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Steven Rado

***AETHRO-KINEMATICS***



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THE REINSTATEMENT OF COMMON SENSE  
AN ALTERNATE SOLUTION TO THE PROBLEMS  
OF MODERN THEORETICAL PHYSICS



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*The Author*



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*"Miserable mind, you get your information from  
your senses, and do you try to overthrow them?  
The overthrow will be your downfall."*

-- Democritus: Atomism. Sixth century B.C.

## **PROLOGUE**

This work attempts to outline a complete description of the physical universe founded and executed on the laws, concepts and ideas of The Kinetic Theory of Gases and on the overriding assumption that all natural phenomena can be derived from, analyzed, described and humanly understood through the comparatively simple kinematics of an all-pervading ideal gas.

This idea is not at all new. In different times, different forms and levels of natural philosophy and science, the idea and search for a fundamental substance as the cause for all natural phenomena has intertwined the whole body of knowledge.

This universal kinematic theory could be presented through the description of an unnamed prototype of an *ideal gas* without even mentioning the discard-

ed, re-established, ridiculed and re-incarnated, and finally totally distorted classical concept of Ether. But with due respect to the hundreds of geniuses who spent their lives on this concept, from Epicurus and Euclid to Newton, Descartes, Bernoulli, Huygens, Faraday, Maxwell, Lorentz and hundreds of others, this worn out hypothesis will be finally and irrevocably clarified and authenticated in this work. Accordingly, the fundamental, single assumption of AETHRO-KINEMATICS reinstates the existence of an all-pervading medium in the form of the ideal gas of Aether.

The spelling of the word, A-e-t-h-e-r, indicates a redefining of this medium by starting over from the era of Descartes' mechanicism, with the firm conviction that the human mind, which has evolved by the sensations of the mechanical world, can only comprehend nature through mechanical pictures, or cannot comprehend it at all! In this realm of mechanicism, *action at a distance* is unthinkable and the only conceivable transmission of *force* from one body to another is by actual bodily contact through collision.

*Motion can only be caused by motion, and can only produce motion in turn.*

The task this theory takes upon itself is that of Descartes'; to weed out all action at a distance forces from physics and replace them with the kinematic understanding of the construction of each force out of the capabilities of an ideal gas. - *KINEMATICS* is distinct from kinetics, mechanics and dynamics which were founded on Newton's conceptually imperceptible mathematical proportionalities among Force, Mass and Acceleration.

*Kinematics is a branch of physics which deals only with the abstract motion of geometrical points without any regard to forces or inertia.*

For some further clarification, it might be added, that one of the characteristics of geometrical points is that in order to distinguish one from the other, they cannot overlap each other in space; that is, *they are impenetrable to one another*, just like the atoms of an ideal gas. It will be attempted to show below that all Newtonian concepts of earthly and celestial mechanics, Gravity, Inertia, Force and Acceleration, including Kepler's Laws of Planetary Motion can be simulated and explained through the simple laws of kinematics applied through the general characteristics of an isotropic, homogeneous ideal gas.

In AETHRO-KINEMATICS, Aether is taken as an all-pervading ideal gas on the ultra-microscopic order of magnitude. The constituents of this medium, named *Aethrons*, are conceptually equivalent to the atoms of an ideal gas; *geometrical points, impenetrable to one another*. – On the average, Aethrons represent the ultimate units of mass, equal to one another and on the average they move with the speed of light. Therefore, Aethrons are the fundamental definitive units of mass and motion.

Aether is a system of equal masses, in which the Newtonian concepts of inertia and the law of the conservation of momentum are naturally reduced to the simple concept of motion and its eternal nature. The collisions among the Aethrons are perfectly elastic and the transfer of motion is instantaneous. For describing the various kinematical phenomena of nature, Aethrons do not need to exert any *action at a distance forces* on one another and therefore they do not need to possess any internal structure that need be the subject of further speculations.

AETHRO-KINEMATICS is founded on the existence of a supermundane, all-pervading ideal gas of Aether. Nevertheless, there are some more or less

important, and allegedly uncontested arguments against this *ideal-gas-model*. Some essential ones are described below in order to avoid the impression that this study is oblivious to those objections :

The hypothesis of the *Transverse nature of light-waves*, which claims that ether must be an elastic solid to sustain restoring forces required to explain the phenomena of polarization and double refraction.

The *Theory of the Expanding Universe*, based on Hubble's galactic red shift, which is a confusing issue regarding to Universal Rotation.

The *Aberration of starlight*, which is supposed to prove that the earth is quietly swimming relative to the motionless ocean of ether.

The *Michelson null result*, the foundation of the arguments of Special Relativity, which postulates a 'way out' of the hopeless choice that either the Earth is not moving, or there is no ether at all.

Some of these arguments will naturally dissolve in the course of the kinematic solution of the major perplexities of modern physics, some others will be dealt with at a later stage when the new theory has gained some credibility through the alternate description of the fundamental natural phenomena.

## ***PART I.***

***Chapter One*** renders a condensed and simplified history of the physical thoughts embodied in Classical Physics, most importantly to emphasize the theoretical duality in its development, which has lead to some seemingly irreconcilable differences between the results and predictions of Newton's Mechanics and those of the classical Electromagnetic Theory.

***Chapter Two*** reviews one of the most important revolutionary breakaways from classical methods by the Theories of Relativity based on the unmitigated acceptance of the duality of the classical theories. For the sake of impartiality some notes are disclosed on the existing doubts and critiques of the present state of Modern Physics by prominent physicists of the later part of the century.

***Chapter Three*** deals with the other main revolutionary concept of Modern Physics; the Quantum Theory and its long term developments, which are also founded on the primary conviction, that the theoretical duality in Classical Physics cannot be relieved conceptually, but only by mathematical supplements.

**Chapter Four** reviews the general opinion and outlook of modern scientists about the revolution in scientific approach, epistemology and philosophy brought by the twentieth century.

## **PART II.**

**The Foreword** is firstly an appeal against the neo-prejudicism of the relativistic philosophy against Aether. Secondly it is a declaration of the non-argumentative nature of this study which is rather an attempt to render an alternate explanation for the unrelieved perplexities of both classical and modern physics.

**Chapter Five** introduces universal rotation and universal gravitation as the most general phenomena of both micro- and macrocosmos and discusses the classical approach of finding their origin and characteristics, culminating in Isaac Newton's laws of Mechanics and his theory of Universal Gravitation.

**Chapter Six** describes Kepler's three laws of planetary motion especially his astronomical formula, initially tailored for the solar system, and later found to be valid for all rotational phenomena both in the micro- and macrocosmos. Follows the re-estab-

lishment of the known, but not sufficiently publicized important fact that Kepler's Formula is the real foundation, from which Newton derived the mathematics of Universal Gravitation and not the other way around.

**Chapter Seven** introduces the kinematic phenomenon of the sink vortex as a natural tendency of an isotropic homogeneous ideal gas and shows a mathematical and mechanical equivalence with those of the phenomenon of gravitation.

**Chapter Eight** contains the kinematic description of Newton's Mechanics and establishes the conceptual content of Newtonian mathematics by describing the underlying kinematics of the concepts of *inertia, force and acceleration*.

**Chapter Nine** – having all the above available, – takes a detour back to Kepler's mythical formula and uncovers its mathematical origin from the sink vortex of an ideal gas. The kinematics of inertia together with the sink vortex is shown to be the plausible concept to explain the elliptical orbits of the planets, satellites and all sub-units of all rotating gravitational systems.



***Chapter Ten*** finally replaces the hypothetical ideal gas with Aether, as a *real*, fundamental and all pervading substance with all the characteristics of an ideal gas. It establishes the already existing and the potentially acquirable knowledge about its order of magnitude, and the size, the average speed, and the density of the Aethrons. Also suggest an approach to realize the fundamental role of the internal kinetic energy of the Aether.

***Chapter Eleven*** – To establish the natural cause for the formation of a Sink-vortex, some ideas and designs are offered for describing the Kinematical Evolution of Matter. Since the electromagnetically organized state of Aether, called matter, takes up less space than its random state, the evolution is accompanied by the continuous and progressive consumption of the free Aether, which therefore represents the initial kinematic cause for the origin of the Sink-vortex and Rotational Gravitation. The resulting natural condensation of the Aether's kinetic energy in matter, finally fills the famous formula  $E=mc^2$  with kinematically conceivable content.

The theory suggests an evolutionary arrow pointing in the opposite direction to that of Entropy.

***Chapter Twelve*** re-establishes Faraday's and Maxwell's initial aether concepts of lines, tubes and fields of forces in the ideal gas model of the Aether and introduces a kinematical understanding of electricity and magnetism without the *action at a distance* attraction and repulsion between elementary charges.

***Chapter Thirteen*** describes the kinematic causality of the *Lorentz Transformation* and that of the Fitzgerald ratio, as the *natural resistance* against the motion of a foreign object within the ideal gas of the Aether. It is shown that there is a perfect mathematical analogy between the aerodynamic theory of resistance, expressed by the Mach number, and the kinematical resistance of the Aether, represented by the Lorentz-Fitzgerald formula. While the air-resistance increases as the speed of the foreign body approaches the speed of sound, the Aether-resistance increases as the speed of a particle approaches the velocity of light.

Thus, this hypothesis clears up all the confusing philosophical speculations about relative motions between light, matter and observer, and the myth of the *relativistic mass-increase*.

Evidently, by these ideas, the Special Theory of Relativity and its philosophical postulates are rendered to be superfluous.

***Chapter Fourteen*** uncovers the fundamental hidden ambiguity of the classical mechanical wave theory, which ultimately led to the theory of *the uniquely transverse nature* of electromagnetic waves. This condition of the transverse oscillation was imposed on the undulatory theory of light by the allegedly otherwise unexplainable phenomenon of *polarization*. In turn, the restoring force required for the transverse oscillation of light made all feasible mechanical model, including *the ideal gas model* of the Aether, physically impossible. After uncovering the misconceptions of the over-simplified mechanics of the *transverse waves on a string* that affected all subsequent wave theories, a new kinematical theory of wave-motion is presented. Based purely on the kinetic theory of *periodical compression pulses*, this hypothesis offers a kinematical solution for all optical phenomena, including double refraction and polarization without the imposed assumption of the uniquely transverse nature of electromagnetic radiation. With this, the seemingly impenetrable theoretic-

cal barrier, that has blocked the ideal gas model of the Aether for two centuries, has been removed.

***Chapter Fifteen*** represents an alternate kinematic description of the production of electromagnetic radiation. With the acceptance of the ideal gas model of the Aether and the kinematic theory of the Aetherial compression pulses, this theory describes the origin of radiation based on the previously established explanation of the electron current. That is, a theory, purely founded on the circulatory flow of the Aether through the terminals of the battery and the resulting cylindrical vortex around and within the conductors. Moreover, this approach creates a plausible picture for the electromagnetic oscillators, where all forces and potential differences are explained by the circulations and local pressure fluctuations of the Aether and in the gas of free electrons locked into the bulk matter of the conductors.

***Chapter Sixteen*** discusses the two main groups of classically unresolved quantum problems:

1) Blackbody radiation, Photo-electric Effect and Compton Effect, where radiation manifests particle nature, justifies the concepts of quanta and photons. In general, the origin of the *wave-particle duality*,

2) The diffraction phenomenon of electrons and other elementary particles, which demonstrates the wave nature of matter, which initiates the De Broglie's hypothesis of matter-waves. In general the origin of the *particle-wave duality*.

A *declaration of insolvability* of each of these problems formed the justification of the mathematically equivalent, but conceptually divergent Quantum Physics, Wave Mechanics, Matrix Mechanics, and Quantum Mechanics.

For every one of these perplexities an alternate kinematic solution is offered in the pursuit of the rehabilitation of conceptual theoretical physics in the reach of human comprehension and common sense.

***Chapter Seventeen*** consists of three parts:

1. A condensed reiteration of the conceptual development of quantum theory from 1900-1930 with the resulting acceptance of the ambiguous Copenhagen interpretation of quantum mechanics.

2. The philosophical and metaphysical argumentation of the last six decades about the obvious success of the mathematical formalism and the obvious incomprehensibility of that success.

3. The Aethro-kinematical analysis and re-interpretation of the meaning and of the limitations of quantum mechanics based on the fundamental ideal gas properties of the all-pervading Aether.

***Chapter Eighteen*** suggests an alternate solution for Hubble's cosmological red-shift, replacing the Doppler effect interpretation with the Aethro-kinematic explanation of dispersion, which re-establishes the validity of the long forgotten Tired Light Theory. This solution, founded on observational facts, finally unites Physics, Cosmology and Cosmogony and relieves the *Rotating Universe* of AETHRO-KINEMATICS from the potential attacks based on the artificial authenticity of the theories of the Expanding Universes, and that of the *Big Bang*.

The following AETHRO-KINEMATIC description of the physical world is clearly conceptual and well within the reach of common-sense logic. The minimal use of simple mathematics serves one purpose only, *to prove the mathematical identity* of the alternative kinematic explanation of the given phenomena with the conceptually unreachable mathematical postulates of modern physics.

