregate volume. The formation of different atoms can then be understood as a process by which a positron core is successively made larger by combination with other cores. The conservation of charge is to be expected, but the conservation of volume implies the presence of an enveloping incompressible fluid, again evidencing the need for an aether medium. The existence of the charged core in a highly energetic environment permeated by heavy negative particles forms a nucleus. The charge has an affinity for heavy particles because they do have their own mutual gravitational attraction and this makes their association more stable. Also the higher the mass of the elements the less sensitive the system to spurious disturbances from light bodies such as electrons. Given the charge quantity at the central core, the nucleus forms to assure the stability criteria discussed earlier in this chapter. There is a limit on the size of the central charge. This charge itself has mass which will increase more than in direct proportion with the charge. Thus, the charge of a uranium core may have its own mass of nearly 2,000 times that of the positron, even though its charge is only 92 times that of this particle. Also, there is a limit on the spatial extent of the nucleon lattice. This reaches the innermost electron shell of the atom when the atomic number is of the order of 40. However, this latter effect may not be relevant because the nucleons are hidden in the charge pattern of the aether. It would seem, therefore, more likely that it is the mass of the central charge core which governs the stability of the heavy nuclei.

Before concluding the chapter some comment about the conservation of charge volume is appropriate. If discrete charges exist in a surrounding pressurized but incompressible medium they will adapt in shape to be spherical. This is assured by the self-repulsion of their intrinsic electric charge. Also, the charge will be distributed within the bounding sphere so that a uniform pressure exists within the body of the charge. The electric energy thus stored by the charge is inversely proportional to its radius. A question of stability arises, particularly as charges of different sizes may exist. To answer this, we can say that, due to the uniform nature of the enveloping medium, if one charge expands another must contract, and yet, energy must be conserved. There can be equilibrium in this exchange relationship and so stability in the charge forms. The energy conservation condition will act to assure that charges of different size do not exchange any of the space they occupy. They will remain mutually stable under normal conditions. The energy criterion is primary to any force action. Nevertheless, the charges will tend to form into families of equal charge and equal sizes or energies. Somehow, nature determines certain possible forms of particles and these forms then prevail to exclude any hybrid varieties which form transiently.

This argument also permits us to understand how charges in the aether might vary in size to change their mass. The author believes that gravitation is due to a modification of mass of certain aether particles. The idea is that there is a cyclic motion of matter with a lattice formed by aether charge and a counter-balancing effect due to motion of other aether charge. The aether adapts to balance the mass of matter present. The balancing charges of highest mass react and become very slightly smaller, so increasing their mass and causing a very small electromagnetic effect which explains gravitation.

Should a reader have difficulty understanding how a particle of charge can be stable and yet vary in size to accommodate kinetic energy as a change of its electric energy also corresponding to its change in mass, he should ask himself a question. How can a charge expand to release kinetic energy to itself when such energy is stored by its contraction? A charge will exchange energy with other charge, but stability amongst families of identical charges is assured by the mutual balance.

15

The Earth's Electricity

We seek to understand the universe in terms of the physical phenomena which we witness in our earthly reference frame. Thus, we knew the earth had a magnetic field and were not at all surprised when we found that the sun had one as well. We discovered how the optical spectra of radiant materials reveal their nature, and it was logical that we should find similar spectra in solar radiation. Minute displacements of the spectral lines were our clues to new cosmic phenomena, and when, for some stars, these displacements became significant we were confronted with a really mystifying problem. The spectral red shifts of the quasars will long remain a unresolved problem because we have no earthly phenomenon by which to formulate comparisons. The earth cannot provide the reference needed for our understanding. Only our theories duly extrapolated can be forged into shapes able to give satisfaction, but there can be little certainty in these matters. The earth is our test bed for theory. Phenomena verified on earth can reasonably be expected to have their counterparts elsewhere in the universe. And so it must be with that phenomenon we know as atmospheric electricity. Somehow the earth retains a negative electric charge. It seems not to have been explained in our reference sources, yet it exists and, if it exists as a terrestrial phenomenon it can presumably exist on the sun. We need to understand it if we are to seek the fullest understanding of solar phenomena. When we discovered nuclear energy, the sun became a nuclear fire. Before that time the sun was a body generating heat, emitting light and somehow surrounded by luminescent clouds. It was hot gas, electrically ionized gas when ionization was discovered, and it became nuclear as our earthly minds grew to comprehend nuclear phenomena. It is indeed surprising that the thunderball, as we have seen, did not become nuclear until 1970. It has been suggested that both the sun and the thunderball are, in fact, mere spheres of rotating aether, but acceptance of this depends upon our belief in the existence of such a medium. We are, when it comes to understanding the nature of astronomical bodies, including that great solar source of our own existence, mere victims of fashion. We depend upon our understanding of phenomena in our terrestrial frame of reference. Why then are we not paying attention to the earth's electric charge? Just because we cannot explain it does not mean that it lacks great cosmic importance.

