PREFACE

"The modern physicist may rightly be proud of his spectacular achievements in science and technology. However, he should always be aware that the foundation of his imposing edifice, the basic notion, such as the concept of mass, are entangled with serious uncertainties and perplexing difficulties that have as yet not been resolved"

Max (Moshe) Jammer (1915 – Year), President of Association for the Advancement of Science in Israel

During the days as a secondary school student at Barewa College, Zaria, Nigeria, in the late 1950s, one had been enthralled by Galileo Galilei's principles of mechanics, Sir Isaac Newton's three laws of motion and law of universal gravitation and Charles Coulomb's law of electrostatics. Galilei's principle of relativity of motion was simple and straightforward. Newton's second law of motion was conceivable and employed for a body acted upon by a force causing acceleration. Newton's law for gravitational force of attraction between two masses, applicable to all bodies in the universe, was imaginable. Coulomb's law, for the electrostatic force of repulsion or attraction between stationary electric charges, was comprehensible.

On the other hand, right from the days as a student of physics at the University of Manchester in England, in the early 1960s, one had been uncomfortable with Albert Einstein's theory of special relativity and theory of general relativity and Max Planck's and Niels Bohr's quantum theories. One found inconceivable the principle of constancy of the speed of light, the relativity of space and time and the prediction of increase in mass with speed resulting in the mass of an electron becoming infinitely large at the speed of light, according to special relativity.

The idea of time being a fourth dimension of space, making a four-dimensional space-time continuum, and the concept of curving or warping of space-time, due to the presence of matter, to create gravitational force of attraction between masses, according to the general theory of relativity, were unimaginable. Bohr's quantum theory of the hydrogen atom was incomprehensible. Was one misplaced or out-of-date or being too incredulous or had one been naïve, simple or stupid or have we deviated too far from the right road and got lost? Certainly, nature could not be so complicated and inconsistent, one had thought.

Throughout the undergraduate student days, one pondered on the theories of special and general relativity, quantum mechanics and Rutherford-Bohr's model of the hydrogen atom, regarded as great triumphs of the human mind and the greatest achievements of modern physics. This issue of greatness boiled down to a choice between expressing one's mind and suppressing it. Under some mental agonies and at the risk of jeopardizing one's scholarship, one opted to forego academic expediency and to express one's mind openly. One rejected the principle of constancy of the speed of light, questioned the prediction of increase of mass with speed, doubted the relativity of space and time, objected to Bohr's quantum mechanics, ventured to ask a few questions and made some propositions. For, as the philosopher and dialectician, Peter Abelard (1709 – 1142) said, *"By doubting we come to question, and in questioning, we perceive the truth"*.

Did the mass of an electron actually increase with its speed, becoming infinitely large at the speed of light, as predicted by special relativity, while its electric charge remained constant? If free space contained "nothing", how could "it" be warped by "time" which is also non-substantive? How could warping of space-time continuum, due to the presence of matter, create gravitational force of attraction between bodies, in accordance with general relativity?

Was Coulomb's law really independent of velocity of the electron, as supposed by classical and relativistic electrodynamics? If not, how did Coulomb's law apply to a moving electron accelerated by an electrostatic field? Was there something else, other than mass becoming infinitely large at the speed of light, which makes that speed as the maximum attainable by an electron, under the acceleration of an electrostatic field?

Back home in 1965, as a physics graduate and teacher, with the fact that electrons were easily accelerated, by an electric field, to the speed of light, in one's mind, one resolved to go back to the basic principles, as demonstrated by Galileo Galilei or formulated by Sir Isaac Newton or enunciated by Charles Coulomb, and do something to bring about an alternative electrodynamics applicable up to the speed of light, with mass of a moving electron remaining constant. At the same time, it is hoped, to provide some good and invigorating materials for teaching mathematics and physics; science subjects in which students appear to be deficient.

In the course of studies and research in mechanics, electrostatics, electromagnetism and electrodynamics, *aberration of electric field* was

found to be the missing link in classical and relativistic electrodynamics. In many years of research, by fits and starts, through trials and errors and after countless presentations, untold distractions and endless rejections, success was achieved, as presented in this book, under the heading: ***"Electrodynamics for a particle accelerated to the speed of light with constant mass"***.

Radiational electrodynamics is the new electrodynamics that makes the accelerating force, exerted by an electrostatic field, on a moving electron, dependent on its velocity. This dependency is due to *aberration of electric field*, which results in a *radiation reaction force*. Work done against the *radiation reaction force* appears as radiation.

