1.1 Introduction

In the development of scientific knowledge, the general belief is that everything that exists has a 'self', an intrinsic nature, which scientific method, over the decades and centuries, is capable of cataloging in a way that is both correct and exact. The Universe exists in a way that is just exactly so, and by carefully sifting evidence which we get from asking the right questions, humans can discover the absolute nature. But the experimental science holds that scientific theories and models of the universe are valid only in the sense that they are useful in predicting events and explaining data consistently, while at the same time making no claim that any thing they describe actually exists.

The Cartesian model says that the world is made of particles of matter, whose behavior was described in classical terms of collisions like the ones that we see on our scale. As research exposed more of the micro-world, physicists continued to describe it in visual terms, which had analogues in the macro world. When the electron was first introduced into the theories, the two main atomic models were the Plum Pudding (electrons embedded in the nucleus) and the Planetary (electrons orbiting the nucleus) models. The effect of the quantum revolution was to force the experts to admit that there was no longer any way to visualize the
electron wave/particle by analogy to anything on our scale. All they could use to relate what they considered to be the reality of the electron was a simple mathematical description.

One should develop a hypothesis that 'doesn't contradict the world' and explain the data neatly and cleverly, but don't expect to describe ontological reality. The realist may retort that the mathematical description is valid as the 'visualization' of the atom, in fact, it is really the most accurate model. Stemming back to the days of Pythagorean, who maintained that numbers were reality, itself, western thought has tended to accord mathematics special status as axiomatic truth. However, developments such as non-Euclidean geometry in the last century, made it difficult to rely on the axioms of mathematics for absolute proof of anything other than statements made within the framework of the mathematics itself. In fact, mathematical truths are just as conventional as the laws of physics and hence we use mathematics to describe physical phenomena. These things are handy as experience filters, but they have no reference to physical fact. Theories of subatomic particles can be as logically self-consistent, but the whole scheme is entirely arbitrary.

It may be pointed out that for a given observed phenomenon, there can be many theories, which provide a rational explanation. Each one is consistent with itself, but at the same time each could contradict the explanation offered by other theories. The history of science is full of examples. For instance, in the midst of the 'Copernican revolution',
astronomers had a choice between a heliocentric or a geocentric model of the universe. Both had advantages and drawbacks, each was consistent with the data available, neither was better than the other at predictions. Debate about the nature of light, whether it was a wave or a particle, continued from Newton’s time until Einstein; more than two hundred years, relating light experimentally, without any proof of what it really is. Of course, the current explanations for the vast group of phenomena that fall under the category ‘light’ is not what it was ten years ago, nor for that matter can two scientists have exactly the same conception of light. If the scientific method is supposed to eliminate all false hypotheses in order to arrive at the truth, the truth will never be found because of the infinite number of hypotheses possible.

In our every day experience there is nothing mysterious or ambiguous about the concept of particles and waves. In science there are only two modes of propagation of energy namely by particle motion and the wave motion. There are two mathematical formulations, the particle mechanics and the wave mechanics. Any physical phenomenon is described completely by any one of these mathematical formulations. A stone dropped in to water and the ripples that spread out from its point of impact apparently has in common only the ability to carry energy and momentum from one place to another.

Classical physics, which mirrors the physical reality of our sense impressions, treats particle phenomena as two separate components of
that reality. The mechanics of particles and optics of waves are traditionally independent disciplines, each with its own chain of experiments and principles based on their results. The physical reality has its roots in microscopic world of atoms, molecules, electrons and nuclei. But the modern concept is that they are neither particles nor waves. The electrons are considered as particles because they possess charge and mass and behave according to the laws of particle mechanics. It is as correct to interpret a moving electron as a wave manifestation as it is to be interpreted as a particle manifestation. The propagation of energy in the form of electromagnetic waves is described by a set of equations, which are unique of wave phenomena.

1.2 Matter and Energy

Matter and energy are supposed to be the two realities of the physical world; this happened to be the scientific truth that is becoming more and more accessible to common people, because of its common and deep practical implications in social life, displayed by technological and industrial progress. Man by observing physical phenomena directly or indirectly, with in his reach of sense perception, is led to interpret them from point of view of a general postulate of philosophical nature.