The subject was given special treatment in a book by H. A. Wilson.* Wilson writes:

> The difference of potential between the earth and a point in the air above it may be found by means of an insulated conductor provided with some device to bring it to the same potential as the surrounding air. . . . The potential difference between the conductor and the ground can be measured with an electrostatic voltmeter connected to the conductor and to the ground by insulated wires. If the conductor is on a pole 10 m. above the ground in the open air away from buildings or trees, the potential difference between it and the ground will be of the order of 1500 volts. The vertical field varies greatly. In fine dry weather it is usually directed downwards, indicating a negative charge on the earth's surface. It varies with the time of day and season of the year. The vertical field has been measured at various heights by means of balloons. It is found to diminish as the height increases, and usually becomes negligible at about 10,000 m.

Wilson then demonstrates the challenge confronting physicists. How can this charge be maintained? Wilson calculates that the conductivity of air would discharge such electricity in about 17 minutes. Yet it is sustained. Various explanations are then reviewed. Rain drops may carry charge downwards to restore loss. But observers say that raindrops are usually positively charged and this could not explain the earth's negative charge. Lightning flashes may account for the current balance. It may be that more flashes convey current upwards than convey current downwards. Hence, if enough lightning flashes occur over the whole earth's surface, we can expect a negative charge

* *Modern Physics*, H. A. Wilson, Blackie, London, 1937, Ch. XVII.

to be held by the earth in spite of steady conduction losses. This seemed quite feasible to Wilson. Note, however, that we cannot then explain the origin of lightning in terms of the existence of the earth's electric field. Wilson then mentions a suggestion by Simpson that charged particles are shot out from the sun. Some reach the earth and the positive ones are stopped in upper regions whereas the negative ones, electrons, penetrate to the lower atmosphere. The problem here is that the electrons would have to move at velocities close to the speed of light to set up the observed charge on the earth. Also experiments to collect the charge they bring with them have yielded null results. So Wilson finally concludes:

> It will be seen from this discussion that we are as yet very far from having a satisfactory theory of atmospheric electricity.

Now, we are interested in this earthly phenomenon because it might tell us more about the source of the sun's energy. So let us question the idea that electrons travelling from the sun at a speed close to that of light can be the cause of the earth's electric charge. First, why should the speed be close to that of light? Well, if the earth has an electric charge it will act on incoming electrons repulsively and slow them down. They have to have enough momentum to fight against the earth's electric field and reach the surface. The number arriving will determine the earth's charge and it will rise to the appropriate value subject mainly to this bombardment rate but also subject to conductivity leakage and lightning discharges. The earth's charge is known from the electric fields we can measure. It happens to correspond to the electron velocity of the speed of light. Is not this a coincidence? Or is it evidence of scientific import? Experimental attempts to collect charge directly from these electrons failed. A large insulated copper collector was used but it acquired no measurable charge when exposed to the sun's radiation. How do we solve this mystery?

Let me quote from another completely unrelated chapter in Wilson's book. In his chapter on Quantum Mechanics at pages 92 and 93 he writes about an experiment involving interference and diffraction of light:

The light acts like particles in this experiment . . . the electrons shot out receive energy from the light. . . . If we suppose that the source of light emits only one photon, the chance of an effect due to this photon occurring at any place will be proportional to the wave intensity, at the place, when the source is supposed to be emitting a continuous train of waves. The waves therefore carry no energy, and the wave theory may be regarded as merely auxiliary mathematics which enables the distribution of the photons to be calculated. Just why such a method of calculation is necessary and why it gives results in agreement with the facts is not known. . . . The velocity of a photon is always equal to the velocity of light, so its momentum is equal to . . . its energy divided by the velocity of light.*