Aberration of electric field, due to motion, is a phenomenon similar to aberration of light discovered by the English astronomer, James Bradley, in 1728. "Aberration" (which means: *deviation from the normal or departure from the stationary*), is a phenomenon observed as a displacement of the direction of the electric field intensity (or light ray) from a source, as a result of motion of a body (or an observer).

Radiational electrodynamics actually involves an extension of Coulomb's law to a moving electron accelerated by an electrostatic field. Newton's second law: (force = mass × acceleration) remains valid, with constant mass, but the accelerating force, due to some kind of impacts on the electron, depends on the velocity of the electron. This aspect of force is treated in line with the concept of the Greek philosopher, Aristotle (350 BC) [1, 2], who maintained that force could only be communicated between bodies by impacts or pressure. An impact is due to a change in momentum as a result of one body impinging on another body.

Consider the force $q\boldsymbol{E}$ on a body of charge q in an electrostatic field of intensity $\boldsymbol{E}$, as due to the "impacts" of infinitesimal "particles" each of mass ξ moving at the velocity of light $\boldsymbol{c}$ in the direction of the field $\boldsymbol{E}$. A "particle" impinging on a stationary body, under a perfectly elastic collision, will recoil with velocity $-\boldsymbol{c}$ and change of momentum equal to $2\xi\boldsymbol{c}$. With η impacts per second, the rate of change of momentum, equal to the impressed force, is $2\eta\xi\boldsymbol{c} = q\boldsymbol{E}$. This gives $2\eta\xi = qE/c$. A "particle", of mass ξ, striking a body moving in the same direction with velocity $\boldsymbol{v}$, will recoil with velocity $-(\boldsymbol{c} - 2\boldsymbol{v})$ and change of momentum equal to $2\xi(\boldsymbol{c} - \boldsymbol{v})$. The accelerating force, from η impacts per second, is $\boldsymbol{F} = 2\eta\xi(\boldsymbol{c} - \boldsymbol{v}) = qE/c\,(\boldsymbol{c} - \boldsymbol{v})$. Newton's second law of motion, for a body of mass m moving with velocity $\boldsymbol{v}$ at time t, gives the accelerating force as:

$$\mathbf{F} = 2\eta\xi(\mathbf{c}-\mathbf{v}) = \frac{qE}{c}(\mathbf{c}-\mathbf{v}) = m\frac{d\mathbf{v}}{dt} \qquad \text{(i)}$$

Equation (i) is the basic expression of *radiational electrodynamics*.

In *radiational electrodynamics*, the difference between the accelerating force ***F*** on a moving charged particle and the force ***qE*** on a stationary charged particle, is the radiation reaction force $\boldsymbol{R}_f = qE/c(\boldsymbol{c} - \boldsymbol{v}) - q\boldsymbol{E}$. If ***E***, ***v*** and ***c*** are collinear, the radiation reaction force is obtained as $-(qv/c)\boldsymbol{E}$ and radiation power, scalar product $-\boldsymbol{v}.\boldsymbol{R}_f$, is qEv^2/c. Radiation power is zero (0) in circular motion where ***v*** and $\boldsymbol{R}_f$ are orthogonal. Work done against the radiation reaction force appears as light or heat. This aspect of radiation, missing in classical and relativistic electrodynamics, informed the choice of the name: *radiational electrodynamics*.

The book is composed in nine separate chapters, as papers 1 – 9, with five appendices. A good knowledge of mechanics, electrostatics, electromagnetism and electrodynamics and a grasp of vector algebra and calculus are required to follow the presentations made in the papers.

In the first paper, titled *"An alternative electrodynamics to the theory of special relativity"*, it is proposed that the speed of light c is an ultimate limit, not because mass of an electron increases with speed becoming infinitely large at the speed of light, but as a result of accelerating force, exerted by an electrostatic field on a moving electron, reducing to zero at that speed. While mass remains constant, the accelerating force on a moving electron becomes zero at the speed of light c and the electron continues to move at that speed as a limit. It is also shown that an electron of charge $-e$ and mass m, equal to the rest mass m_o, revolves in an electrostatic field of magnitude E due to a positively charged nucleus, in a circle of radius r given by:

$$r = \frac{mv^2}{eE\sqrt{1-\frac{v^2}{c^2}}} = \frac{m_o v^2}{eE\sqrt{1-\frac{v^2}{c^2}}} = \gamma r_o \qquad \text{(ii)}$$