The reciprocal transformation of the two physical realities, matter and energy is widely known. By means of nuclear reactions, immense reserves of energy condensed in matter have been made available. The
principle of conservation of energy imposes itself as an indispensable basis for the interpretations of physical phenomena. The science with its theoretical foundations consolidated with in an exclusively materialistic view revealed it contrary to consider energy, since energy is not within the reach of sense perception. The substantiality of energy was left out of question when the inevitable impasse arose out of the necessity when scientists tried to interpret on a scientific basis, the apparently conflicting formulations, the mechanical as well as electrical phenomena. In due course inexplicable and irreconcilable paradoxes emerged out in the theoretical formulations that harmonize the conflicting aspects and physical facts and events. Mathematics is put to severe inadequacies that have to be admitted in order to preserve the framework of physical laws and theoretical formulations.

In its general features, the crisis of physical sciences will go on surmounted as long as one persist admitting nothing but matter as the real consequence and real constituent of the physical world. The acknowledgement of energy, as a physical entity subtler than matter and indirectly perceptible to human eyes was established as the first step for science to approach with equal objectivity to the phenomena.

At present the acknowledgement of charge and the field, both imperceptible for the human sense, has become inevitable. The energy is some thing that is associated with the fields and fields only. The energy and fields are now considered as the two basic constituents of physical
world, because mass is simply another form of energy, perceptible to
human senses. The charge is to be recognized as the third important
physical entity, since charge and fields are inseparable.

Based on charge neutrality theorem and superposition theorem along with
basic electromagnetic laws, the supremacy of charge and fields as primary
constituents of matter is to be established.

1.3 Energy Conservation

There is a fact, a law, governing all phenomena that are known to
date. The law is called 'law of conservation of energy'. There is certain
quantity, which we call energy that does not change in the manifold of
changes which nature undergoes. It is a mathematical principle. The law
says that there is a numerical quantity, which does not change when some
thing happens. The energy has a large number of different forms, and
there is a formula for each one. The heat and mechanical energy, mass
energy, chemical energy, electrical energy, radiant energy are some of the
various forms of energies. It is to be realized that energy does not exist as
itself. In one way or other, this abstract physical entity is associated with
some other physical entity. We have so far no knowledge about what
energy is. However there are formulas for calculating some numerical
quantity, which is recognized as energy. It does not tell us the mechanism
or reason for the various formulas.
The energy, which has to do with the location relative to some thing else, is called potential energy. The general principle is that the change in energy is the force times the distance the force is pushed. The kinetic energy is that possessed by a body by virtue of its motion. An elastic string in its stretched condition has the possibility of doing work and is said to possess energy. This elastic energy, as the spring passes through equilibrium position, is converted in to kinetic energy of motion. As it goes back and forth between compressing and stretching condition of the string, the elastic energy and kinetic energy alternate one in to another. When the string finishes moving back and forth, another form of energy is brought in-the heat energy.

1.4 Fields- Reservoir of Energy

The electrical energy is some thing pushing and pulling by electrical charges. The radiant energy, the energy of light, is nothing but coupled electric and magnetic field variations that move with the speed of light which exhibit typical wave behavior. The chemical energy is due to the geometry of charge distribution-particularly of electrons in the formation of atoms and molecules. The matter is nothing but the permutation and combination with a specific geometry and structure of charged particles - of course along with neutron, which is again a combination of still subtler charged particles, namely quarks. The mass energy, the nuclear energy \( E=mc^2 \) is realized as radiant energy and as
kinetic energy. An object possesses energy by its sheer existence. The nuclear energy is due to the arrangement of nuclear particles inside the nucleus. In all the above physical phenomena we see that any form of energy is electrical in nature. One way or other there is a link between one form of energy and the other. The only one kind of energy that so far has evaded this generalization is kinetic energy of moving objects. The kinetic energy, which is in equivalence to heat energy which exhibits itself as the lattice energy of oscillating charges, is a function of mass and hence the force of inertia. There cannot be a second argument in expecting that all forms of energy to have a common origin—an origin that is of course from charges and fields.

The law of conservation of energy is most useful in making analysis and deriving the mathematical formulas to all natural phenomena. A positron and an electron standing still and doing nothing when they come together just disappear and radiant energy is radiated in a definite amount which can be exactly calculated. In whatever form the energy exists, the fundamental feature of the energy is linked with charges and fields. The chemical energy is something associated with charges and their related fields. The elastic energy is nothing but electrical energy arising out of the geometry of charges. The radiant energy is nothing but coupled electric and magnetic oscillations propagating in space with the speed of light.