# **PART I.**

## ***THE DUALITY OF THEORETICAL PHYSICS***

# CHAPTER ONE

## CLASSICAL PHYSICS

In Aristotelian philosophy, 'rest' was generally regarded as the natural state of matter, meaning that anything not continually pushed or pulled in some way must sooner or later return to its natural state of rest. Galileo Galilei's greatest contribution to physics was to be able to break away from this philosophy, ruling for two thousand years, and to establish a new concept of motion in empty space; now called the principle of *inertia*.

The *inert* property of all material bodies is the resistance against any change in the state of their motion. The phenomenon that moving bodies on the Earth tend to slow down and eventually stop comes

from the fact that there are always some external forces in action, that slow down and stop the motion. In an imaginary experiment, however, where all external forces were removed, a body would move indefinitely with uniform speed on a straight line.

In Isaac Newton's mechanics, Galileo's inertia became the fundamental concept of the laws of motion, from which he derives the concepts of acceleration and force. In turn, from these concepts with the aid of Johannes Kepler's three empirical laws of planetary motion, Newton formulates the Law of Universal Gravitation and establishes a complete and successful theory of *celestial mechanics*.

Both Galileo's Principle of Inertia and Newton's Laws of Motion demand that space must be mechanically neutral in which no resistance is offered to the motion of material bodies. The Classical Principle of Relativity only works in space that has no mechanical effect on the Laws of Motion. From this, it follows that Newton's force of gravitation, the force of mutual attraction which produces the acceleration of distant bodies must be an *action at a distance* without any mechanical transmission of that force from one point of space to the other.

Some other philosophers of the seventeenth century, however, like Rene Descartes and Christian Huygens, had entirely different ideas about mechanics and space. Descartes' fundamental postulate of mechanics was that the only thinkable and conceivable interactions between material bodies are the actual bodily collisions among them and refused all theories that assumed *action at a distance* between material bodies. His Universe was filled with an all-pervading Aether, a supermundane mechanical medium, in which the heavenly bodies were caught and carried along. The planets, for example, were carried on their orbits by the Aether particles of a giant vortex with the Sun in its center. while the satellites were carried by the vortices of the planets.

Huygens also filled the Universe with Aether as the transmitting medium for the propagation of his sound-like mechanical waves of light and attempted to explain gravity as an effect of the grand scale motion of this same mechanical medium. Both of them and other contemporaries strongly criticized Newton's theory of gravitation declaring that the admittance of an inherent mutual attraction between bodies, a force that produces motion at a dis-

tance without mechanical mediation is an unacceptable regression to occult qualities. In defense of his earthly and celestial mechanics, Newton showed that Descartes' vortex scheme is contradicted by the observable facts stated in Kepler's Third Law of planetary motion. Against Huygens' wave theory of light, Newton introduced his *corpuscular theory of light* which does not require a transmitting medium. With these arguments Newton temporarily saved the perfect void of the universe for the sake of the concept of inertia, his celestial mechanics, and the theory of universal gravitation, all based on *empty space*.

“Newton claimed nothing more for his discovery than that it provided the necessary instrument for mathematical prediction, and he pointed out that it did not touch on the question of the mechanism of gravity.”

However he also said: “To suppose that one body may act upon another at a distance through vacuum, without the mediation of anything else,...is to me so great an absurdity, that I believe no man, who has in philosophical matters a competent faculty for thinking, can ever fall into.’ ” (Whittaker: Aether and Electricity, 1919-1962).

Nevertheless, Newton's laws of mechanics and universal gravitation, together with his mathematical innovation of the differential calculus, have been working with great success and opened up a new direction in scientific research; Mathematical physics, which is a way of getting results through mathematical predictions without the necessity of a conceptual understanding of the given phenomena.

Clearly, whether the mechanics of gravity, inertia and force are understood or not, Newton's mathematics was most powerful in analyzing and predicting both earthly and celestial phenomena of motions.

It took almost a century after Newton's death for the aether to regain some of its territory in theoretical physics. This happened in the beginning of the nineteenth century, when Thomas Young and Augustin Fresnel with their theories of interference and diffraction gave the final blow to Newton's corpuscular theory of light. With this victory of the wave theory, the luminiferous Aether filled up space once again to serve as the transmitting medium for the waves of light all through the Universe.

Parallel to this, Michael Faraday and James Clerk Maxwell achieved a complete conceptual and

mathematical theory for electric and magnetic phenomena, also based on the various dynamic properties of the mechanical aether. Finally, all these theories had been consolidated into one great scientific achievement by the prediction and experimental proof, that light itself is also an electromagnetic wave having the same speed of propagation as the electric and magnetic forces.

James Clerk Maxwell wrote in the *Encyclopedia Britannica*: "The evidence for the existence of the Luminiferous Aether has accumulated as additional phenomena of light and other radiations have been discovered. And the properties of this medium, as deduced from the phenomena of light, have been found to be precisely those required to explain electromagnetic phenomena. Whatever difficulties we may have in forming a consistent idea of the constitution of the aether, there can be no doubt that the interplanetary and interstellar spaces are not empty but are occupied by a material substance or body, which is certainly the largest, and probably the most uniform body of which we have any knowledge."

In general, physicists and philosophers of the nineteenth century saw classical physics as the com-

pletion of the world-picture, culminating in Newton's mechanics, the discovery of the first and second laws of thermodynamics, the growth of electromagnetism and the development of statistical mechanics based on the classical conceptions of causality and determinism. They were confident that the difficulties were merely passing pains of growth, the solutions of the detail problems were within the scope of the mechanical world-picture and with a satisfactory model of the aether, the final correlation of the two major departments of physics, mechanics and electromagnetism, would be achieved in the near future.

Nevertheless, in the first three decades of the twentieth century, certain unresolvable problems led to a profound modification of the whole of physical thoughts. This historical period also marks the beginning of *Modern Physics*.

As the number of unsuccessful attempts to solve the detail problems grew, it gradually became ever more evident that a fundamental contradiction and duality existed in classical theoretical physics. The two major physical theories, Newton's mechanics and the Electromagnetic Theory, each successfully explained a multitude of various physical phenome-

na, were based on two entirely contradictory concepts of *space*.

On the one hand Earthly and Celestial Mechanics was founded and explained on the assumption that *space is perfectly void*.

On the other hand, in its development the electromagnetic theory was wholly dependent and perfectly understandable through the mechanical transmission of forces and energy by the hypothetical aether, *pervading all of space*.

Emerging from this duality, there were two major problems that could no way be fitted into the smoothly functioning mechanical Universe.

One of the perplexing puzzles appeared in the unexpected experimental results in the measurements of the speed of light.

The other puzzle showed itself at about the same time in the uncovering of a theoretical and mathematical inadequacy of the electromagnetic theory to explain the facts of the interaction between matter and radiation. To give a proper quantitative description for these phenomena, two entirely new theoretical systems had to be developed:



1. The *theories of relativity*, dealing with the constancy of the speed of light, re-evaluates the concepts of space and time and finally geometrizes Newton's mysterious force of gravitation.

2. The somewhat simpler system of *quantum theory* revolutionizes the classical conception of continuity of energy and radiation and empirically establishes the fundamental *quantum* of interchange of energy between radiation and matter.

Both systems are now accepted pillars of *modern physics*. Both describe the phenomena in their fields quantitatively, in terms of consistent mathematical relationships, but offer no conceptual understanding for their effectiveness. They do not answer the Newtonian 'how' anymore than Newton's laws answered the Aristotelian 'why.'

Hence, in accepting a purely mathematical description of nature, physicists have been forced to abandon both the ordinary world of sense perception and the validity of *common sense* derived from that.

## THE SPEED OF LIGHT-WAVES

One of the questions which arose from the duality of *classical physics* was about the model of the all-pervading aether.

In order to transmit light-waves with the speed of 300.000 km/ sec, the aether was supposed to be denser than the heaviest metal. However, at the same time, it must be able to pass heavenly bodies without the slightest measurable resistance: Could theory correlate these two totally contradictory requirements? – All attempts have failed to design a mechanical model for such a medium, and toward the end of the nineteenth century a special experiment was designed to answer this dilemma one way or another. Initially James Clerk Maxwell suggested the experiment in the same article, quoted above: "If it were possible to determine the velocity of light by observing the time it takes to travel between one station and another on the Earth's surface, we might, by comparing the observed Velocity of Light in the opposite directions, determine the velocity of the aether with respect to these terrestrial stations."

If light-waves are propagated in the motionless sea of Aether and the Earth is orbiting around the Sun submerged in this same medium, then because of the Earth's motion relative to the aether, our measurement of the *speed of light-waves* should be different in different directions.

No doubt, the *measured* speed of the sound-waves will be different when it is taken in different directions on the top of a railroad car which moves relative to the motionless air. In case when the train moves toward the source, its speed will be added to the normal speed of sound, and if it moves away from the source, its speed will reduce the measured speed of sound. The differences in these measurements will be equal to the speed of the train relative to the air. The speed of sound is always the same if it is measured relative to the air.

Analogous to this, the famous Michelson-Morley experiment was designed to discover a difference in the measurements of the speed of light due to the Earth's motion relative to the motionless aether.

The orbital velocity of the Earth is 30 km/sec, hence if the Earth moves toward the light source, the speed of light and the speed of Earth should be added and measure a total of 300.030 km/sec. If the light propagated in the same direction as the Earth moves in the motionless Aether, the speed of light should measure 299.970 km/sec. The actual experiment was more complicated, but the basic idea was the same. The measuring methods were more than

sufficient to sense the expected difference, but all attempts through 60 some years failed to show anything other than a definite *null result*.

It follows that at least one of the assumptions of the experiment is faulty; either the Earth is not in motion relative to the aether, or light is something different than waves of the aether, or something must be wrong with our method of measurements.

After the shocking null result of the Michelson-Morley experiment, there were a number of ingenious efforts to escape from this scientific and philosophical stalemate. The most successful was the Contraction Theory of G.F. Fitzgerald (1893) which proposed that all objects must suffer a contraction in the direction of its motion because of the resistance of the aether. If all solid bodies contract in the direction of their motion, then the measuring of distances will also be affected by the motion of the devices and the null result can be explained. The theory also assumed that the extent of this contraction should be proportional to both the speed of motion of the object and the *speed of light*. The ratio,  $\beta$  (Beta) between the length of an object at rest, to its length in motion is expressed by the formula:

$$\beta = \sqrt{1 - V^2 / C^2}$$

Where  $C$  is the velocity of light and  $V$  is the velocity of the body, both measured relative to the motionless aether. This contraction is extremely small at ordinary velocities. With the Earth's orbital speed of 30 km/sec, the contraction would be merely 62.5 meter in the earth's 12,000 kilometer diameter.

The next steps in this theory were made by Dutch physicist, H.A. Lorentz, who showed that, based on the electromagnetic structure of matter, the resistance of aether would indeed produce a contraction in the same ratio as Fitzgerald proposed. He went on to show that if the contraction is applied to subatomic particles in rapid motion, their *mass must increase* in the same proportion as their length decreases.

This prediction was exactly verified before the turn of the century by experiments conducted in the first particle accelerators and brought up the idea, that if the motion relative to the aether produces a measurable increase in the mass of the moving particle, then this might reveal Absolute Motion.

Thus, experiments were designed to find if this mass increase maybe different in different directions, but like all others, they gave null results.

If two particles move in opposite directions in an earthly laboratory, they must show different extents of mass increase and the same time reveal the Earth's motion relative to the Aether.

Unfortunately, this method also failed to show the expected difference in exactly the same way as the Michelson-Morley experiment. There was no mass-increase difference in the opposite directions, and all efforts to detect and measure the Earth's *absolute motion* relative to the motionless Aether had to be discarded. With this, at the beginning of the twentieth century, the *duality* of theoretical physics was in its full-blown perplexity and the two major theories of classical physics stubbornly refused all attempts at consolidation.

*Hence, either one or the other, or the approach of trying to consolidate them must be wrong.*

## CHAPTER TWO

### RELATIVITY

#### THE SPECIAL THEORY OF RELATIVITY

The motion of something can only be described relative to something else. Since Descartes, it is customary in physics to use rectangular coordinates with the  $x,y,z$  axes as a frame of reference to describe the motions of a particle. Newton's basic laws of mechanics can describe the positions, motions and momenta of bodies in terms of the  $x,y,z,t$  coordinates, where  $t$  marks the time.

With the same method, the forces acting on the bodies can also be described by the  $x,y,z$  components

of the force vector. An inertial frame is a frame of reference which is either at rest or moving with uniform speed on a straight line, in which a body not under the influence of forces, and initially at rest, will remain at rest.

From the nature of inertia, follows the classical principle of relativity, which states that no mechanical experiments can distinguish between the state of rest and the state of uniform motion on a straight line. Galileo's illustration for this principle was the cannon-ball drop from the top of the mast of a ship (the ship itself is an inertial frame of reference). The ball hits the deck right at the bottom of the mast regardless whether the ship is at rest or in uniform motion on a straight line. On a train, riding smoothly on a straight track, the balls on a billiard table obey exactly the same laws of mechanics as in the pool hall on the ground. According to the classical principle of relativity no mechanical experiment can reveal the difference between the two systems.

