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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

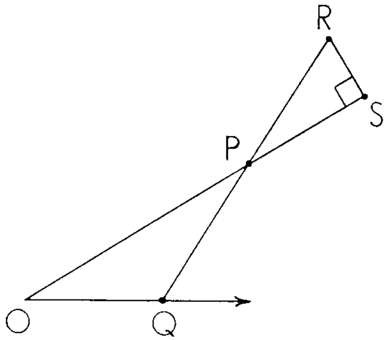

Fig. 7

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

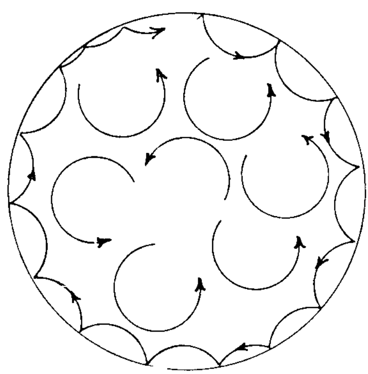

Fig. 8

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

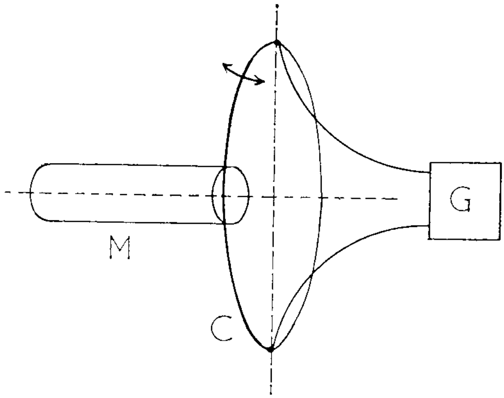

Fig. 9

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.*