Of all the forms of energies, the mechanical energy, both kinetic and potential energies, though unified with thermal energy in the law of
mechanical equivalence with heat, that resulted in the industrial revolution of the last century, apparently seems to have no direct link with charges and fields. The mechanical energy, mainly a function of mass, and mass being a collection of charges both positive and negative should necessarily have its origin to charges and fields. Hence inertia, the root cause of mass must be due to the interaction of charges with some hither to unknown aspect of space.

1.5 Inertial Momentum and force

The discovery of laws of mechanics was a dramatic moment in the history of science. The motions, linear as well as oscillatory, motion of planets with their minute perturbation due to other planets were easily computed from Newton's laws of motion. Galileo made a great advance in the understanding of the principle of inertia. If an object is left alone, is not disturbed, it continues to move along the straight line with a constant velocity if it was originally moving or it continues to stand still if it was just standing still. The next requirement is a rule for finding how an object changes its speed if some thing is affecting it. The specific way of determining the change in the velocity of a particle under different influences (forces) is called Newton's second law. The time rate of change of a quantity called momentum is proportional to the force, the momentum being defined mass times velocity. The term mass is a quantitative measure of inertia. The effect of force varies inversely as
mass. Newton and Galileo gave the definition for mass but inertia of an object is taken for granted. It was accepted that inertia is an innate property of matter by nature. The origin of inertia and mass, the entities that accommodate mechanical energy, has something to do with surrounding space where the object exists. All energy-storing mechanisms have their origin to electrical charges and their fields. The argument may be arrived from the consideration of the law of conservation of momentum also.

According to Newton, the total momentum of any interacting system does not change because of any mutual interaction between them. The increase in momentum of one due to the other is exactly compensated by the decrease of the same in the second due to the first, if we consider a two-particle system. When two bodies of equal masses collide with equal speeds and then rebound, for a brief moment when they are in contact both are compressed. At the instant of maximum compression they both have zero velocity hence zero kinetic energy. The bodies are immediately decompressed in a kind of explosion and fly apart again. If this speed of rebound is less than the initial speed, there is a net loss in the kinetic energy. Where did the kinetic energy gone? Definitely the difference in kinetic energy is within the bodies as heat energy as vibration energy of the lattice associated with charges. The random motion of atoms of a closed system furnishes a measure of heat energy, if squares of velocities are summed up. This sum will be a positive quantity having no directional
character. The heat energy is there, whether or not the body moves as a whole.

1.6 Momentum in Electromagnetic fields

The conservation of energy in the form of heat is not obvious. On the other hand, if the velocities are directly summed, the sum has a directional character and as a result there is a drift of the body in a particular direction and such gross momentum is readily observed. Therefore, the momentum, mechanical quantity is difficult to hide. Nevertheless momentum can be hidden in electromagnetic fields.

One of the propositions of Newton was that the interactions at a distance are instantaneous. It turns out that such is not the case. In situations involving electrical forces, if an electric charge at one location is suddenly moved, the effect on another charge at another place does not appear instantaneously. There is a delay. In those circumstances, even if the forces are equal, the momentum will not check out; there will be a short time during which there will be trouble, because for awhile the first charge feel a reaction force and will pick up certain momentum. But the second charge has felt nothing and has not changed its momentum. It takes time for the influence to cross the intervening distance, which it does at the speed of light. During that tiny interval of time, the momentum is not conserved. Of course when the second charge has felt the force of the first one, the momentum equation will checkout all right,
but during that small interval momentum is not conserved. How do we account for this? During this interval there is another kind of momentum besides that of particle momentum, which is the momentum of the electromagnetic field. If we add the field momentum with the momentum of the particles then the momentum is conserved at any moment all the time. The fact that the electromagnetic field can possess momentum and energy makes the field very real. The better understanding of the original proposition that there are just forces between the particles has to be modified to the idea that the particles make a field and a field acts on a particle. The field itself has such familiar properties as energy content and momentum, just as particles can have.