Apart from the interesting recognition by Wilson that waves carry no energy, a thesis expounded elsewhere in this work, he asserts the truth that wave mechanics do not explain; they just happen to work correctly. One may yet have to analyse the aether to really understand the whys and wherefores of the utility of wave mechanics in treating the problems of Nature. But this is digressing from the point which the discerning research-minded reader will already have appreciated. If light acts like particles and electrons 'shot out' receive energy from light, we have answered the anomaly confronting us above. The sun emits light. Light travels at the speed of light. It comes in packages known as photons. Photons impart momentum to electrons in atoms and thereby ionize the air. An electric field is established in the atmosphere in appropriate relationship with the absorption of solar radiation. We do not need electrons from the sun. All we need is light. This will impart momentum to electrons in atoms and sustain their displacement towards the earth. An electric field will be maintained directly in dependence upon the sun's radiation. The earth will have an electric charge which is seemingly negative but the effect will be more analogous to the Maxwell displacement in an insulator medium when an electric field is applied. It is just that the same effect is produced by light radiation, or rather the total electromagnetic radiation from the sun.

Now, as stated above, we know that the speed of light is the

* The text has been changed in the quotation by replacing mathematical symbols for terms 'velocity of light' and 'energy'.

key to the relationship between the momentum and the energy which is needed to hold an electron down in the earth's electric field. This is easily verified because we know the earth's potential gradient at its surface and its electric charge per unit area. Hence we know the force urging this surface charge into the ionized air adjacent the earth's surface. For equilibrium the solar radiation pressure is absorbed by the earth's atoms at the surface and, though deployed to urge the displacement of electrons and ions, this displacement is effectively neutralized by the balancing field (the potential gradient) due to the earth's surplus of electrons. The rate of supply of solar radiation energy per unit area is the quantity known from measurements. Taking this quantity, the earth's electric field and the charge then deduced from this field, we find that the balance condition will occur if the momentum of solar radiation happens to be the rate of supply of solar energy divided by the velocity of light. Conversely, the earth's electric field can actually be deduced in quantitative terms from the value of solar energy radiation since it is well known that a photon imparts momentum in proportion to its energy divided by the speed of light.

Due allowances must, of course, be made for the inclination of the radiant solar beam and the heat absorption effects of the atmosphere. The earth itself will not store much of the solar heat. Its surface temperature reacts rapidly to the daily cyclic changes in the solar heat supply because the earth has a poor heat conductivity. Thus, heat received by radiation is convected or radiated upwards without the balance being upset by any significant thermal inertial effects in the earth's surface material. It is the balance of radiation energy which is really effective at the earth's surface in developing electric field. It appears that much of the upward heat transfer is by convection and convection plays no part in inducing electric fields comparable with those induced by radiation action. We must also take note of the tremendous heat capacity of the atmosphere. This does absorb solar energy during the day and it develops downward radiation throughout the night, sustaining the earth's electric field even when the sun is not visible. Of course, the measured electric field varies cyclically during the 24 hour period. Three factors co-operate in developing cyclic variation, different radiation patterns for the atmosphere, the sun and the earth's surface. The atmosphere absorbs and re-radiates solar energy and since it has a high thermal capacity its heat content will cycle about a mean value with substantial phase-lag relative to the direct action of the sun. Curve A in Fig. 10 is representative and shows maximum radiation in the early evening. The sun's radiation when resolved into its vertical components will vary as indicated in curve B. The combined effect of atmospheric and solar radiation

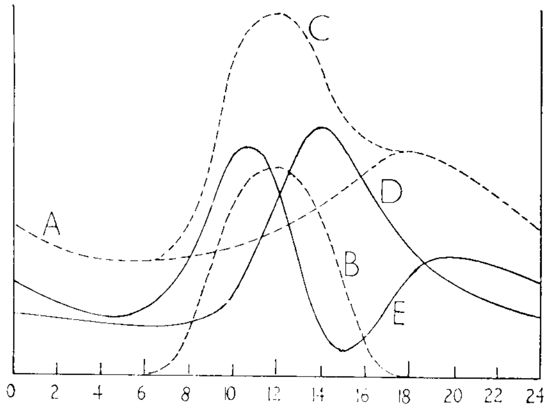

Fig. 10

is the curve C having a substantial midday peak. This radiation heats the earth and, in keeping with the heat emission properties of usual materials at earth temperature, about half will be re-radiated upwards. The effect is shown at D, with the peak in the early afternoon. The peak is significant because radiation is very sensitive to increase in temperature and the earth's surface temperature is readily changed in dependence upon incident radiation. Subtraction of curve D from C gives the resultant downward radiation, curve E, as a measure of the earth's potential gradient. The curve has two peaks during a period of 24 hours and, indeed, this is exactly what is observed experimentally.