Sometimes it is necessary to compare the positions, motions or the velocities of a body, observed from two different coordinate systems, which are moving relative to each other. The method of calcu-

lating the speed of motion from one inertial system to the other, is simply based on the addition of distances or velocities.

Galileo's example: If a man walks on the deck of a ship with the speed of 1 mph. The ship moves with the same speed in the same direction relative to the shore. Then the man's total speed relative to the shore is 2 mph. If the man walks with the same speed in the opposite direction, then he will be at rest relative to the shore. This method is called the Galilean, or Classical Transformation.

Sound spreads in still air through spherical compression waves. The speed of propagation of sound is 330 meter/sec. This speed comes from the elastic properties of the air and therefore it must always be measured relative to the motionless air.

(Unless otherwise specified, the following quotations are taken from Einstein's work of *The Evolution of Physics*, written with Leopold Infeld, published in 1938.)

"We are sitting in a closed room so isolated that no air can enter or escape. Experiment has shown that the velocity of sound in air is the same in all directions, if there is no wind and the air is at rest in the

chosen coordinate system. Let us now imagine that our room moves uniformly through space. A man outside sees, through the glass walls of the moving room, everything which is going on inside. The whole room is in motion relative to the coordinate system of the outside observer.

"Here again is the old, much discussed problem of determining the velocity in one coordinate system if it is already known in the other.

"The observer in the room claims: The velocity of sound is, for me, the same in all directions.

The outside observer claims: The velocity of sound spreading in the moving room and determined in my coordinate system is not the same in all directions. It is greater than the standard velocity of sound in the direction of the motion of the room and smaller in the opposite direction."

## THE ALL-PERVADING ETHER

"There is now an important question: Could we repeat what has just been said of sound waves in the case of a light waves? Does the Galilean transformation apply to mechanical, as well as optical and electrical phenomena?

"In the case of the sound waves in the room, moving uniformly, relative to the outside observer, the following intermediate steps are essential for our conclusion: (A) The moving room carries the air in which the sound wave is propagated. (B) The velocities observed in two coordinate systems moving uniformly relative to each other, are connected by the classical transformation.

"The corresponding problem for light must be formulated a little differently. Let us assume, that the light waves move through ether as sound waves moved through air. Is the ether carried with the room as the air was?

"Since we have no mechanical picture of ether it is extremely difficult to answer this question. If the room is closed, the air is forced to move with it. There is obviously no sense in thinking of the ether this way, since all matter is immersed in it and it penetrates everywhere. No doors are closed to ether. If that is true, then no analogy with sound wave is possible and the conclusions drawn in the case of sound do not hold for a light wave."

Actually it is quite simple to create an analogy between sound and light in this respect. Imagine a

cage moving through the motionless air with an inside and outside observer, and the air would freely flow through the cage. If the cage moves 30 m/sec relative to the air, the inside observer will measure the speed of sound  $330 \text{ m/sec} + 30 \text{ m/sec} = 360 \text{ m/sec}$  in one direction and  $330 - 30 = 300 \text{ m/sec}$  in the other direction, while the outside observer, being at rest relative to the air, will measure 330 m/sec in every direction and also measure 30 m/sec speed for the moving cage. In fact, the Michelson-Morley experiment, was based on exactly the same analogy where the Earth was moving through the motionless ether, and this was the expected difference in the measurement of the speed of light they were looking for. This was the difference that has never been found and the null result became the starting point of the Special Theory of Relativity.

As Einstein summarizes:

"All our attempts to make ether real failed. It revealed neither its mechanical construction, nor absolute motion\* (Earth's motion relative to the ether). Nothing remained of all the properties of the ether except that for which it was invented, i.e., its ability to transmit electromagnetic waves.

"Our attempts to discover the properties of the ether led to difficulties and contradictions. After such bad experiences, this is the moment to forget the ether completely and to try never mention its name. Our only way out seems to be to take for granted the fact that space has the physical property of transmitting electromagnetic waves, and not to bother too much about the meaning of this statement. We may still use the word Ether, but only to express some physical properties of space!

"Let us now write down the facts which have been sufficiently confirmed by experiment without bothering any more about the 'e - - - r' problem.

"1. The velocity of light in empty space always has its standard value, independent of the motion of the source or receiver of light." (Here it is established that light is a wave phenomenon. In the corpuscular theory the speed of light would be affected by the motion of the source, like the speed of a bullet depends on the speed of the gun. )

"2. In two coordinate systems moving uniformly relative to each other, all laws of nature are exactly identical and there is no way of distinguishing absolute uniform motion.

"3. Positions and velocities are transformed from one inertial system to another according to the classical transformation. The contradiction is then evident. We cannot combine (1), (2), and (3).

"It is not at once obvious why the 3 points cannot combine. In (2) "all laws" of physics is mentioned, that includes the laws of mechanics and electromagnetics, and according to the latter, the speed of propagation of electromagnetic waves is always the same relative to the motionless ether.

"Therefore, the speed of light should be different for observers who are moving relative to each other and relative to the ether. But (2) states that it should be the same, and if we apply the simple classical transformation laws (3), the contradiction between (1) and (2) becomes evident.

"The classical transformation seems too obvious and simple for any attempt to change it.

"We have already tried to change (1) and (2) and came to disagreement with experiment. All theories concerning the motion of 'e - - - r' required an alteration of (1) and (2).

"This was no good. Once more we realize the serious character of our difficulties. A new clue is needed and

it is supplied by accepting the fundamental assumptions (1) and (2), and strange enough though it seems, giving up (3), the classical transformation.”

The result is the two fundamental postulate of The Special Theory of Relativity:

“1. The velocity of light in vacuum is the same for all coordinate systems moving uniformly, relative to each other.

“2. All laws of nature are the same in all coordinate systems moving uniformly relative to each other. It is essential here, as always in science, to rid ourselves of deep-rooted, often uncritically repeated, prejudices. Since we have seen that changes in (1) and (2) lead to contradiction with experiment, we must have the courage to state their validity clearly and attack the one possibly weak point, the way in which positions and velocities are transformed from one coordinate system to another.”

## THE LORENTZ TRANSFORMATION

“Once more, the example of the moving room with the outside and inside observers will be used. Again a light signal is emitted from the center of the room and again we ask the two men what they expect to

observe, assuming only our two principles and forgetting what was previously said concerning the medium through which the light travels.

“The inside observer: The light signal traveling from the center of the room will reach the walls simultaneously, since all the walls are equally distant from the light source and the velocity of light is the same in all directions.

“The outside observer: What I see is a light signal traveling with standard speed, the same in all directions. One of the walls (of the moving room) is trying to escape from, and the opposite wall is approaching the light signal. Therefore, the escaping wall will be met by the signal a little later than the approaching one.

“Comparing the predictions of our two observers we find the most astonishing result, which flatly contradicts the apparently well-founded concepts of classical physics. Two events which are simultaneous in one coordinate system may not be simultaneous in another coordinate system. Two events, i. e. the two light beams reaching the two walls, are simultaneous for the observer on the inside, but not for the observer on the outside.



“In classical physics, we had one clock, one time flow for all observers in all coordinate systems. Two events happening at the same time in one coordinate system, happened necessarily simultaneously in all others. Assumptions (1) and (2), the relativity theory forces us to give up this view.

“We remember: The velocity of light is the same in all inertial coordinate systems. It is impossible to reconcile this fact with the classical transformation. The circle must be broken somewhere. Can it not be done just here?

“Can we not assume such changes in the rhythm of a moving clock and in the length of the moving rod that the constancy of the velocity of light will follow directly from this assumptions? Our argument can be reversed: If the velocity of light is the same in all coordinate systems, then moving rods must change their length, moving clocks must change their rhythm and the laws governing these changes are rigorously determined.

“We have to substitute new laws and deduce them from the fundamental assumptions of the special theory of relativity. Let us not bother about the mathematical expression for this new transforma-

tion law, and be satisfied that it is different from the classical. We shall call it briefly the Lorentz transformation.”

As it was mentioned before; When Fitzgerald recommended his contraction hypothesis, Lorentz derived his transformation laws from the electromagnetic structure of matter and worked out the mathematics of a complete theory of transformation.

One of the consequences of his theory, the predicted mass-increase of high speed particles, had been verified by experiments before 1905.

“It can be shown that Maxwell’s equations, that is, the laws of the electromagnetic field are invariant with respect to the Lorentz transformation, just as the laws of mechanics are invariant with respect to the Classical transformation. – In all inertial coordinate systems the same laws are valid and the transition from one coordinate systems to another is given by the Lorentz Transformation.”

Here are Asimov’s notes on the subject:

“What is the difference between starting with the assumption of the Lorentz-Fitzgerald contraction and deducing from it the constancy of the velocity of light, or starting from the assumption of the mea-

sured constancy of the velocity of light and deducing from it the Lorentz-Fitzgerald contraction?!

"If that were all, there would be no significant difference, indeed. However Einstein combined his assumption concerning the measured constancy of the velocity of light with his first assumption, that all motion is relative.

"This meant that foreshortening or mass-gain was not a 'real' phenomenon but only a change in measurement. While Lorentz who was still clinging on to ether, stated that they are real electromagnetic effects.

"Einstein deduced a further conclusion from his assumption and went beyond the Lorentz-Fitzgerald dealings of length and mass, to take up the question of time as well. Again the Fitzgerald ratio is involved." (Understanding Physics, 1966).

Moving clocks are slowing down in the same ratio as moving rods are contracting. And of course the different rhythm of moving clocks is just as unreal as the relativistic foreshortening or mass-gain.

All in the eye of the measuring observer !

"The Lorentz transformation is the basic set of equations for special relativity. H.A. Lorentz introduced

the transformation one year before relativity was proposed by Einstein, though this was then unknown to Einstein. Many years later, in 1932, an experiment by Kennedy and Thorndike disproved the Lorentz viewpoint, which was based on the existence of the ether. By then, it had already become clear many years before that Einstein had pointed out the real significance of the transformation. Though Lorentz had introduced the transformation from considerations based on the existence of the ether, Einstein obtained the same transformation in a derivation rejecting the ether but assuming the constant value of  $c$  for all Galilean observers." (A.Shadowitz, Special relativity, [69])

## THE LIGHT-CLOCK AND SIMULTANEITY

Einstein continues :

"Let us first answer a simple question. What is a clock?" Any physical phenomenon may be used as a clock, provided it can be exactly repeated as many times as desired. – How can we make sure that distant clocks always show exactly the same time? I could stand near one of the clocks and look at a televised picture of the other. but this would not be a

good proof. The televised picture is transmitted through electromagnetic waves and thus travels with the speed of light. Through the television I see a picture which was sent some very short time before, whereas on the real clock I see what is taking place at the present moment.

“This difficulty can easily be avoided. I must take television pictures of the two clocks at a point equally distant from each of them and observe them from this center point. Then if the signals are sent out simultaneously, they will all reach me at the same instant.

“For the definition of simultaneous events, the clocks are synchronized by the help of signals. It is essential in our arrangement that these signals travel with the velocity of light, the velocity which plays such a fundamental role in the Special Theory of Relativity.”

For some undisclosed reasons, in this work published in 1966, Einstein stays away from his famous ‘train-experiment’ which proves that simultaneity is relative and here he simply assumes that it is. Nevertheless it can be seen that the prescribed method of synchronizing by light signals together with the postulate of the constant velocity of light

directly lead to the same conclusion.

“According to the classical principle of relativity, no mechanical experiment can distinguish between the state of rest of a system or its uniform motion on a straight line. In this respect, when two observers are in motion relative to one another, each of them can rightfully assume that he is at rest and the other is in motion. Also, as the postulate of the special theory guarantees, both observers measure the same value for the speed of light.

It follows that as they pass by and observe the synchronized clocks of one another, both of them will arrive to the following conclusion:

“I am at rest at the center of my system, therefore the signals emitted from my two clocks with the speed of light reach me simultaneously. The other observer, however, is in motion and as the signals are emitted by the clocks, he is moving toward the signal coming from the front and away from the one emitted at the rear.

“Since the speed of light has the same value for him regardless of his motion, the two signals cannot reach him simultaneously.”

If both observers record the same event in space, they will expect that the other marks a different time for the event than themselves. Consequently, the two observers must mutually arrive to the conclusion that simultaneity is relative.

“What happens when two sets of clocks are moving uniformly, relative to each other? The classical physicist would answer; ‘nothing, they still have the same rhythm...’. But this is not the only possible answer. We can equally well imagine a moving clock having different rhythm from one at rest. Let us now discuss this possibility. What is meant by the statement that a moving clock changes its rhythm?”

To answer this question, the following procedure is recommended by Atkins, Physics, 1976 [480]:

“We shall try to avoid making any assumptions about time and space. Instead we shall always consider an experimental procedure whereby an observer can measure a time interval or a distance and compare his measurements with another observer moving relative to him. However, in the interpretation of these measurements we shall assume without questions the validity of the modern principle of relativity.