An electromagnetic field has waves, which we call light, when impinges on objects it carries in a certain amount of momentum per second. This is equivalent to a force. Light can exert a force by bombarding an object. Though this pressure is very small, it is possible to measure this force with sufficiently delicate instruments.

1.7 Force fields

Although it is interesting to study the physical laws simply because they help us to understand and use nature, one ought to stop every once a while and think ‘what do they really mean?’ The meaning of any statement is a subject of interest and troubled philosophers from time
immemorial. The meanings of physical laws are even more interesting and it is believed that these laws represent some kind of real knowledge.

Let us examine the meaning of the laws of Newton. The meaning of force, mass and acceleration is to be properly understood. We can intuitively sense the meaning of mass and we can define acceleration if we know the meaning of position and time. The concept of force is to be given an extra emphasis. If a body is accelerating, then there is a force in it. The force is mass times acceleration is the most precise beautiful definition of force. The law of conservation of momentum is valid if the sum of all external forces is zero. The real meaning of force should be some thing different. The force will be defined completely only when the reason for the requirement of a force to generate acceleration is properly understood. The Newton's law is simply an observational law. It does explain why a force is necessary to change the state of a system. The force is supposed to have some independent properties, in addition to the law $F=ma$, but the specific independent properties that force should embody were not completely described by Newton or by any body else. The forces should be very simple by nature. A complete law of gravitation is simplest form of forces. If there were nothing but gravitation, then the combination of gravitation and Newton's law would have been a complete theory.

The electrical forces are considered to be more fundamental than any other forces. Objects carry electrical charges, which consist simply of
electrons and protons. If any two bodies are electrically charged, there is an electrical force between them. In the analysis of the most fundamental kind, an interesting and important concept of fields has been developed. Experience has shown that the concept of fields is of great utility. A charge produces a field and a field exerts force on the charge. A very important aspect of the concept of fields is the principle of superposition, which states that the total field at any point due to a large number of charges making the fields is the vector sum of the fields due to the individual charges.

The molecular forces are forces between atoms. These forces have never been explained on the basis of classical physics. However, the force between atoms is understood to be fundamentally electronic in origin. The attractive forces between two atoms at relatively short distances are attributed to the dipole-dipole force. When the atoms or molecules get closure they repel each other. The molecular forces are due to vastly complex interactions of all the electrons and nuclei in one molecule with all the electrons and nuclei of the other. At a certain distance \( d \) the resultant of the forces is zero, so that the atoms are held in equilibrium at that distance apart from one another. At the equilibrium distance the forces are so poised that there exist a balance under the action of the forces.

If the atoms are pushed together than the equilibrium distance by an external influence, the repulsive force is generated due to the proximity of
the positive nuclei and the external force is counter balanced. If the atoms are pulled away the attractive force is enhanced, but when the stretching force exceeds attractive force, the atoms get separated, the bond is said to be broken. In many circumstances, if the displacement is not too great, the restoring force is proportional to the deformation and the body is restored in its original position. When the distortion is too large, the body is torn apart or crushed, depending on the kind of distortion. Hook’s law governs this behavior and the limiting force for which this law is valid depends on the nature of the material, determined by the geometry of distribution and the number of charge particles.

The forces that have not revealed their origin and till date retain themselves hidden in mystery are the nuclear forces. These forces have a very tiny range, which is just about the same as the size of the nucleus. With particles so small and at such tiny distance, only quantum mechanical laws seem to be valid. Any formula that can be written for nuclear forces will be an approximation. The nucleons themselves being positive cannot by themselves change their fundamental character of repulsion as they approach each other to such small distances. The space, which they occupy, should have some thing to do with the nuclear forces. The various attempts to understand the nuclear forces have led to the discovery of numerous strange particles, but the origin of these forces remain obscure.
One of the most important characteristic features that were attributed to force was its material origin and this is not just the definition. In dealing with the force, the assumption is made that the force is zero unless some physical body is present. If we find a force that is not equal to zero, we also find some thing in the neighborhood of the source of that force. This idea of force is to be reassessed. Having identified the electromagnetic field to possess momentum and energy, the force field is to be recognized to exist independently. The force experienced by a body is the effect of the force field. We cannot ignore the force field simply because there is no material body over which the force field produces its effect.