In Fig. 11 data presented by Swann in 1919 is reproduced.* It

* *Jour. Franklin Inst.*, 188, p. 577, 1919.

applies to a typical summer day, presumably at a North American location. The curve shows that the earth's potential gradient, as measured, was of the order of 100 volts per metre but the interesting point is that the form of the curve is exactly

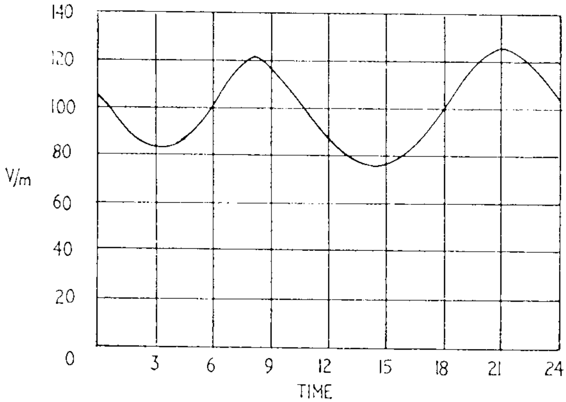

Fig. 11

that which we can predict on the theoretical account given above. Swann observes that the average potential is higher in winter than in summer. This may seem surprising at first but, in fact, it verifies the theory just presented. The curve such as A in Fig. 10 will always be representative of radiation coming vertically downwards, whereas the curve B depends upon the angle of inclination between the vertical and the sight line to the sun. In fact, curve B in the figure is developed as a full cycle of a sine wave on the assumption that at noon the sun is directly overhead. In the northerly part of the hemisphere, and particularly in winter, there is further attenuation of the direct solar radiation. Thus, curve A will become more predominant in winter and curve B will be less predominant. Additionally, since the solar radiation is impacting the earth's atmosphere more obliquely in winter relative to summer, a higher proportion of the sun's radiation energy is absorbed and this, in turn, contributes more to curve A while removing the strength from curve B. The lower temperature of the earth in winter ensures that the back radiation is significantly reduced. In summer, although the energy received is greater than in winter, the fact that more of the radiation comes in at an angle and a higher proportion re-radiated by the earth results in the actual radiation pressure and the consequent electric field being greater in winter than in summer. Of course, this distinction between winter and summer effects only applies in certain latitudes.

There can be little doubt that the earth's electric field is therefore generated by the pressure action of solar radiation as described. It is interesting to observe that Swann, writing in 1919, came very close to realizing this mechanism. He analysed the effect of gamma radiation impinging on electrons and used data for ionization based on experimental measurement of the effects of 'radiation from above'. At this time, Swann could not have been aware of the later discovered Compton Effect which showed that all the electromagnetic solar radiation received at the earth can be absorbed to impart momentum to electrons.

The above account of the origin of the earth's electric field is not an explanation of the phenomenon of lightning. Nevertheless, just as Wilson imagined that lightning might provide the current needed to sustain the earth's charge, we can now invert this argument and say that the solar radiation pressure will restore the charge dissipated by lightning flashes.

It is evident that some physical mechanism triggers discharges in the atmosphere. A cloud, for example, will absorb rather more radiation than the clear atmosphere. Therefore, the cloud will become charged. It becomes a giant capacitor floating in the sky. Atmospheric conditions conducive to the formation of dark thunderclouds will enhance this action. Then, when clouds interact electrostatically, either with themselves or with the earth, we may find a substantial positive charge is drawn towards a substantial negative charge and lightning discharges occur. What the explanation of the earth's electric field does offer is the mechanism by which charge is induced. All the many factors, such as ice or water droplets, which have been observed to contribute to the initiation of thunderstorms, may still perform their recognized roles. However, we do not preclude by the new ideas put forward in this work the prospect of cosmic lightning discharges at the sun's surface, for example. We do not need to argue that ice is an essential feature of the physical basis of lightning and that this precludes cosmic thunderstorms save, as Sir Basil Schonland concedes,* in 'dying stars having relatively cold atmospheres'.