“Imagine two physicists A and B, each in his own space ship equipped with a laboratory, traveling through empty space with different constant velocities. A convenient clock for our present purpose can be constructed as follows:

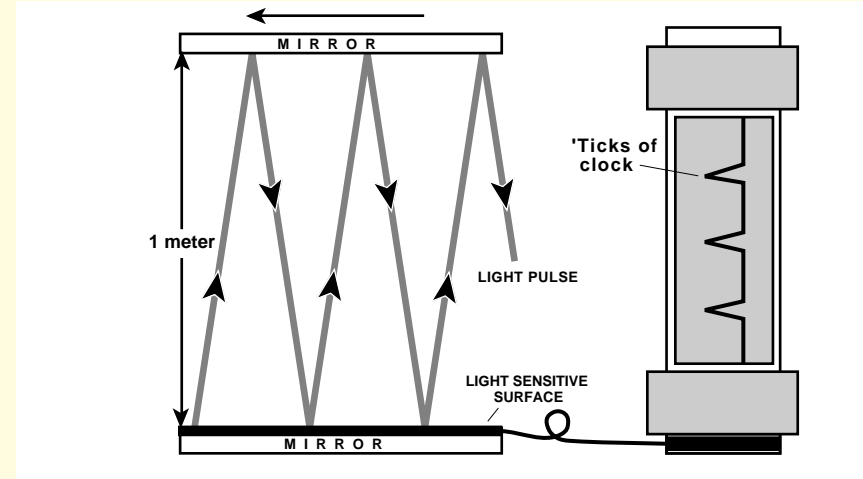


Figure 2-1,

“Two parallel mirrors are placed exactly 1 meter apart. A pulse of light is continually reflected backward and forward between these mirrors. Every time the pulse reaches the lower mirror, it operates a light-sensitive device and a pen makes a mark on the paper moving past it.

“Each mark on the paper can be regarded as a ‘tick’ of the clock. In term of our present units, we can say that in between ticks, the light travels 200 cm with the speed of light,  $3 \times 10^{10}$  cm/sec. The number of ticks per second is 150,000, 000. The two space physicists must, of course, use the same value for the velocity of light.

“It might be argued that, by designing a clock based upon the properties of light, we have prejudiced the situation by making our measurements necessarily sensitive to any peculiarities in the behavior of light.

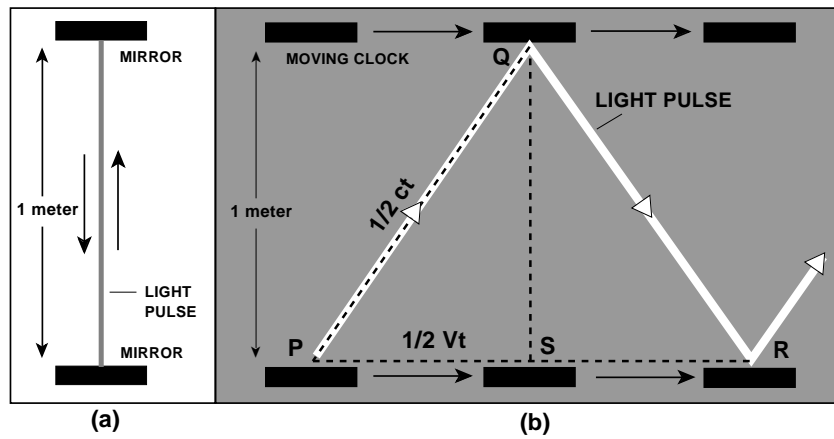


Figure 2-2.

“What will happen when two physicists make observations on one another’s clocks? To make a start on this problem, we assume, that the two clocks are held so that the line joining the two mirrors of each clock is perpendicular to the direction of the relative velocity (Figure 2-2).

“Now let us consider A’s point of view on the behavior of B’s clock as compared with his own. As far as his own clock is concerned, he sees that the light between the mirrors travels vertically up and down on the same line. Since B is passing by him, A does not see the pulse of light traveling up and down between the mirrors along the same path as it does in his own clock.

“While B’s light pulse is traveling from one mirror to the other, the mirrors themselves are moving relative to A, therefore he sees B’s light pulse travel in a diagonal path between the two mirrors; from P to Q and from Q to R, along the line of PQR.

“Applying Pythagoras’ theorem to the right angled triangle PQS, simple mathematics shows that A must conclude that B’s clock is slower than his own in the same ratio as that of the Lorentz-Fitzgerald contraction.

“It is not permissible, however, to say that B’s clock is slow compared with A’s. This would introduce a basic difference between the two observers which is contrary to the principle of relativity. The correct statement is that, according to A’s observations, B’s clock is slow. The same goes for B’s observations about A’s clock. The total observational phenomenon is called the slowing down of clocks, or time dilation.”

“Yet another example. Take a yardstick; this means that a stick is a yard in length as long as it is at rest in a coordinate system. Now it moves uniformly. Will its length still appear to be one yard? How are we to measure this stick in motion? At a given moment two observers simultaneously take snapshots, one of the origin of the stick and the other of the end.

“Since the photographs had to be taken simultaneously, which is, as we already know, a relative concept depending on the coordinate system, it seems quite possible that the result of this measurement will be different in different coordinate systems moving relative to each other. – We can well imagine that not only does the moving clock change its rhythm, but also that a moving stick changes its length, so

long as the laws of the changes are the same for all inertial coordinate systems. – An assumption should not be regarded as unreasonable simply because it differs from that of classical physics. We can well imagine that a moving clock changes its rhythm, so long as the law of this change is the same for all inertial coordinate systems.”

Thus, with the aid of these and other similar thought experiments based on his fundamental postulate of the absolute speed of light, Einstein succeeded to derive the identical formula, that Lorentz derived from the electromagnetic nature of matter and on the assumption of a resistance of the aether against the motion of matter. From here on, the Lorentz Transformation became the mathematical expression of the postulates of special relativity.

## RELATIVISTIC MECHANICS

“The velocity of light is the same in all coordinate systems. It is impossible to reconcile this fact with the classical transformation. We must accept the concept of relative time and relative length in every coordinate system, because it is the best way out of our difficulties.

“In classical physics we had transformation laws for space but not for time, Time was the same in all coordinate systems. However, in the relativity theory, it is different. We have transformation laws different from the classical for space, time, and velocity.”

Thus, in relativity four variable coordinates are needed to describe an event. Three for the three dimensions of space and one for the dimension of time. In short, this representation is called a four dimensional space-time continuum, where continuum simply means that the units of measurements both in space and in time are infinitely divisible and can be taken as continuous.

“But the relativity theory claims that all laws of nature must be invariant with respect to the Lorentz transformation and not to the classical transformation. Or in other words classical mechanics cannot be valid if the velocities approach that of light.

“It was simple to change classical mechanics in such a way that contradicted neither the relativity theory nor the wealth of material obtained by observation and explained by classical mechanics. The old mechanics is valid for small velocities and forms the limiting case of the new one.”

As Asimov explains:

“To put it briefly, it is possible to deduce from Einstein’s assumption of the constancy of the measured velocity of light that the velocity of any moving body will always be measured as less than the velocity of light. This can be achieved by applying the Lorentz-Fitzgerald ratio to the classical addition of velocities.”

Thus when someone throws a ball ahead from a moving car, classical physics simply adds the two velocities, the velocity of the car relative to the ground and the velocity of the ball relative to the car. The sum of these two equals the velocity of the ball relative to the ground. The relativistic addition of velocities is again based on the Fitzgerald ratio, which governs, how much less than the ball’s velocity relative to the car has to be added to the car’s velocity in order that the two could never exceed the speed of light. This difference, of course, is immeasurable when the velocities involved are very small. In those cases the relativistic and classical addition of velocities are identical.

The last important consequence of relativistic physics, is the equivalence of mass and energy.

Einstein explains :

“A body at rest has a definite mass, called the rest mass. We know from mechanics that every body resists a change in its motion (inertia); the greater the mass, the stronger the resistance, and the smaller the mass, the weaker the resistance.

"But in relativity theory we have something more. Not only does a body resist a change more strongly if the rest mass is greater, but also if its velocity is greater.... In classical mechanics the resistance of a given body was something unchangeable, characterized by its mass alone. In relativity theory it depends on both rest mass and velocity. The resistance becomes infinitely great as the velocity approaches that of light.

“According to the theory of relativity, there is no essential distinction between mass and energy. Energy has mass and mass represents energy. Instead of two conservation laws we have only one, that of mass-energy,  $E=mc^2$ .

“The old energy-substance is the second victim of the Theory of Relativity. The first was the medium through which light waves were propagated.

“The influence of the theory of relativity goes far beyond the problem from which it arose. It removes the difficulties and contradictions of the field theory; it formulates more general mechanical laws; it replaces two conservation laws by one; it changes our classical concept of absolute time. Its validity is not restricted to one domain of physics; it forms a general framework embracing all phenomena of nature.”

From the work of Robert Martin Eisberg about the experimental verification of the theory :

“The Theory of Relativity was designed to agree with the experimental fact that the velocity of light is observed to be the same in frames of reference which are in uniform translation with respect to each other.

“However, in addition to achieving this, the theory predicts a number of new phenomena, such as length contraction, time dilation, relativistic increase in mass, and a relation between mass and energy. These predictions of the theory of relativity have been confirmed in every point and there is now universal agreement on its validity.” (Fundamentals of Modern Physics, 1964).



## THE GENERAL THEORY OF RELATIVITY

One of the basic assumptions in the special theory was that it is impossible to measure absolute motion; that any observer had the privilege of considering himself at rest, or moving uniformly on a straight line. However when considering non-uniform motion, the possibility arises that this is not so. Galileo and Newton were convinced that accelerated motion, and rotation are absolute, which can be detected, not related to anything else.

The smoothly running train with the billiard table is a good example. While the train is moving uniformly on a straight line, the classical relativity principle is valid, but any change in the state of motion of the train, either in the speed or in the direction would show up in the movements of the balls on the table and from the directions and accelerations of them the change in the train's motion can be calculated, without the necessity to relate it to anything outside of the train. For the case of rotation, there is Newton's famous bucket experiment: when a bucket of water is rotated, the surface of the water shapes itself into a parabola, forming a concave surface in the bucket.

If the bucket is placed into a closed coordinate system which is in rotation, the observer, who also rotates, cannot see the rotation of the water, but from the concave surface of it, he can detect that the whole system is in rotation. Is this proof of absolute motion in absolute space? Are there special frames of reference that can reveal absolute space and motion?

Atkins addresses these in his book, 'Physics' :

"There would appear to be one such frame, that of the fixed stars. Leon Foucault showed its existence with his pendulum in 1851. By a weight suspended so as to be free to swing in any direction, he showed that the pendulum's direction was not affected by the rotation of the earth, but in fact it keeps its plane of motion, while the Earth makes a complete rotation under it once every twenty-four hours. Careful observations has shown that the plane of motion of the pendulum was fixed relative to the fixed stars. Do the fixed stars represent absolute space and the rotation of the Earth's rotation, absolute motion?

"In Newton's mechanics the answer was a definite 'yes'. These phenomena were contributed to the basic property of all matter, called inertia, which however, is merely a name for something unexplained.

"The questions still remain: What causes inertia? Why does mass resist acceleration? Why does centrifugal force appear when a body rotates?"

"The Austrian philosopher, Ernst Mach suggested that there is a hitherto unrecognized interaction between a moving body and all the other matter in the Universe.

"This interaction depends on the acceleration of the body relative to the distant matter. Can we adopt the underlying philosophy of relativity and describe the situation from the point of view of an observer sitting on the body and moving with it?"

"If a spaceship begins to accelerate in a forward direction the crew-men feel an inertial pressure impelling them to the rear. But they might insist on being at rest and interpret their observations according to Mach, that all the stars and galaxies are moving backward and this acceleration of the other matter of the Universe drags them backward. The same applies to rotation of the Earth, by assuming that the earth stands still, while the whole Universe rotates around it. The point is, that inertial effects cannot be used to prove absolute motion."

In classical physics, while motionless ether filled all space, there was a hope that a special frame of reference could be detected; the ether frame that would explain absolute motion, and maybe even inertia. But this idea, together with the whole hypothesis of ether was discarded by the conclusions of the Special Theory of Relativity.

## SOME MORE THOUGHT EXPERIMENTS

"Einstein, in his general theory of relativity, worked out what properties the Universe must possess to prevent the determination of absolute motion in the case of non-uniform motion." (Asimov: Understanding Physics)

Here is Einstein's basic approach to the problem of absolute and relative frames of reference:

"Could we build a real relativistic physics valid in all coordinate systems? A physics in which there would be no place for absolute, but only relative motion. ..this is the program for the general theory of relativity. But in sketching the way in which it was accomplished, we must be even vaguer than we have been so far. New difficulties arising in the development of science, force our theory to become more and more abstract.

"To embrace an ever wider region of facts, we must make the chain longer and longer. The simpler and more fundamental our assumptions become, the more intricate is our mathematical tool of reasoning. Although it sounds paradoxical, we could say: modern physics is simpler than the old physics and seems, therefore, more difficult and intricate."

The essential characteristic feature of gravitation was discovered by Galileo, namely that all bodies fall (i.e. accelerate) equally fast at a given place in a gravitational field. Since then this phenomena has been tested with very high precision. Einstein in his general theory of relativity raised this discovery to the rank of a basic principle, called The Principle of Equivalence and claiming that:

"In a homogeneous gravitational field all motions take place in the same way as in the absence of a gravitational field in relation to a uniformly accelerated coordinate system."