where $m = m_o$ and $r_o = m_o v^2/eE$ is the classical radius. This variation of radius of revolution, in equation (ii), has the same effect as increase of mass with speed, according to the relativistic mass-speed formula:

$$m = \frac{m_o}{\sqrt{1-\frac{v^2}{c^2}}} = \gamma m_o \qquad \text{(iii)}$$

The second paper is titled: *"Revolution of a charged particle round a centre of force of attraction"*. Here, it is shown the revolution may be by an electron going round a positively charged stationary nucleus or the motion may be by two particles, of equal and opposite charges and the same mass, going round their centre of mass. Circular motion of an electron, round a centre of revolution, is shown to be without radiation and inherently stable, outside quantum mechanics. In the stable state, charged particles revolve in circular coplanar orbits round a centre of attraction. Radiation, at the frequency of revolution, occurs only when a charged particle is dislodged from the stable circular orbit. An excited particle revolves in an unclosed elliptic orbit with emission of radiation, in many cycles of revolution, before settling back into the stable circular orbit. Interactions between particles moving in different orbits, gives radiation of discrete frequencies as given by the Balmer-Rydberg formula for the spectrum of the hydrogen atom.

The third paper titled: *"A nuclear model of the hydrogen atom outside quantum mechanics"*, introduces a new nuclear model for the solid or liquid state of the hydrogen atom. It consists of a number N_h of coplanar orbits. In each orbit, a particle carrying the electronic charge $-e$ and a multiple nm of the electronic mass m, revolves round under the attraction of a nucleus of charge $+eN_h$. The number n (1, 2, 3… N_h) leads to quantization of the orbits. A particle revolves in the nth circular orbit, without radiating, or it moves in an unclosed (aperiodic) elliptic orbit, in many cycles of revolution, emitting radiation, before reverting back into the nth stable circular orbit.

The fourth paper titled: *"A non-nuclear model of the hydrogen atom"*, introduces a non-nuclear model for the atom of hydrogen gas. It consists of a number N_h of coplanar orbits. In each orbit, two particles carrying the electronic charges e and $-e$ and a multiple nm of the electronic mass m, revolve in the nth orbit, under mutual attraction, round their common centre of mass. If a particle is disturbed by being dislodged from the nth circular orbit, it moves in an unclosed elliptic orbit, with emission of radiation, before reverting back into the nth circular orbit.

The fifth paper comes under the title, *"On the speed of light in a moving medium"*. Here, monochromatic light emitted by a stationary source is incident normally on the plane surface of a medium of refractive index μ, moving with speed v in a vacuum, in the normal direction. The speed of transmission w, in the medium, is derived as:

$$w = \frac{c}{\mu} + v\left(1 - \frac{1}{\mu}\right) \qquad \text{(iv)}$$

where c is the speed of light in a vacuum. The speed of light c is an absolute constant relative to the source. This simple equation (iv) is used to give a non-relativistic explanation of the result of Fizeau's experiment, which measured the speed of light in moving water, without recourse to the theory of special of relativity.

The sixth paper, titled, *"On the energy and mass of electric charges in a body"*, clarifies the origin of inertia. The mass m of an electric charge, in terms of electrical quantities, is deduced as proportional to the square of the charge. It is then shown that the electrostatic energy of a body of mass M, containing a distribution of equal number of positive and negative electric charges, is $\frac{1}{2}Mc^2$. The total energy E of a mass M, moving at speed v, with kinetic energy $\frac{1}{2}Mv^2$, is then obtained as:

$$E = \frac{M}{2}\left(c^2 + v^2\right) \qquad \text{(v)}$$

Equation (v) is in contrast to the mass-energy equivalence law of Einstein's theory of special of relativity, which gives:

$$E = Mc^2 = \frac{M_o c^2}{\sqrt{1 - \frac{v^2}{c^2}}} \qquad \text{(vi)}$$

where M_o is the rest mass and the relativistic mass M becomes infinitely large at the speed of light c. Equation (vi), with infinite mass at speed $v = c$, is the main issue in the sixth paper. An infinite mass, which is the mass of the whole universe, is not tenable at a point anywhere in space.