It was not really necessary to consider the origins of lightning in this book about the aether. The topic has been included in order to show that the seemingly uncertain source of the earth's electricity can be explained in association with lightning and in such a way as to suggest that the apparent surface temperature of the sun is enhanced by lightning discharge. Heat radiation from the solar energy source induces electric fields which charge the solar atmosphere.† Lightning discharges produce high temperatures in transient striations which occur continuously, making the sun appear hotter than it really is. It is also interesting to note that Jupiter, for example, appears to have a temperature higher than it should have if all the heat it received from the sun is re-radiated. This suggests an internal heat source but equally it suggests a non-uniform temperature, inasmuch as the disproved heat balance assumes uniformity of temperature.

In the next chapter we will examine the prospect of discovering the source of the sun's energy.

* See page 13.

† The action of radiation pressure, that is photons, on electrons in stars is discussed by M. Stix at p. 161 of *Astronomy & Astrophysics*, January 1970 and used to explain charge displacement and magnetic fields resulting from stellar rotation of this charge.

16

The Cosmic Aether

What has been accomplished in this book so far? A case in favour of re-admitting the banished aether has been presented. But what is the reader's verdict? Not proven? It is time to believe that a thunderball is a whirlpool of aether when we can reproduce thunderballs experimentally and harness their use in storing energy until heat is needed in a furnace application. We can await proof in the next century when someone contrives this experiment, and perhaps succeeds in cooling objects by extracting aether whirlpools developed within them. It is unnecessary to believe in an aether-based explanation of gravitation and terrestrial magnetism when our measurements tell all we need to know for practical purposes and there is existing theory which apparently satisfies the majority of those interested. It is mere speculation to presume to explain the origins of the solar system. Such speculation can be tolerated if founded upon accepted physics, but to invoke an aether in such an explanation is asking for a little too much credulity.

The reader has to be cautious. He need not be so cautious about believing Dirac's theory of the electron. After all, in spite of the criticism presented in this book, there is general acceptance of Dirac's work, abstract or not. And if you have to teach physics to others you must surely teach the physics which has appeal, abstract though it may be. So by all means be suspicious. Our minds are all part of a slow moving world made all the more inert by interactions which push and pull new ideas in all directions but prevail in rejecting what we do not want to believe. The aether is not wanted by the modern physicist.

If this book has been of interest it has served its purpose. Acceptance is not expected.

In the author's book *Physics without Einstein* a full analysis and detailed quantitative account of the physics of the aether were presented. What was offered was an alternative to Relativity which went further and gave rigorous evaluations of the basic universal constants of physics. The Fine Structure Constant and the Constant of Gravitation were important results but also quantities such as the binding energy of the deuteron and the geomagnetic moment were shown susceptible to evaluation by the aether structure presented. Having discovered or, as some would say, contrived or built such a new theory, it was appropriate in this present work to attack the established theory. Relativity is intriguing because it is so elusive. It is seemingly impregnable. Yet, as we have seen, it has a weakness in respect of boundary criteria. The grand edifice of Relativity is built on the wrong foundation. In this work there has also been an attack on the abstract ideas in the physics of the electron. The alternative offered is an explanation which is no more abstract than the classical physics of the nineteenth century and yet one which actually explains the nature of mass. Above all, the alternative offered is not sterile. It is as fruitful as Nature herself.