This principle is the foundation of the General Theory of Relativity. The rest of this chapter will concern itself with presenting and explaining Einstein's theories and will be quoting extensively from his works.

It should be noted here first, that there are three different concepts of mass, which are distinguished by the method of measuring them : a) Inertial Mass, which is measured by the acceleration produced by a known force. b) Passive Gravitational Mass, measured by its weight, (the property of matter that is acted on by a gravitational field), and c) Active Gravitational Mass which produces a field, measured by the orbit of a body, i.e. the centripetal acceleration caused by the field.

From Einstein's notes:

"The law of inertia was gained by the contemplation of an idealized experiment. From that example and later from many others, we recognized the importance of the idealized experiment, created by thought. Here again idealized experiments will be discussed. There are four of them to demonstrate the train of thoughts of the general theory of relativity to achieve the above described program: physics without absolute motion."

### FREE FALL – ACCELERATED FRAME...

"Imagine a great elevator at the top of a skyscraper, much higher than any real one. Suddenly the cable

supporting the elevator breaks, and the elevator falls freely towards the ground. An observer takes a handkerchief and a watch from his pocket and drops them. What happens to these two bodies? For the outside observer, who is looking through the window of the elevator, both handkerchief and watch fall toward the ground in exactly the same way, with the same acceleration.

"We remember that the acceleration of a falling body is quite independent of its mass (or density) and that it was this fact which revealed the equality of gravitational and inertial mass.

"For the inside observer the handkerchief and the watch remains were he let them go. He finds that no forces act upon the two bodies, and so they are at rest, just as they were in an inertial coordinate system. All bodies (in the elevator) behave in the way expected by the law of inertia. (The classical principle of relativity\* is valid). Our new coordinate system rigidly connected to the falling elevator differs from an inertial system in only one respect. The inertial character of this coordinate system is limited in space and time. This local character of the coordinate system is quite essential.

*"The inertial character of this coordinate system is limited in space and time. This local character of the coordinate system is quite essential.*

"If our imaginary elevator were to reach from the North Pole to the Equator, with the handkerchief placed over the north pole and the watch over the equator, then, for the outside observer, the two bodies would not have the same acceleration...(they would both fall towards the center of the earth on exactly perpendicular and not parallel paths)...and for the inside observer they would not be at rest relative to each other, (but accelerating toward each other.) and our whole argument would fail.

"The dimensions of the elevator must be limited so that the equality of acceleration of all bodies relative to the outside observer maybe assumed."

It is equally important to save the assumption of the inside observer that he is in an inertial system and not in a gravitational field, which would be obvious if the elevator was large enough to detect that the bodies are not at rest but moving towards each other while gravitating towards the center point of the gravitational mass.

"With this restriction, however, at least we can indicate a coordinate system in which all the physical laws are valid, even though it is limited in time and space. If we imagine an other elevator moving uniformly relative to the one falling freely, then both these coordinate systems will be locally inertial.

"All laws are exactly the same in both. The transition from one to the other is given by the Lorentz Transformation. Accelerated motion of the elevator in the gravitational field exist for the outside observer rest and absence of the gravitational field exist for the inside observer. We see from this example that a consistent description of physical phenomena in two different coordinate systems is possible, even if they are not moving uniformly, relative to each other.

"This example shows that it is possible to change non-uniform motion produced by a gravitational field into uniform motion merely by looking at it from a different coordinate system. The frame of free fall. The conclusion is that gravitational acceleration cannot be accepted as absolute motion. But for such description we must take into account gravitation, building so to speak, the bridge which effects a transition from one coordinate system to the other."

## THE PRINCIPLE OF EQUIVALENCE

For the next subject Einstein introduces a different idealized experiment where the elevator uniformly accelerates upward.

"This represents an inertial coordinate system, in which the law of inertia (classical principle of relativity) is valid. Someone outside has fastened a rope to the elevator and is pulling, with a constant force. It is immaterial how this is done. Again we shall listen to the explanation of the phenomena going on in the elevator and given by both the outside and inside observers.

"The outside observer: 'My coordinate system is an inertial one. The observers inside the elevator are in absolute motion. They do not find that bodies on which no forces are acting, are at rest. If a body is left free, it soon collides with the floor of the elevator.

'The observer inside must always be on the floor because as soon as he jumps, the floor will reach him again.'

"The inside observer: 'I do not see any reason for believing that my elevator is in absolute motion. My watch, my handkerchief and all the bodies are falling

because the whole elevator is in a gravitational field.'

"There are two different conclusions; either nonuniform motion and the absence of a gravitational field for the outside observer, or rest and the presence of a gravitational field for the inside observer. The outside observer might also assume that the elevator is in absolute nonuniform motion. But motion which is wiped out by the assumption of an acting gravitational field cannot be regarded as absolute motion."

This is the conclusion mentioned before.

However, it should be noted, that the same restriction has to be applied to this example as to the previous one. This accelerated motion of the elevator will not produce exactly the same motions as the centripetal force of gravity, which, of course, can be detected if the size of the elevator is not restricted properly.

## THE BENDING OF LIGHT

At this juncture Einstein brings the phenomena of light into his argument, and goes on with his thought experiment;

"Now imagine that a light ray enters into the (accelerated) elevator horizontally through a side window

and reaches the opposite wall after a very short time. Again let us see how the path of the light would be predicted by the two observers. The outside observer: 'The light ray enters the window and moves horizontally, along a straight line and with constant velocity towards the opposite wall. But the elevator moves upward (accelerating) and changes its position. Thus the ray will meet a point not exactly opposite its point of entrance, but a little below.'

"The inside observer, who believes in the gravitational field acting on all objects in his elevator, would say, 'a beam of light is weightless and therefore will not be affected by the gravitational field. If sent in a horizontal direction, it will meet the wall at a point exactly opposite to that at which it entered.'

"If there is nothing illogical in either of the explanations just quoted, then our whole previous argument is destroyed, and we cannot describe all phenomena in two consistent ways, with and without a gravitational field. But there is fortunately, a grave fault in the reasoning of the inside observer, which saves our previous conclusion. A beam of light carries energy and energy has mass (special theory.) But every inertial mass is attracted by the gravitational field as

inertial and gravitational masses are equivalent. A beam of light, therefore, will bend in a gravitational field exactly as a body would, if thrown horizontally with the velocity equal to that of light."

## ROTATION

This time imagine that the room of the inside observer is rotating relative to the inertial coordinate system of the outside observer. What will be the conclusions of the two observers?

"The outside observer: 'Your coordinate system is in rotation and therefore it is in absolute motion. The classical principle of relativity is not valid in your coordinate system, because all bodies in it have the tendency to move away from the center of the room, eventually all hitting the walls. From this phenomenon you can conclude that your system is in absolute rotation. On the other hand my system is inertial and I am at rest.'

"The inside observer: 'I do not want to hear anything about absolute motion. My coordinate system is just as good as yours. What I noticed was your rotation relative to my room. No one can forbid me to relate all motions to my room. As for the tendency of the bodies to move towards the walls, I hold a

strange gravitational field acting in my room responsible for it.' "

Note that this strange gravitational field requires an even greater restriction, since it replaces centripetal acceleration, which is directed radially inward, with a centrifugal acceleration, which is directed radially outward. – Einstein still concludes:

"It follows from these examples that there is a well-founded hope of formulating a relativistic physics. But for this we must first tackle the problem of gravitation.

"We saw from the examples of the elevator the consistency of the two description. (With or without gravitational field). Non-uniform motion may or may not be assumed.

"We can eliminate absolute motion from our examples by a gravitational field. But then there is nothing absolute in non-uniform motion. (Remember example 1, where in free fall an inertial system could be reinstated). The gravitational field is able to wipe it out completely...

"...But absolute motion is made possible only by the idea of an inertial system, for which the classical principle of relativity is valid. Therefore ...the ghost

of absolute motion and (with it the concept of) inertial coordinate system can be expelled from physics and a new relativistic physics built."

## THE SPECIAL THEORY AND NEWTON

"The general theory of relativity attempts to formulate physical laws for all coordinate systems. The fundamental problem of the theory is gravitation. The theory makes the first serious effort, since Newton's time to reformulate the law of gravitation. But is this really necessary?

"In Newton's law of gravitation, the force between two masses depends upon their distance from each other. The connection between force and distance, as we know, invariant with respect to the classical transformation, which law does not fit the frame of special relativity. On the other hand, distance is not invariant to the Lorentz Transformation.

"We tried to generalize Newton's gravitational law, but it opposed obstinately all our efforts to simplify and fit into the scheme of the special theory of relativity. Even if we succeeded in this, a further step would still be necessary: the step from the inertial coordinate systems of special relativity to the arbi-

trary coordinate systems of the general relativity theory.

"On the other hand, the idealized experiments about the falling elevator show clearly that there is no chance of formulating the general relativity theory without solving the problem of gravitation.

"From our argument we see why the solution of the gravitational problem will differ in classical physics and general relativity.

"1. The gravitational equations of the general relativity can be applied to any coordinate system. Theoretically all coordinate systems (uniform and non-uniform) are permissible. By ignoring the gravitation, we automatically come back to the inertial system of the special relativity theory.

"2. Newton's gravitational law connects the motion of a body with the action of another body at the same time in the far distance. In Maxwell's field-equations we realized a new pattern for the laws of nature. They connect events, with other events which happen a little later in the immediate vicinity. The same way, our new gravitational field-equations are describing the changes of the gravitational field.



"3. Our world is not Euclidean. The geometrical nature of the world is shaped by masses and their velocities. The gravitational equations of the general relativity theory try to disclose the geometrical properties of our world."

## THE GEOMETRY OF SPACE

Einstein goes on to explain his statement in 3. above, with another thought-experiment.

"What is meant by the statement that our three-dimensional space has a Euclidean character? It means that all logically proven statements of Euclidian geometry can also be confirmed by actual experiment. We can construct objects corresponding to the idealized objects of Euclidean geometry. The edge of a ruler or a light-ray corresponds to the 'straight-line;' the sum of the angles of a triangle built of rigid rods is measured 180 degrees; The ratio between the radius and the circumference of all circles are always the same.

"But we can imagine that some discrepancies could be discovered, and if we should not succeed in combining Euclidean geometry and physics into a simple consistent picture, we should have to give up the idea

of our space being Euclidean and seek more general assumptions about the geometrical character of our space."

"Let us consider another experiment with rotation. This time there are two disks, one above the other on a mutual axis. Both disks have a very small and a very great circle on them and the upper disk is in rapid rotation. The lower disk is at rest.

"The observer on the upper, rotating disk begins measuring the radius and the circumference of the small circle. The disk near the center has very small velocity. This means that the measuring rod will not be different for the upper and lower observer, and the results of these two measurements will be the same for both. Now he places the measuring rod on the radius of the great circle. The rod is moving relative to the lower observer, however a rod moving perpendicular relative to an observer, does not contract.

"Therefore the measurements of the radii of the great circles will also be the same for both observers. But it is not so with the fourth measurement! The rod placed on the circumference of the great circle in the direction of motion now will appear contracted to the lower observer, compared to his resting one.

"If, therefore, we apply the results of the special relativity theory, the ratio of the two radii cannot be equal to the ratio of the two circumferences for the upper observer, as it is for the lower one. This means that the observer on the rapidly rotating disk cannot confirm the validity of the Euclidian geometry in his coordinate system. The breakdown of the Euclidean geometry is due to absolute rotation."

Similar result follows the curving of the light-ray in the accelerated elevator. Example 3.

"If we wish to reject absolute motion and to keep up the idea of the General Theory of Relativity, then physics must be built on the basis of a geometry more general than the Euclidean.

"The changes brought about by the general relativity theory cannot be confined to space alone. Suppose, the inside observer takes two clocks and places one on the smaller inner circle and the other on the larger outer circle. The clock on the inner circle has very small velocity, therefore we can conclude that its rhythm will be the same as that of the lower observer's inside clock.

"But the clock on the large circle has considerable velocity, changing its rhythm compared to the out-

side clock of the lower observer and therefore compared to the clock placed on the small circle.

"Thus the two rotating clock will have different rhythms and applying the results of the special relativity theory, we again see that in our rotating coordinate system we can make no arrangements similar to those in an inertial coordinate systems. (To hold the principle of relativity valid.)

"In order to make all coordinate systems permissible, the existence of an appropriate gravitational field must be assumed, with its influence upon rigid rods and clocks. The gravitational field, non-Euclidean geometry and clocks with different rhythms are all closely connected."

At this point, touching the most complex and least understood terrain of the General Theory, it seems to be helpful to quote several different descriptions of the relativistic connection between *Euclidean* and *non-Euclidean* geometry, and the phenomenon of gravitation, so the reader can choose the one that gives the most clarity.

a) Calder, – Einstein's Universe, 1979 , [60]

"Albert Einstein abolished the 'force of gravity' and said that the planets and moons were falling freely

and travelling as straight as they could go through curved space. The massive body distorts time and space around it and those distortions guide the movements of other objects in its vicinity. The curvature (of space) is sufficient to cause an object that is travelling at the right speed to go right around the massive body back to its starting point....