1.8 Absolute frame of reference

The problem of absolute motion of bodies, namely the motion with respect to a fixed frame of reference and interpretation of various experimentally observed facts in terms absolute motion has formed a burning question in physics for more than a century. Newton was forced to admit that the absolute motion of a uniformly moving system could not be detected by mechanical experiments conducted with in the system [1]. But with the recognition of the wave theory of light, a new element, unknown to Newton was introduced in to the problem of absolute motion. For the wave nature of propagation of light, even under its most universal electromagnetic form, given by Maxwell, demanded the assumption of a hypothetical medium called ‘ether’
which filled uniformly all space and penetrated all matter. It was supposed that
all heavenly bodies move freely through ether and light originate and propagate
through the same ether [2].

With the introduction of the ether, an all-pervading medium, scientists
became more hopeful of tackling the old problem of absolute motion of bodies,
left unsolved till then by mechanical means, by the use of optical instruments.
They asked themselves the simple question: what happens to ether when
heavenly bodies physically move in the sea of ether? If ether is carried along
with the moving material bodies there will be no relative motions between the
two, so that there is no change in the velocity of light relative to the material
bodies. The absolute motion relative to ether could not be detected by optical
phenomena. If the ether remained in space while the material bodies are in
motion, there will be a relative motion between the ether and the material body
and hence there will be a change in the velocity of light relative to the material
bodies, on account of their motion in ether. As a consequence, optical
instruments could detect the absolute motion relative to the ether. The increase
in the precision of determination of optical paths, by means of interferometer of
A.A. Michelson, led to the anomaly that it is impossible to detect the existence
of an ‘ether drift’ required by the theory of steady state ether [3].

But the problem received different solutions from different scientists. Hertz
is of the opinion that ether was completely carried along by the moving bodies.
Fresnel and Fizeau held that ether was partially carried by the moving bodies.
Lorentz [4] on the other hand, defended a stationary ether hypothesis,
maintaining that ether was absolutely at rest, even that part of it which penetrated the moving bodies.

The difficulties and anomalies encountered in different solutions of the problem of absolute motion through ether suggested to scientists that the very concept on which the question was framed might after all be wrong. This was exactly what occurred to Einstein and made him to suppress ether altogether and thereby does away with the problem proposed. Einstein proposed a radically new idea that motion through ether is a meaningless concept, while motion relative to material bodies alone has physical meaning and significance. This smashing of time honored hypothesis of absolute motion had to be brought in to alignment of the known laws of optics.

The existence of ether has long remained a necessary axiomatic assumption in the explanation of all natural phenomena such as gravitation, propagation of energy in vacuum electric and magnetic fields etc in which there is apparently action at distance. It had to be defined by the exigencies of the circumstances and was supposed to be rarer than the most rarified gases, which penetrated all the matter and did not offer any resistance to the propagation of light waves and motion of bodies. At the same time, it had to be most rigid solid to account for transverse nature of light waves demanded by polarization. It appears to be endowed with intrinsic properties, which are quite contradictory. But such an ether theory was the life-center of Fresnel’s elastic solid theory of light waves. First, there is the nature of the medium in which the undulations occur, the so-called ether. There is by no means the case, but at
least we know that there is nothing remotely resembling a fluid or solid medium with mechanical waves running through it [5]. More important for our purposes is the fact that knowledge of properties of light waves traveling in free space does not tell us about light. It does enable one to understand its emission or absorption or predict what will happen when the waves move from air into glass or vice versa. Maxwell’s electromagnetic theory of radiation dispensed ether as the medium, minimized the difficulty to some extent.

Einstein [6], however, was impressed by the fact that Maxwellian electrodynamics led to asymmetries, which did not show themselves in any observation. Reflections such as these, combined with insoluble problem concerning motion in ether, led Einstein to first reduce ether to a mere shadow and ultimately ignore it, adopting a fundamental principle that relative motion alone determine the nature of all phenomena. Einstein has nowhere denied the existence of ether. He has left the problem an open question, being satisfied with the fact that all-natural phenomena can be adequately explained without the intervention of ether. It is the opinion of most of the physicist that if ether does not exist, one shall be forced to accept the principle of action at distance. When the gravitational field is considered as a deformation of space, which would be meaningless if the space, is totally empty with out ether.
1.9 The electromagnetic theory

Maxwell [7] in 1873, starting with a novel idea of a displacement current, in the dielectric medium in which electric phenomena take place worked out the electromagnetic field equations, on the assumption that this dielectric current obeyed the same law as the ordinary conduction current with certain limits. The final differential equation corresponding to the electromagnetic field was found to be of same type as those of any progressive wave motion.