The aether permeating and surrounding our earth is contemplated as a uniformly dense positively charged electric continuum containing discrete negative electric charges formed in a lattice array. Because of the translational motion of the earth some of these negative electric charges are free from the lattice as we have already noted in Chapter 4. The lattice determines the electromagnetic frame of reference and moves as a unit in a cyclic motion. The lattice charges are displaced from their neutral positions in the continuum and move in centrifugal balance. This motion determines the time parameter and is necessary to vitalize the aether and prevent a condition of negative electrostatic interaction energy, as may be shown mathematically. The continuum is endowed by the presence of some relatively sparse but massive aether particles which assure dynamic balance by the continuum system and which perform the key role in determining the electromagnetic action we know as gravitation. Also, each such particle is associated with an electron moving with the lattice system. Such electrons qualify the electrostatic interaction state a little and actually prime the aether with energy so that it may sustain gravitational fields. This will, of course, seem very complicated and it is beyond the scope of this work to analyse the aether structure in detail. It suffices here to note that an aether expansion process may occur by which the massive positively charged aether particles expand to become a part of the uniform continuum and the corresponding electron becomes a negative lattice particle. Energy is released in this process, contributing to motion. Moreover, all the elementary particle forms of matter we know can be produced in transitional phases of this expansion process. The massive aether particle has nearly three times the mass of the proton. The creation of matter is a consequence of the expansion of space, the transient by-product of an expansion which permits parts of the aether occupied by such matter to adapt its stable state to a new apportioning of the particle populations.

Now, it appears that matter as we know it, as atoms, protons, etc., can only come into existence if an abundant supply of electrons and positrons is available.* Accordingly, we must anticipate the matter creation process to occur steadily at the unstable boundaries between aether of different polarities. If the earth's aether contains essentially low-mass negative particles, it cannot sustain the matter creation process. Nor can aether, according to the above model, with all polarities reversed. It is at moving boundaries between two such types of aether that we can look for the charge constituents to create matter.

This takes us to the concept that the sun contains aether of polarity opposite to that surrounding it and permeating the planets. The origin of the sun itself is the matter created as the two aethers meld at their interface, the enveloping aether form gradually closing in as the inner aether form appears to shrink by the polarity inversion process. But there is a prime movement of the boundaries owing to the translational motion of the solar system. In this way, atoms are being formed steadily from the aether and emit photon radiation generated from their thermal condition. Probably the nuclear interchanges, as heavier atoms form from the already created proton-sized matter, are the true

* See Chapter 7 of the author's *Physics without Einstein.*

source of the heat generating this radiation. But this account has gone beyond merely asserting a nuclear origin for solar radiation energy. The origin of matter has been traced to the aether. The gradual process of formation of matter as the solar aether shrinks in company with the gradual expansion of space is a feature of this new explanation as is the catalytic action of electric discharge phenomena in transforming the radiation source.

It is still speculation. Where is there any evidence? Well, the reversals of magnetism in astronomical bodies may provide some evidence. Remember that in Chapter 7 it was noted that Dirac said there was no way of distinguishing a star from one in which all the polarities of its constituent charges are reversed. This may be true as between two stars but, if all polarities in a particular star were to reverse, as they would if the aether inverted polarity, there would be a reversal of the magnetic field.

The same is true for the earth. Dirac also envisaged that, for reasons of symmetry, perhaps half the stars were made up of matter of inverted polarity, anti-protons substituting for protons and positrons for electrons.

Applying symmetry considerations to the aether we then may expect aether to comprise vast cubic cells of one polarity interposed between identical cells of opposite polarity as depicted in Fig. 12. Stars are indicated in a random distribution but a star in a region of positive aether would have an aether core of negative polarity on the principles outlined. Further, the symmetry, preserved even as space expands, would ensure that the flat boundaries are stable and not regions for matter creation.

We are still speculating, but at least have the comfort of the similar speculation by Dirac. But now let us examine some interesting evidence.

The solar system moves steadily through space following a curved path about a remote point in our galaxy. The earth shares this motion and every time the solar system passes one of the aether boundaries in Fig. 12 the earth's magnetic field will reverse direction. If the sun moves at right angles to a flat boundary, the earth's field will reverse at regular intervals. More likely is the migration of the sun along an oblique trajectory,

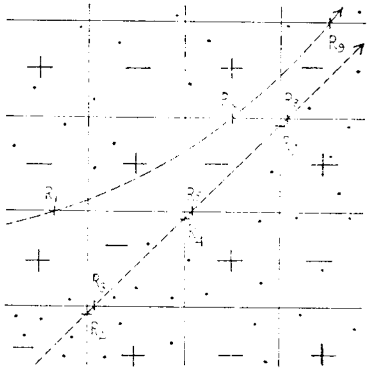

Fig. 12

such as one of those depicted by the broken lines in Fig. 12, and this would result in irregular reversals of the geomagnetic field. However, such irregular reversals would be systematic and could occur rapidly if the solar system passed close to an intersection between the aether boundaries. Three reversals could occur very close to each other in time in this occasional circumstance.