The seventh paper, under the title, *"A unification of electrostatic and gravitational forces"*, shows that the electrostatic forces of repulsion and attraction, between the masses of two neutral bodies, in accordance with Coulomb's law, cancel out exactly. The gravitational forces, being proportional to the product of the masses, also proportional to the product *of* the sum of squares of the electric charges in one body *and* the sum of squares of the electric charges in the other body, add up to constitute the force of attraction due to gravity, in accordance with Newton's universal law of gravitation. This result of *radiational electrodynamics*, making gravitation as electrical in nature, offers a simple explanation of the long-awaited unification of electrostatic and gravitational forces. It is an exciting discovery which should put general relativity to rest.

The eighth paper gives an explanation of the result of Roger's experiment with electrons revolving in a circle and Bertozzi's experiment with high-energy electrons moving in a linear accelerator, without recourse to special relativity. The results of both experiments are in agreement with *radiational electrodynamics* on the basis of accelerating force decreasing with speed, reducing to zero at the speed of light.

The ninth paper treats longitudinal and transverse waves created by oscillating atomic charged particles. While the longitudinal waves, between the oscillating particles, are absorbed by the particles, manifesting as heat, the transverse waves are emitted as light radiation.

In *radiational electrodynamics*, *mass* is not a fundamental quantity of measurements. The fundamental quantities are put as *Length (L)*, *Time (T)*, *Electric Charge (Q) and Electric Voltage (V)*. In this (Metre-Second-Coulomb-Volt) system of measurements, the dimension of *mass (M)* is $[L^{-2}T^{2}QV]$. There is no fractional exponent of the dimension of a fundamental quantity *(L,T,Q or V)* in the dimension of any derived quantity, such force or energy.

We are under no illusion that these nine papers on *radiational electrodynamics* would gain easy acceptance, far less from the physics establishment committed to the current theories. Often, physicists dwell on complicated mathematics rather than seek simple explanation of a physical phenomenon. Indeed, every phenomenon in nature has a simple explanation and a mathematical expression, subject to experimental verification. Experiments do not lie, but interpretation of the results might be wrong and, consequently, the mathematical expressions and theoretical explanation might be complicated and lead to wrong ideas.

It is said, *"Great ideas changed the world, but the greatest idea is founded on simplicity"*. Simplicity, it seems, is seldom a criterion for the acceptance of a new idea. Nowadays, the more complicated a theory is the more likely to engage the academics and impress the students. However, a theory too complicated to be understood by an intelligent and conscientious student, is probably wrong. For a student, the grounds for belief in any scientific theory are not just its complexity or acceptance in the academia or the authorities of the masters but its simplicity and consistency in nature and natural sense. Nature, when unraveled, is found to be simple, consistent, beautiful and wonderful.

Attempts to get the papers published in reputable scientific journals, at home and abroad, had failed. Publishers tend to restrict their journals

to one discipline. So, papers with interdisciplinary approach, even closely related ones like Mathematics, Physics and Engineering, might not find a place for acceptance. Also, most referees and reviewers of papers would rather promote their specialties and protect their interests than consider submissions from outsiders, intruders, skeptics or dissenters. One referee rejected a paper from the author on the grounds that it would have amounted to "re-writing the books". Who is afraid of re-writing the books? Surely, if books had not been re-written, knowledge would have been stale and referees would have had no work to do! By the grace of God, learning will progress, often with new advances from unexpected quarters. We thank the Almighty God for giving us the power to produce this work. The assistance and encouragements from our students, friends and well-wishers, are gratefully acknowledged.

For some time now the author has resorted to communicating the results in these papers by way of speeches, lectures, newspaper articles, advertisements, letters and self-financed publications, as in this book, and through the Internet. The communications have been targeted mainly at students, the young generation that is enlightened and least blighted by habits and prejudices. There is a strong tendency among us, the older generation, to keep behaving and believing in the old ways. We forget that advances in science, which we now so vigorously defend, were made mostly by persons who dissented. They defied suppression by authority and dared to speak their minds, contrary to the accepted doctrines. This was what the greatest scientist of all time, Galileo Galilei of Pisa, did and he was punished for it and left to be disgraced and he suffered alone.

Let us end this preface with the words of the most celebrated physicist, Albert Einstein, man of the 20th century, who pleaded:

> *"I beg you please to overcome your aversion long enough in this instance to read this brief piece as if you had not yet formed any opinion of your own but had only just arrived as visitor from Mars."*

I thank the reader for the attention and hope that this book is found as stimulating as much as I enjoyed writing it. I beg forgiveness for any mistake or presumption in the book and plead for corrections and amendments accordingly.

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