"With no expenditure of energy and no force acting on it, the object follows a curved track. The requirement for an orbit is that you should be moving sideways to start with at the appropriate speed. Go too slowly and you will drop down and collide with the source of gravity; go too fast and you will fly away into space. Amazingly, Einstein started from a completely different view of gravity and arrived at the same law with which Johannes Kepler and Isaac Newton conjectured about the relationship between the speed of motion required for an orbit at a given distance from the massive body."

b) Rothman, – The Laws of Physics, 1963, [140]

"Gravitation produces exactly the same acceleration of all bodies. Einstein decided that it must reflect a basic property of the gravitational field. To explain this he worked out a new method of describing the

gravitational field which did not use the word 'force' at all. Instead he said the space around a massive body (star or planet) is 'curved' so that the object travels along a path dictated by the curvature. This idea is the core of Einstein's general theory of relativity."

c) Richtmyer, – Introduction to Modern Physics 1955, [74]

"The Principle of Equivalence implies that we perceive a gravitational field on earth only because we are using the wrong frame of reference. We ought to use a frame relative to which the earth is accelerated upward at the rate of 'g' (Gravitational acceleration);

"Then we would find that the apparent gravitational field had completely disappeared. From this standpoint gravitational influence consists merely in determining what class of frames it is relative to which there is no apparent field, and relative to which free bodies move in straight lines.

"It does not follow, however, that the gravitational influence of one piece of matter on another is entirely illusory. For only a uniform gravitational field can be transformed away in its entirety by the proper frame of reference. Any field can be transformed away in

the neighborhood of a single point but, in general the choice of frame that does this varies from point to point.

"There remains the problem as to the law according to which gravitating matter determines which frames have the inertial property. Einstein surmised that the law could probably be stated most simply in terms of a formulation that would permit not only of any frame of reference in the ordinary sense, but of any sort of generalized coordinates.

"With the aid of the mathematician Grossmann, he found out how to write physical laws in a form that is valid for any choice of space-time coordinates whatever. The method involves the use of general tensor analysis. Einstein found that among all possible guesses as to the correct law of gravitation this stood out in contrast to all others as the simplest in mathematical form. He adopted this law as a tentative hypothesis then proceeded to look for predictions based on it which could be tested by experiment."

d) Taylor, – The New Physics, 1972, [218]

"Einstein realized that in order to satisfy the Principle of Equivalence, gravity must be described by some geometrical property of space-time. The ability

to write down the laws of physics in a fashion independent of the reference frame, in other words, of coordinates used to take measurements of positions, times and velocities, is called general covariance.

"Since a gravitational field could not really be replaced by an accelerating frame of reference, Einstein required that the theory of gravitation satisfy the principle of general covariance. Evidently, if distorted frames of reference are to be used in which to formulate the laws of physics, we are effectively working in curved space-time. Possibly we are living in a curved space-time, in a similar fashion to the curvature experienced on the surface of a balloon.

"In a geometrical theory, particles should move along paths that are intrinsic to the curvature of space-time and independent of the coordinate frame used to make detailed measurements. Such paths in curved space, called geodesics; these paths are the shortest length between any two points. Using this condition that particles move along geodesics in the warped space-time, whose curvature is due to the distribution of matter. Einstein showed that Newton's equations of motion were valid, provided the curvature caused in space-time was not too great."

e) Atkins, – Physics, 1974, [533]

"A good practical definition of a straight line, which might have been accepted without question before the general theory, is that it is the path followed by a beam of light in vacuum. But as it has been shown that light is bent in a gravitational field and no longer travels along a straight line. There is a genuine problem.

"Suppose we could draw a triangle around the sun out of light-beams connecting the three corners. Because of the bending of light in the sun's gravitational field, we can be sure that the sum of the three angles formed by the curved light-beams will be greater than 180 degrees, and this result is in flagrant contradiction to the precepts of Euclidean geometry. Physicist must therefore seriously ask whether it is not possible to use another, more general system than Euclidean geometry.

"This course was the one followed by Einstein. The general theory assumes that the four dimensions of space and time show the same sort of peculiar behavior. Space-time is curved! This curvature is produced by the gravitational effect of nearby matter. The curvature increases as the mass of the nearby matter is

increased, and also increases if the matter is brought nearer."

f) Barnett, – The Universe and Dr. Einstein, 1957, [95]

"So far as the surface of the Earth is concerned, Euclid's geometry is not valid. A giant triangle, drawn on the Earth's surface from two points on the equator to the north pole, would not satisfy Euclid's theorem that the sum of the interior angles of a triangle is always equal to two right angles or 180 degrees.

"And if someone should draw a giant circle on the Earth's surface, he would find that the ratio between its diameter and its circumference is less than the classic value 'Pi'. These departures from Euclid are due to the curvature of the Earth, and man did not discover this fact by getting off the Earth and looking at it.

"The curvature of the Earth can be computed very comfortably by a proper mathematical interpretation of easily observable facts. In the same way, by synthesis of astronomical facts and deduction, Einstein concluded that the Universe is neither finite nor Euclidean.

"It has already been shown that Euclidean geometry does not hold true in a gravitational field. Light-rays does not travel in straight lines when passing through a gravitational field. For each concentration of matter in the Universe, there is a corresponding distortion of the space-time continuum.

"Each celestial body, each galaxy creates local irregularities in space-time, like eddies around islands in the sea. The greater the concentration of matter, the greater the resulting curvature of space-time and the total effect is an over-all curvature of the whole space time continuum. The combined distortions produced by all the incalculable masses of matter in the Universe cause the continuum to bend back on itself in a great cosmic curve."

g) Einstein: – 'Notes on the origin of The General Theory of Relativity,' Centenary volume, 1934, [307]

"When by the Special Theory of Relativity I had arrived at the equivalence of all so-called inertial systems for the formulation of natural laws, (1905) the question whether there was not a further equivalence of coordinate systems followed naturally.

"If only a relative meaning can be attached to the concept of velocity, ought we nevertheless to perse-

vere in treating acceleration as an absolute concept? From the purely kinematic point of view there was no doubt about the relativity of all motions whatever; but, physically speaking, the inertial system seemed to occupy a privileged position.

"I was of course acquainted with Mach's view, according to which it appeared conceivable that what inertial resistance counteracts is not acceleration as such but acceleration with respect to the masses of the other bodies existing in the world. But this provided no workable basis for a new theory.

"Within the framework of the special theory of relativity, I tried to frame a field-law for gravitation, since – owing to the abolition of the notion of absolute simultaneity, – it was no longer possible to introduce direct action at a distance....But in the theory the acceleration of a falling body was not independent of its horizontal velocity or the internal energy of the system (relativistic mass increase). This did not fit with the old experimental fact that all bodies have the same acceleration in a gravitational field... I now abandoned as inadequate the attempt to treat the problem of gravitation, within the framework of the Special Theory of Relativity....

"The principle of the equality of inertial and gravitational mass now could be formulated quite clearly as follows: In a homogeneous gravitational field, all motions take place the same way as in the absence of gravitational field in relation to a uniformly accelerated coordinate system. For the moment the one important thing was the discovery that a reasonable theory of gravitation could only be hoped for from an extension of the principle of relativity.

"Galileo's formulation of the principle of inertia amounts to this: a material point, which is acted on by no force, will be represented in four dimensional space by a straight line, that is to say, by the shortest line, or more correctly an extremal line. This concept presupposes that of the length of a line element, that is to say, a metric.

"The timelike extremal lines of this metric furnish the law of motion of a material point, which is acted on by no force. The coefficients of this metric at the same time describe the gravitational field with reference to the coordinate system selected. Therefore a physical significance attaches not to the differentials of the coordinates but only to the Riemannian metric corresponding to them.

"A workable basis had now been found for the General Theory of Relativity.

## EXPERIMENTAL VERIFICATION

Asimov, – Understanding Physics , [121] :

"The consequences of the Special Theory of Relativity – mass increase with motion and the equivalence of mass and energy, for instance – were easily demonstrated. The validity of the General Theory was much more difficult to prove. Einstein's picture of gravitation produces results so nearly like those of Newton's picture, that it is tempting to consider the two equivalent and then accept the one that is simpler and more 'common sense,' and that of course, is the Newtonian picture.

"However, there remained some areas – at least three important ones – where the consequences of the Einsteinian picture were indeed somewhat different from those of Newton's:

- 1) The advance of the perihelion of Mercury.
- 2) The bending of light in a strong gravitational field.
- 3) The change of the wavelength of light in a strong gravitational field.

"1) The closest point of an elliptical orbit of a planet is called the 'perihelion'. It was known before relativity that the planet Mercury does not repeat its motion exactly as it is orbiting around the Sun, but its perihelion is slowly advancing.

"Part of this discrepancy was explained in Newton's picture by the gravitational effects of the planets, but there was still a part unexplained. It was greater by 43.03 seconds than it ought to have been. This meant that the advance of the Mercury's perihelion is supposed to make a complete extra turn in every 3,000,000 Earth years.

"In 1915 Einstein showed that the General Theory of Relativity altered the view of gravity by just enough to introduce an additional factor that would account for the unexplained portion of the motion of the Mercury's perihelion.

"2) The effect of the predicted bending of light in a gravitational field is very small. Even if the light coming from a star just grazed the Sun's enormous mass, the shift in the star's position would be only 1.75 seconds of arc. Nevertheless in 1919 an elaborate expedition was sent to the Island of Principe, West Africa to test the predictions of relativity. The

experiment was conducted twice, six months apart, to have the sun at the two opposite end of the sky, and the results in both cases confirmed the validity of the General Theory.

"3) Finally Einstein predicted that light would lose energy if it rose against gravity and would gain energy if it 'fell'. The loss of energy would show a very small decline in the frequency and an increase in the wavelength.

"In 1925 the spectrum of a white dwarf, (thousands of times heavier than ordinary stars) the companion of the star Sirius confirmed the prediction. Later, by a 1958 experiment, called "The Mossbauer effect, the same prediction was confirmed in a laboratory demonstration."

Einstein's own summation :

"The problem of testing the General Theory of Relativity by observation is an intricate one and by no means definitely settled. As we are concerned with principal ideas, we do not intend to go deeper into this matter, and only state that the verdict of experiment seems, so far, to confirm the conclusions drawn from the General Relativity Theory."



## SOME RETROACTIVE NEGATIVES

### 1. ABSOLUTE MOTION.

Nigel Calder, – Einstein's Universe, 1979, [115] :

"Having sung the praises of Einstein's theory, I must now prepare the philosophically minded reader for a nasty shock: special relativity is not after all, strictly correct ! What is false is nothing less than one of Einstein's fundamental assumptions: That it is impossible for an astronaut moving at steady speed to tell whether he is moving or the outside world is moving. In fact it turns out that he can. Recent discoveries do, though, give us back something not unlike the absolute frame of space that Einstein thought he had abolished. To cut a long story short: empty space is filled with energy corresponding to a temperature of about three degrees (3K) above absolute cold. The quantity of radiation is immense. For every atom of hydrogen in the Universe there are about a hundred million particles of 3K radio energy, and their total mass-energy is about one thousandth of the mass of the galaxies.... Also it is remarkably uniform in every direction.... For one, traveling at high speed in space, the microwave energy will appear, by the Doppler-effect, more

intense in the direction in which he is moving and weaker in his wake.... The 3K radio-energy pervading space provides the means of measuring a steady speed in relation to the universe at large.

" In a spaceship you could adjust your motion until you see the 3K radio-energy to be exactly the same in all directions; then you are at rest (relative to the Universe)."

Based on this phenomenon... "experimenters from the Lawrence Berkeley Laboratory made a cosmic speedometer for the Earth. They found that the intensity of the 3K radio energy was strongest in the direction of the constellation Leo. Considering the motion of the Earth around the Sun, and of the Sun in the Milky Way, it turns out that the Milky Way is cruising through the Universe at 1/500 of the speed of light (400 miles a second) in that direction."

Thus, absolute motion is about rehabilitated!

### 2. EXTENSION OF THE PRINCIPLE OF RELATIVITY.

"The basic postulates of special relativity state that, the velocity of light in vacuo is the same for all coordinate systems moving uniformly relative to each other, and that all laws of nature are the same in all

coordinate systems moving uniformly relative to each other."

"To Einstein, who held that space is emptiness and motion is relative, the apparently unique character of non-uniform motion was profoundly disturbing. In the Special Theory of Relativity he had taken as his premise the simple assertion that the laws of nature are the same for all systems moving *uniformly* relative to one another. And as a steadfast believer in the universal harmony of nature, he refused to believe that any system in a state of *non-uniform* motion must be a uniquely distinguished system in which the laws of Nature are different. Hence as a basic premise of his General Theory of Relativity, he stated: The laws of nature are the same for all systems regardless of their state of motion."