The reversals of the earth's magnetic field are typified by experimental data presented by A. H. Cook in the August 1970 issue of *Physics Bulletin* at page 350. These data are portrayed in Fig. 13.

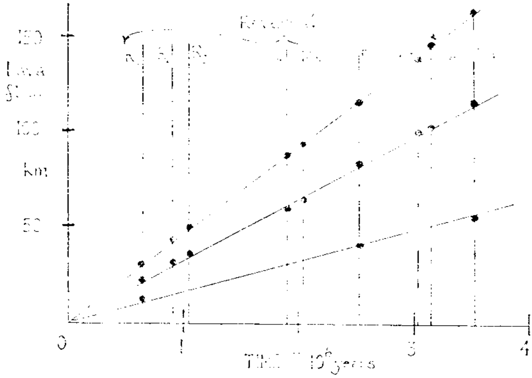

Fig. 13

Compare now these reversal data with a steady rate of progress along the trajectories in Fig. 12. Regard them as depicting motion in a circle from different viewpoints relative to the coordinate system created by the aether symmetry. The reversals in Fig. 13 can be matched exactly by the steady motion depicted in Fig. 12. Reversals are indicated at R_1, R_2, R_3, etc. Further, there is the expected orbital pattern. This provides an assuring check on the proposal that there is an aether with symmetrical polarity inversion as depicted. Interested readers will see that given known data for the speed of the solar system through space, as measured relative to an assumed isotropic cosmic background radiation,* we can work out the cell dimensions of the aether. The lattice spacing is of the order of 300 light years. Also, from the earth orbit evidenced by the magnetic reversal data, an estimate can be made of the distance to the point in our galaxy about which we are moving and the orbital period of this galactic motion. An orbital period of 10^8 years is indicated by the data.

Before ending this book it is perhaps important to comment about the Michelson–Morley Experiment. Traditionally, aether theory has been set in conflict with the null result of this experiment. The author has dealt with this conflict in his previous works† and has really nothing to add that is new. Reference is, however, made to the recent analysis of Ruderfer‡ who has reviewed the subject only to conclude that the aether is very much in evidence and in no way rejected by the Michelson–Morley approach.

Ruderfer writes:

In retrospect, the search for dynamic proof of an ether has been a sterile one. It has distracted us for over a century from what may be stated as the original fundamental question: Is the space between matter a void or a plenum? When approached in this way, the ether may be viewed as a natural extension of the known hierarchal structure of matter—ponderable bodies, compounds, atoms, elementary particles. The relative rapidity of the discovery of this series and the prevalent belief in the existence of an elementary particle substructure

* E. K. Conklin, *Nature*, June 7, 1969, p. 971, gives 160 km/sec.

† The books referred on page 130.

‡ M. Ruderfer, *Lettere al Nuovo Cimento*, Series I, Vol. 3, pp. 658–62, 1970.

presages further structural delineation in the microcosm, conceivably ad infinitum. The ether may then be regarded as the repository of all the submicroscopic structures that may conceivably exist but are beyond present observational limits. The attribution of energy properties to such a plenum inevitably follows. In fact, the measurable QED and the relativistic effects of matter on the vacuum and space–time provide independent support for the necessity of ascribing energy properties to the ether; from the minuteness of these effects of the interaction of matter and ether, it must be surmised that the ether energy density must be much greater than that of matter. That all of the energy of the observable universe may then originate from the ether now becomes plausible.

Later he writes:

In summation, the various physical disciplines appear to be intricately interwoven with the concept of an ether. One may wonder if the widespread rejection of an ether, which primarily derives from the inability to dynamically detect it, is worth the loss of its synergistic potential in physical theory.