A more detailed analysis showed that in a progressive plane polarized electromagnetic wave the electric and magnetic intensities were at right angles to each other, and both were perpendicular to the direction of propagation. The electromagnetic wave is propagated with a velocity equal to $\frac{1}{\sqrt{\mu_0\varepsilon_0}}$ in vacuum where $\mu_0$ and $\varepsilon_0$ are the constants of vacuum namely electric permittivity and magnetic permeability respectively. By measuring the same electrical quantity in the electromagnetic systems, their ratio could be experimentally determined and was found to be $3.10^{10}$ m/sec, which is the same as the velocity of light. This naturally led Maxwell, in 1865 to conclude that light also is essentially an electromagnetic phenomenon.

According to this new concept, light is considered as the result of rabidly alternating displacement currents in the medium, which gives rise to magnetic effects, similar to those associated with conduction currents. The two fields electric and magnetic, inseparably associated, the one varying proportionately with the other and the variation of one giving raise to the other,
urge each other forward with finite velocity. The fact that these naturally perpendicular electric and magnetic fields are always confined to a plane perpendicular to the direction of propagation accounts very well for the transverse nature of light waves. The replacement of the vibrations of a mechanical ether of the older wave theory by the variations of the inseparably connected electric and magnetic field vectors at once removed many of the difficulties of the elastic solid theory of the solid ether of Fresnel [8]. The ether came to be considered as merely a medium whose displacements constituted the electromagnetic field.

Due to the failure of the experiments to detect ether directly at present the idea of postulating ether as even as a mere carrier of electromagnetic waves was given up by the scientists. What ever be the ultimate fate of ether, Maxwell's great discovery of the essential identity between electrical and optical phenomena still remains intact. The superiority of electromagnetic theory was soon fully recognized; first because it enabled the velocity of light to be deduced from purely electromagnetic measurements and second because of its very nature, it allowed only transverse plane light waves.

Electromagnetic waves were actually produced and detected twenty years after Maxwell proclaimed his views. Experimental demonstration of the actual existence of electromagnetic waves by Hertz [9] proved further that they obeyed all the laws applicable to light waves and were propagated with the same velocity as that of light. At the present day these electromagnetic waves
have passed far beyond the academic stage and experimental science by virtue of their worldwide application in radio, television and internet communication.

Electromagnetic waves originate as a result of periodic motion of the electric charges. The spectroscopic studies show that each element has a characteristic spectrum, which, arises from the atoms and molecules of the sample. We may legitimately conclude that the atoms and molecules contain electric charge, the vibrations of which send out electromagnetic radiation. All of them are propagated with the same velocity through space, which is devoid of matter; and all consist of electric and magnetic fields in mutually perpendicular in directions. The electromagnetic theory provides a clue to the inner mechanism of such origin of radiation by stating that accelerated charge radiate energy. Maxwell himself has foreseen the conception of the electromagnetic fields in localization and propagation.

Having dispensed the existence of ether, by the negative result of Michelson- Morley [10] experiment, the electromagnetic theory is badly in need of a physical medium through which radiant energy manifest and propagates. The radiant energy that reach the earth emitted by stars, which are several thousand light years away should necessarily have a medium that is perfectly and ideally elastic by nature, no matter whether it is perceptible for physical senses or not. Moreover, the velocity of light is a function of the constants of the medium in general, and that the velocity here naturally being the function of the constants $\epsilon_0$ and $\mu_0$, the choice of the medium is simply electromagnetic.
Since electric and magnetic field variations are the quantities that are propagated, the medium should be electric by nature. The magnetic field variations naturally follow the electric field variations. The existence of such an electric field medium will also account for the black body radiation. Maxwell himself has stated that there exists conceptual difficulty in the form of the medium in which coupled electric and magnetic field oscillations generate and propagate.

1.10 The quantum concept

Due to an extensive experimental development, modern quantum mechanics throw a considerable insight into the structure of atoms and molecules. The concept of nature of light has also been influenced by quantum theory. The proposition of Planck was directly opposed to the classical ideas, namely that an oscillating electric system does not impart energy to the 'electromagnetic field' in a continuous manner but do so in a finite amounts of "quanta" [11].