Einstein, – Die Grundlage der Allgemeinen Relativitäts theory, 1916, (Anthology, [493])

"The need for an extension of the postulate of relativity; In classical physics and no less in the Special Theory of Relativity, there is an inherent epistemological defect.... We will elucidate it with the following example: Two fluid bodies of the same size and nature hover freely in space.... Let either mass as

judged by an observer at rest relatively to the other mass, rotate about the line joining the masses. This is a verifiable relative motion of the two bodies. Now let us imagine that each of the bodies has been surveyed by means of measuring instruments at rest relatively to itself, and let one surface prove to be a sphere and the other an ellipsoid of revolution. What is the reason for this difference in the two bodies? "Newton's mechanics does not really satisfy the requirement of causality, since it makes a fictitious cause (inertia) responsible for the observable difference.

"The only possible answer must be that the physical system consisting of the two bodies, reveals no imaginable cause to which the differing behavior can be referred. The cause must therefore lie outside of the system and be caused by distant masses which we have not included in the system." (Mach's theory of inertia)

"These distant masses take over of the fictitious cause. It follows that of all imaginable spaces, in any kind of motion relative to one another, there is none which we may look upon as privileged *a priori* without reviving the above mentioned epistemological

objection. The laws of physics must be of such a nature that they apply to systems of reference in any kind of motion. Along this road we arrive at an extension of the postulate of relativity."

### 3. CONSTANCY OF THE VELOCITY OF LIGHT .

Remember that the 'laws of physics' include the laws of the Electromagnetic Theory too, and as it has been established by the Special Theory for uniform motion, one would expect that somehow the constancy of the measured velocity of light should also hold for systems in nonuniform motion. Accelerated motion, from the standpoint of velocity can be taken as a sequence of uniform motions with increasing velocities.

If in uniform motion the measured constancy of the velocity of light is secured by the contraction of rulers and the slowing down of clocks, then acceleration should result in *continuous contractions* of rulers and in continuous decreases in the rhythm of the clocks, thereby assuring the measured constancy.

However this is not really the case...

Einstein, – The Foundation of the General Theory of Relativity (Anthology, [489]) :

"It will be seen from these reflections that in pursuing the General Theory of Relativity we shall be led to a theory of gravitation, since we are able to 'produce' a gravitational field merely by changing the system of coordinates. It will also be obvious that the principle of the constancy of the velocity of light in vacuo must be modified, since we easily recognize that the path of a ray of light with respect to K' (accelerated system) must in general be curvilinear, if with respect to K (uniformly moving system) light is propagated in a straight line with a definite constant velocity."

Discussing the subject within the frame work of general relativity, Calder writes:

"An atomic clock on the ceiling of an accelerating spaceship will be seen to run slightly faster than a clock mounted on the floor. Look up and the acceleration carries you towards the clock, so that you see the clock registering its next second sooner than you would if the spaceship were travelling at a steady speed; look down, and the indications of the other clock are delayed, so it is running slow... If you are accelerating towards a source of light, its speed seems greater. If you are accelerating away from it,

its speed seems diminished.... A cardinal rule of relativity, that light always seem to travel at the same speed, applies only to systems that are moving at a steady rate, or else falling freely under gravity."

#### 4. *THE PRINCIPLE OF EQUIVALENCE* .

The extension of the basic postulate of relativity seems to fail even more seriously. The very fundamental idea of the General Theory, 'the sword that in Einstein's hand slayed the dragon of absolute motion', that a gravitational field can be replaced by a similarly accelerated system, has been proven to be unacceptable.

Calder, – Einstein's Universe, [78] :

"The equivalence of acceleration and the experience of gravity is the cosmic principle of Einsteinian physics. There are two versions of it. The 'weak' principle says, as Galileo did, that all objects fall at the same rate under gravity. The strong equivalence principle declares, as Einstein did, that the laws of physics are the same everywhere and at all times throughout the observable universe, despite any effects of motion or gravity. The latter is what Einstein craved for during his years of mental struggle."

Herman Bondi, – The relativity theory and gravitation, 1979. (Centenary, [114])

"Gravitation as a universal force (Newton) must be measurable everywhere, and our position on the surface of a massive body, the Earth, is highly atypical of the Universe, most of which is empty. How does one observe gravitation in empty space? Since everything falls the same way, nothing measurable seems to be left. Are we thus talking about a pseudo-force, one which can be observed if one has a solid ground under one's feet but not in space?

"A closer analysis shows this pessimism to be misplaced.

"Though all bodies fall equally fast, this common acceleration varies with position. Consider a spacecraft in orbit near the Earth and remember that it is of finite size, small though it is compared to the scale of its orbit.

"The acceleration of free fall at the point of the spacecraft closest to the Earth is higher than at its middle, which is, in turn higher than at the point of the spacecraft furthest from the Earth. Specks of dust near the part of the spacecraft furthest from the earth will tend to drift further that way, for they will

fall with the local acceleration which will be marginally less than the 'compromise' acceleration adopted by the spacecraft as a whole. Similarly, dust near the part of the spacecraft closest to the Earth will fall a little faster than the spacecraft.

"Thus the astronaut will observe dust settling in the two portions of the (freely falling) spacecraft, furthest from and nearest to the Earth. From this fact he will be able to infer that he is in a gravitational field."

"Indeed, this effect has been used to engineer a 'gravity gradient' stabilization for certain spacecrafts. Hence we arrive at the following conclusion: since in physics we always define quantities by how we measure them, a gravitational field is a relative acceleration of neighboring particles. The concept of 'uniform gravitational field,' i.e., one where the acceleration is the same throughout the field, according to this analysis would be described as a zero gravitational field.

"It is curious that Einstein, who in other areas of physics (notably Special Relativity) criticized anything that transcended actual experience, should in the case of gravitation have insisted instead on the

physical equivalence of accelerated frames. Such equivalence does not in fact hold! But Einstein proceeded from the Principle of Equivalence to his general relativistic theory of coordinate transformation, and ignored the fact that gravitation cannot be completely transformed away by a general acceleration of an extended region, however small.

"The magnitude of Einstein's achievement in creating a theory of gravitation is of course not lessened by such consideration.

"Hence the extension of the principle of relativity failed, but in the procedure physics became richer with the *geometrization of gravity*."

## **CHAPTER THREE**

### FROM QUANTUM THEORY TO PROBABILITY WAVES

In spite of the spectacular revolution of Einstein's theories of relativity, which equally effected physics, epistemology and philosophy, the real water-shed in the history of science proved to be Max Planck's seemingly more modest *quantum theory of action*, published in the year of 1901.

This hypothesis turned out to be the starting point for a comprehensive theory which, far more than relativity, overthrew a centuries old world-picture. All physical theory that did not take *quanta* into account, but

assumed energy to be continuous, is now lumped together as *classical physics*, where as physical theories that do take quanta into effect is now *modern physics* with the convenient dividing point of the year 1900.

In the course of an attempt to resolve some discrepancies between the observed energy spectrum of thermal radiation and the predictions of the classical theory, Planck was led to the idea that a system executing simple harmonic oscillations can only have energies which are integral multiples of a certain finite amount of energy.

A closely related idea was later applied by Einstein in explaining the photoelectric effect, and by Bohr in a theory of the complex features of the atomic spectra. Subsequent development in the same direction by de Broglie, Schrodinger and Heisenberg constitutes what is known in modern physics as the *quantum theory*.

### THE SPECTRUM

In 1666 Isaac Newton made the first crucial advance in the study of light and colors. He allowed a beam of white sunlight, coming through a small hole into a dark room, to fall on a prism. The beam of

refracted light then struck a white surface, producing an extended band of colors in the same order as they do in the rainbow; red, orange, yellow, green, blue, violet. This phenomenon was named *dispersion* and the image of the range of colors, *spectrum*.

Since the spectrum was produced from white sunlight going through a colorless glass, Newton concluded, that white light must be composed of a vast assemblage of different varieties of colors, each with its own characteristic way of being refracted.

Newton's spectrum seemed to be continuous, as though all the infinite possible refractivities were present in sunlight. Before the turn of the nineteenth century, however, William Hyde Wollaston discovered a few dark lines in the sun's spectra. Shortly after Joseph von Fraunhofer, working with finer prisms, noticed hundreds of such dark lines and carefully mapped the relative positions of the most prominent ones. These spectral lines, called *Fraunhofer-lines*, are always found at the same place of the color spectrum.

One generation later Gustav Robert Kirchhoff started to use prisms and the spectra for analyzing chemical elements, founding the science of spectroscopy. It was already known that the vapors of different ele-

ments, heated to incandescence, produce light of different individual colors. Kirchhoff passed such light through a spectroscope and found that each element produced only a few refractive varieties which spread widely apart.

The exact position of each line was measured against a finely calibrated background and it was found that each element always and *uniquely* produces lines of the same color at the same specific place of the spectrum. Therefore, this so called *emission spectrum* came into use as the *chemical finger-print* for each element.

By allowing white light to go through cooled sodium vapor, Kirchhoff also found that the gas absorbs precisely the same varieties of the white light that it emits when heated. This method produces dark absorption lines at the same places where the emission lines fall when the sodium vapor is heated. The resulting image is called an *absorption spectrum*, which gives us a wealth of information about the elements contained in the sun and the stars.

Thus, in general, Kirchhoff discovered that the substance which absorbs certain frequencies of light, also emits the same frequencies when it is heated. It follows then, that if a body appears to be perfectly black, its

substance is capable of absorbing all white light and if such a *black body* is heated to incandescence, its emission should be as complete as its absorption. As a result of Kirchhoff's work at the end of the nineteenth century, physicists became interested in the quantitative aspects of radiation and in the manner in which such radiation varied with temperature.

Usually the electromagnetic radiation of a heated body is characteristic of the chemical composition of its hot surface. However, it has been found possible to simulate an *idealized* heated solid, by constructing a cavity in a metal block with a small hole, a so-called *cavity radiator*, equivalent to a *black body*. Consequently, this device emits radiation which depends only on the temperature of the heated solid, independent of its chemical composition.

The distribution of the radiant energy at various wavelengths is also the same for all cavity radiators. By reasoning based on thermodynamics, if the temperature of such cavity radiator is constant, the quantity of the radiant energy absorbed and emitted by the internal walls per second is equal. Such *isothermal enclosure* is in the state of *thermal equilibrium*.

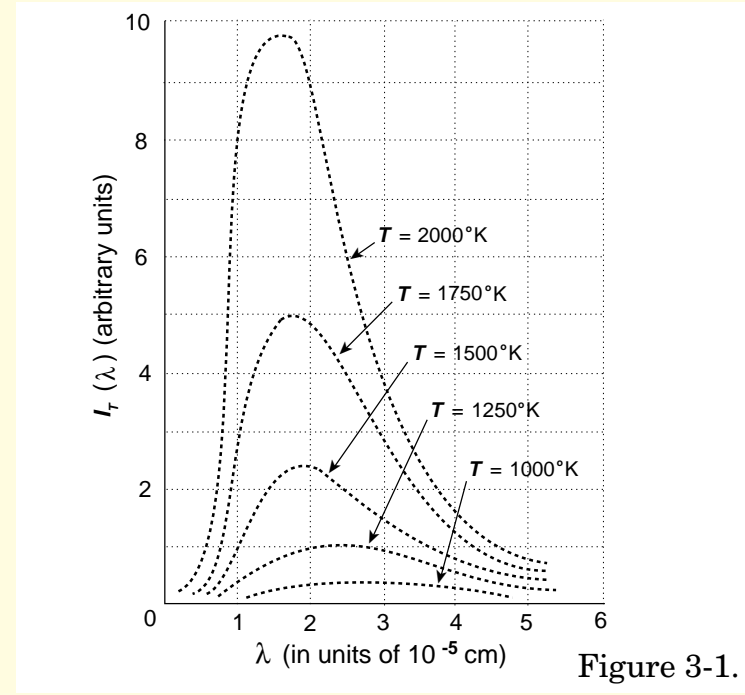


Figure 3-1.

Figure 3-1 illustrates the experimental facts plotted by wavelengths ( $\lambda$ ) against the quantity of radiated energy at different absolute temperatures. The total energy radiated at a given temperature is represented by the area under the curve.

In 1879 Joseph Stefan, Austrian physicist established his empirical law, stating that the total energy



radiated by a black body increases as the *fourth power of the absolute temperature*.

As it is shown by the energy curves, at any given temperature, a greater amount of energy is radiated in the shorter than in the longer wavelengths. It can also be stated, that more energy is radiated in higher than lower frequencies. At each temperature, however, there is a certain frequency at which the maximum energy is radiated, called the *peak frequency*. Above that the radiated energy per frequency gradually decreases.

In the next decade German physicist, Wilhelm Wien, experimentally determined the distribution of radiation among various wavelengths at different temperatures. He also found empirically, that *the wavelength of the maximum energy radiation multiplied by the absolute temperature is a constant*. The statement of this relationship between temperature and maximum energy wavelength, is called, *Wien's displacement law*. – At this stage four branches of Classical Physics were involved in the analysis of the problem of black body radiation; The Theory of Electromagnetic Waves, Thermodynamics, The Kinetic Theory of Gases, and Statistical Mechanics.

Based on the atomic theory of matter, and on the analogy of sound waves, water waves, and the waves on a string classical Electro- magnetic theory suggested, that radiation is produced by the simple harmonic oscillation of the atoms, the amplitude of which is proportional to the temperature of the heated body.