This is seemingly a good note on which to end, but why should the reader be left to ponder a philosophical problem? Instead, the reader is offered the stimulating thought that the aether is about to reveal its essential role as a source from which matter originates and into which matter dissipates itself. There is energy conservation but matter is really particles of energy in an intermediate state of decay between their primordial origin (particles having a mass some 5063 times that of the electron) and their primordial destiny (particles of about 0·0408 electron mass units or part of the fluid plenum, depending upon their polarity). These quantities are fully explained in the author's analysis elsewhere.* But now it appears that some further experimental support is at hand. Such particles, as ingredients of the unseen aether, have never been detected directly, but if the aether contains particles of these dimensions what would be their consequence to electromagnetic wave propagation? Might not they affect frequencies corresponding to their annihilation or creation? The related photon frequencies correspond with energies of 2·58 GeV and 20·9 keV, respectively. It is then

* *Physics without Einstein.*

interesting to quote a problem of cosmic X-rays recently reviewed in *New Scientist and Science Journal*:*

> The main stumbling block to progress is the shape of the X-ray spectrum. This has a curious discontinuity at 20–40 keV, usually termed the kink or break; it corresponds to a break at 2–5 GeV in the parent electron spectrum, which is itself hard to explain.

It must ever be remembered that when we look up into space we are not just looking at the stars, but are also looking into the aether. If we see things which are difficult to explain in terms of the phenomena we associate with ordinary matter then perhaps we should take note of the aether and develop our understanding of aether science.

If we want to stay in the laboratory, however, maybe we should turn back to page 28 and question Wilson's experiment with the swinging iron bar. His experiment really tested the effect of swinging the earth relative to a detector on the bar. This is possible if you rely on Einstein's principle, which Wilson did. In an experiment in which he rotated a test specimen relative to the earth frame he did observe a magnetic effect. Of this, he said:

> The current appeared to be due to residual magnetism in the iron case, which could not be got rid of.

This was in spite of the fact that he rotated the specimen about vertical and horizontal axes.

Relativity killed Wilson's experiment, just as:

> Einstein's special relativity killed this idea of the ether. But . . . one can get over the difficulties of reconciling the existence of an ether with the special theory of relativity.

So said Dirac†, but let us not theorize. Rather let us examine these effects which Wilson cannot get rid of.

* Page 287, February 11, 1970.
† P. A. M. Dirac, *Scientific American*, May, 1963, p. 50.

Appendix

The Law of Electrodynamics

Consider two electric charges of equal mass positioned at A and B in Fig. 14. Let the forces AF′, BF denote the electromagnetic field interaction exerted between the charges. The value of AF′ or BF, as an attractive force, is the product of the two charges in electromagnetic units multiplied by the scalar product of their velocities and divided by the square of AB. The velocities of the charges are represented by u, v in the directions AO and BO, respectively, as shown.

We now suppose that an external force acts on the system. The force will be effective through the centre of gravity of the two charges and will be equally apportioned in providing an action AX′ or BX at A and B. The total force on the charge at A is then AX′ + AF′ and this may be resolved into a component AP at right angles to AO and a component AU along OA. Similarly, the total force on the charge at B is BX + BF and this may be resolved into a component BQ at right angles to BO and a component BV along OB.

The nature of the force component BV is that needed to slow down the charge at B, since we assume its speed is changing due to the interaction effects. Then, for there to be no turning action on the system as a whole, this force component must have a counterpart at A. Hence, we equate UX′ and BV. Similarly, for speed changes at A there is the force component AU which is balanced by the force VX induced at B.

Given the positions of A and B, the interaction force BF, and the vector directions u and v, we can then derive the value of the force AX′ or BX from the geometry of Fig. 14. To find the force on B, draw FQ in the direction opposite to u, determining Q by the perpendicular to v from B. Then derive V by drawing FV (shown by the broken line) from F perpendicular to u, V being

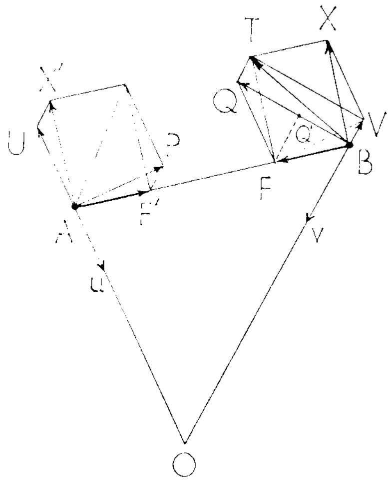

Fig. 14

at the interception with the velocity direction v through B. The electrodynamic force on the charge at B is then BF + BV + FQ, adding to BT.

Note that for action between discrete charges, if u and v are parallel then the force FQ′ applies at B but then BV will cancel FQ′ and so the electrodynamic force on B will act directly towards A.

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