On the basis of Planck's theory, Einstein [12], in 1905 revived the corpuscular model of light in the new form by assuming that light quanta exists as real particles and called them "photons" there by explained photoelectric effect. The energy imported to the secondary particles is independent of intensity, but depends only on the frequency of radiation. As the years went on the support for the quantum theory increased and a situation arose that the simultaneous validity of both wave and corpuscular theories of light had to be
recognized. Detailed theory of interaction of matter with the field required the extension quantum mechanics to what is known as quantization of electromagnetic fields. Dirac [13], first carried out the process of quantization electromagnetic fields. It is Dirac who laid the foundations of Quantum Electrodynamics in which, light is considered as the energy contained in quantified electromagnetic fluctuations. So a photon of light is nothing but electric and magnetic field variations, propagating through 'empty' space!!

So with the omission of ether in the theory of relativity, another important conclusion followed concerning the intrinsic nature of radiation. Radiation came to be considered as 'particles' of energy, which propagate in absolute vacuum with a 'velocity' that depends up on the physical properties of the 'medium'. This new concept of radiation was forced up on, not only by the theory of relativity but also by the observed facts like black body radiation, photoelectric effect, Compton effect [14], Raman effect and their theoretical explanation by quantum theory. The quantum hypothesis that accounts the black body radiation [15] and photoelectric effect [16] so elegantly is to be rationalized with proper theoretical basis. If radiation is to be considered as particles of energy, the classically accepted distinction has to be given up. Although the theory of relativity leads indirectly to the new quantum concept of radiation, it does not deny the validity of the laws of electromagnetism. It leaves the electromagnetic field laws just as they stand, unlike in case of mechanics. The theory of relativity actually developed out of experiments on light, which forms a part of electromagnetic phenomena.
The new theory envisages together both corpuscular and wave aspects of electromagnetic radiation. As regards the wave aspect, it introduces a further refinement by considering, the distinction between electric and magnetic fields as relative one, depending up on the reference employed. The study of radiation of was originally made with visible light and the problem proposed even by the ancient Greeks is that how does light reach the earth from sun and the stars, through apparently empty space? The tendency of light to travel along straight lines, naturally led to the conclusion that all sources of light must shoot off rapidly moving minute particles, which entering the eye produce the sensation of light. Newton [17] at the end of 17th century adapted this corpuscular theory, which offered satisfactorily explanation for the phenomenon like rectilinear propagation of light at plane surfaces. But it could not account for the phenomenon of refraction and led to a wrong conclusion, that light should travel quicker in a denser medium than rarer contrary to experimental observation. According to quantum theory, if radiation is emitted as tiny lumps of energy quanta and they travel with the speed of light, without a medium for propagation, it is very difficult to conceive the idea of the frequency associated with the quantum of energy of a single photon. The meaning behind the assumption of frequency linked with the quantum of energy is to be explored in detail. The aim of this thesis is to identify the medium to incorporate the quantum nature of radiation also in such a formulation.
1.11 Conclusion

*Matter is the macroscopic manifestation of the subtest form of physical entity, energy. Matter is perceptible to human senses but the energy is not within the reach of perception.*

*The charge and fields, intera-prceptible entities, perceptible by the effects they produce on matter, are intermediate to energy and matter.*

*The electromagnetic field is identified to possess momentum and energy; the force field is to be recognized to exist independently.*

*The force experienced by a body is the effect of the force field. We cannot ignore the force field simply because there is no material body over which the force field produces its effect.*

The scientific community is yet to find out an alternative to ether, in the event of the same being dispensed with, according to the negative result of Michelson-Marley experiment. We are badly in need of a physical entity that will effectively substitute ether but unlike ether it should really physical instead of hypothetical.

1. Such a medium should serve as the absolute frame of reference with respect to which the motion of objects is measured.

2. The entity should be the medium for generation and propagation of electromagnetic waves.
3. The entity should account for the frequency linked with the energy quanta.

4. The entity being a carrier of electromagnetic waves should be electrical by nature.

Apart from these it will be seen that the entity unearthed, accounts for inertia and zero-point energy also. The present work analyzes the possibility of the existence of such a medium in the form of equilibrium cosmic field.
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