The oscillating atoms produce oscillating electric and magnetic fields which propagate in the space of the cavity, and are eventually absorbed and re-emitted by the walls. Based on Wien's empirical law of displacement, the task of theoretical physics was to derive a mathematical formula from the above theories, which would result in the same distribution curves as those plotted from the experimental facts.

Although the displacement law merely represented a simple inverse proportionality between temperature and the maximum energy wavelength, there was no sensible conceptual explanation for such distribution of radiation and all attempts of deriving the right formula from classical physics failed.

One of the two most important attempts to produce the proper mathematics was Wien's proposal derived from special assumption concerning the process of emission and absorption of radiation.

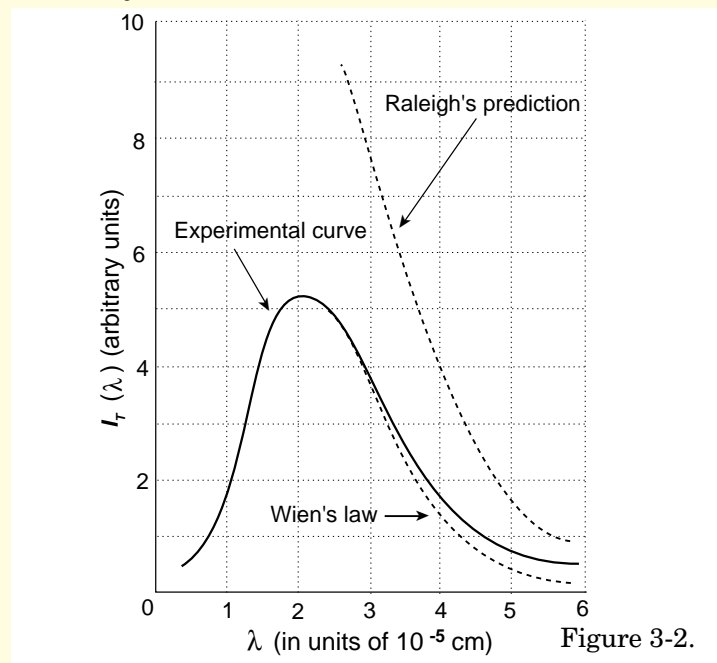
The other attempt was proposed by Raleigh and Jeans founded upon a general consideration of the probabilities of the energy distribution, and on the classical mechanical law of the equipartition theorem.

Wien's formula contained two unexplained constants to be found experimentally, but with them it could be made to fit the experimental curve at the wavelengths shorter than the maximum energy wavelength. However, his curve was considerably off at longer wavelengths.

The Raleigh-Jeans probability formula was free from all unknown constants, however, at wavelengths near or beyond the maximum energy radiation it gave enormously wrong values. In fact, their solution assigned no maximum at all. This prediction, of course, was not supported by the experimental facts and received the somewhat sarcastic name: *The Ultraviolet Catastrophe*. – By the end of the century, the intensive theoretical and mathematical research on the black body radiation produced three different energy curves illustrated by Figure 3-2:

1) A plotting of the experimental facts. 2) The curve given by Raleigh's equation, a fair approximation in lower frequencies but totally wrong in the higher ones.

3) The theoretical curve plotted by Wien's Law, which was close to the experimental curve at higher frequencies, but not justified in the lower ones.



Thus, based on the classical theories, there was no sensible conceptual and mathematical explanation of why the amount of radiating energy should be distributed among the frequencies in the manner observed through the experiments.

## PLANCK'S CONSTANT

At this stalemate, in 1899 Max Planck, a German scientist, began to consider the problem. From a purely mathematical point of view he found that by a very simple addition of a  $-1$  term Wien's equation can produce a curve that perfectly matches the experimental facts. This formula, although a very important mathematical achievement, was still totally empirical and gave no clue to a conceptual understanding of the phenomenon.

Planck sought such an understanding in terms of a model of the atomic processes taking place at the cavity walls. He assumed that each atomic oscillator emits electromagnetic energy at a characteristic frequency into the cavity and absorbs the same from it. Hence, it should be possible to deduce the characteristics of the cavity radiation from those of the oscillators with which it is in equilibrium.

He asked the following question: What if all frequencies were not radiated with equal probability, as Raleigh assumed, but besides the plain probability, there was some other factor that decreases the chances of radiation in the higher frequencies? With such a factor there would be two opposite tendencies to govern

the distribution of the energy of the black-body radiation. Raleigh's random probability would be dominant at low frequencies, but in the distribution of the energy at higher frequencies this new factor would take over and reduce Raleigh's extreme probabilities to match with Wien's predictions.

But is there any conceptual explanation to account for such artificial mathematical tendency?

In an article in 1913, (quoted by Sambursky's 'Physical Thoughts, Anthology', [482]), Max Planck attempts to give a conceptual explanation for his quantum theory of radiation as follows:

"Let us imagine a sheet of water in which strong winds have produced high waves. Even after the total cessation of the wind, the waves will be maintained for some times and will pass from one shore to the other. But there will be a certain characteristic change in them.

"During their impact on the shores, the energy of motion of the longer and coarser waves is converted to an ever greater extent into the energy of motion of shorter and slighter waves; and this process will continue until at last the waves have become so small and their motion so slight that they are quite lost to view.

"That is the familiar transmutation of visible motion into heat, of molar into molecular, of ordered into disordered motion (entropy); for in ordered motion many neighboring molecules have a common velocity, whilst in disordered motion every molecule has its separate and separately directed velocity.

"But now let us take another and quite analogous process, not dealing with water waves but with waves of light and heat.

"Let us assume that rays emitted by a brightly glowing body are collected by suitable mirrors into a completely enclosed hollow space. Here also there will be a gradual transmutation of the energy of radiation from longer waves to shorter waves, from ordered radiation to disordered radiation. The longer and coarser waves correspond to the infra-red rays, and the shorter and slighter waves correspond to the ultra-violet rays of the spectrum.

"Hence according to the Classical Theory we must expect the total energy of radiation to concentrate itself upon the ultra-violet portion of the spectrum; or in other words, we must expect the infra-red and the visible rays to disappear gradually and convert themselves ultimately into invisible ultra-violet or chemical rays.

"But of such a phenomenon no trace can be discovered in Nature. The conversion sooner or later attains a perfectly definite and assignable limit, and after that, the radiation-conditions remain stable in every respect. In the case of the water waves, the disintegration of the energy of motion is limited by the fact that the atoms hold the energy together. In a way, each atom representing a certain finite material quantum which can only move as a whole.

"In the same sort of way certain processes must be at work in the case of light and heat rays, although they are quite an immaterial nature, which shall hold together the energy of radiation in definite finite quanta, and shall unite it the more strongly the shorter the waves and the quicker therefore the frequency of the oscillations."

Thus, Planck made the bold assumption that energy does not flow continuously, but it is given off in discrete quantities and that a radiating body could only give off one *quantum* of energy or two or any integer number, but never a half or a quarter or any part of a whole unit. Furthermore, Planck went on to suppose, that the amount of energy of such quanta is proportional to the frequency, of light in which it is radiated.

If the energy content,  $E$  of one quantum of radiation is proportional to the frequency of that radiation, then  $E = h \times \nu$ , where  $\nu$  is the frequency and  $h$  is a constant of proportionality, commonly called *Planck's constant*. Solving this equation for  $h$ , we find, that  $h = E/\nu$ . Since both the energy and the frequency are measurable quantities, the value of  $h$  can be found empirically. In order to correlate Raleigh's probability equation with Wien's empirical results, Planck derived his own equation, containing  $h$ , as the value of a counter tendency of Raleigh's probability. If  $h$  is the right value, then  $h \times \nu$  should describe the distribution of black body radiation, as actually observed over the entire range of frequencies.

It has been found that the best working value of

$$h = 6.6256 \times 10^{-27} \text{ or}$$

$$h = 0.00000000000000000000000000000066256 \text{ erg / sec.}$$

Notice, how fine the scale is. For the visible, orange light of wave-length  $6000 \text{ \AA}$  with a frequency  $5 \times 10^{10} / \text{sec}$ . The energy content in a quantum is,  $5 \times 10^{10} \times 6.625 \times 10^{-27} = 3.33 \times 10^{-10} \text{ ergs}$ .

In order to acquire a kinetic energy of this magnitude, a grain of sand would have to fall a height of only

$3 \times 10^{-10} \text{ cm}$ , which is much less than the diameter of a single atom.

Hence the quantum theory offers the following explanation: Violet light, with twice the frequency of red light, would have to radiate in quanta twice the size of those of red light. In each frequency only a full quantum of energy can be radiated, therefore the probability of the accumulation of a full quanta in violet light is only half of the probability to accumulate a quanta in red light.

The higher the frequency of light, the smaller is the probability that enough energy would accumulate to form a complete quantum without bleeding off to form a quanta of lesser energy content in the lower frequencies. It also follows, that with increasing temperature, the probability of forming larger quanta would increase and the radiation peak would advance into higher frequencies.

## REVIVAL OF THE CORPUSCULAR THEORY – THE PHOTON.

Planck's hypothesis was introduced mainly in order to explain the distribution of black-body radiation and science was not ready at that time to accept such radi-

cal change of view, just for that one victory. Even Planck himself tried to draw his quantum theory as close as possible to classical notions by supposing that only the energy of the oscillators were quantized, but the radiation was still propagated in the continuous manner of electromagnetic waves.

Meanwhile in a different department of physics, in the last two decades of the century, physicist were beginning to understand that electricity was associated with the movements of subatomic particles called *electrons*, and developed methods to detect them and measure their velocities. During the experimentation it has been found that certain frequencies of light produce the ejection of these electrons from metallic surfaces.

This new phenomenon, named, *photoelectric effect*, introduced another prime puzzle into the subject of the interaction between radiation and matter. German physicist, Philip Leonard, in 1902 found that for each metal surface, that showed photoelectric effect, there is a *threshold frequency*, only above which, the ejection of electrons can happen.

Higher frequency light falling on the metal, liberates electrons with proportionally greater velocities. Leonard also found that increasing the intensity of

light only increases the number of electrons ejected, and does not effect their individual velocities. Somehow, therefore, the kinetic energy of the *photo-electrons* is uniquely connected to the frequency, but independent from the intensity of the radiation which liberates them from the metal. – There was no classical hypothesis to account for this phenomenon until in 1905 Einstein proposed a bold innovation that made use of Planck's quantum theory of radiation.

"There is an essential formal difference between the theoretical pictures physicists have drawn of gases and other ponderable bodies and Maxwell's theory of electromagnetic processes in so-called empty space. Whereas we assume the state of a body to be completely determined by the positions and velocities of an, albeit very large, still finite number of atoms and electrons, we use for the determination of the electromagnetic state in space continuous special functions, so that a finite number of variables cannot be considered to be sufficient to fix completely the electromagnetic state in space.

"The energy of a ponderable body cannot be split into arbitrarily many small parts, while the energy of a light ray, emitted by a point source of light is,

according to Maxwell's theory of light, distributed continuously over an ever increasing volume.

"The wave theory of light which operates with continuous functions has been excellently justified for the representation of purely optical phenomena and it is unlikely ever to be replaced by another theory. One should, however, bear in mind that optical observations refer to time averages and not to instantaneous values and notwithstanding the complete experimental verification of the theory of diffraction, reflection, refraction, dispersion and so on, it is quite conceivable that the theory of light will lead to contradictions with experience, if it is applied to the phenomena of the creation and conversion of light.

"In fact, it seems to me that the observations on black-body radiation, photo-luminescence, the production of cathode rays by ultraviolet light and other phenomena involving the emission or conversion of light can be better understood on the assumption that the energy of light is distributed discontinuously in space.

"According to the assumption considered here, when a light ray starting from a point is propagated, the energy is not continuously distributed over an

increasing volume, but it consists a finite number of energy quanta, localized in space, which move without being divided and which can be absorbed or emitted only as a whole." (Einstein; About the creation and conversion of light; Sambursky, An Anthology of Physical Thought, [499].)

Here is Einstein's popular explanation from his work (Einstein, Infeld, The Evolution of Physics, [260]):

"Homogeneous light, such as violet light, which is, as we know, light of a definite wave-length and frequency, extracts electrons from a metal surface. The electrons are torn from the metal and a shower of them speeds along with a certain velocity. From the point of view of the energy principle we can say: the energy of light is partially transformed into the kinetic energy of expelled electrons. The observed electrons all have the same speed, the same energy, which does not change when the intensity of the light is increased.

"Obviously, we cannot deduce from the wave theory the independence of the energy of electrons from the intensity of light. We shall, therefore, try another theory. We remember that Newton's corpuscular theory of light, explaining many of the observed phenomena of light, failed to account for the bending of light (refrac-

tion, diffraction and interference), which we are now deliberately disregarding.

"In Newton's time the concept of energy did not exist. Later, when the concept was created and it was recognized that light carries energy, no one thought of applying these concepts to the corpuscular theory. Newton's theory was dead and, until our own century, its revival was not taken seriously.

"To keep the principal idea of Newton's theory, we must assume that homogeneous light is composed of energy-grains and replace the old light corpuscles by light quanta, which we shall call photons, small portions of energy, travelling through empty space with the velocity of light. The revival of Newton's theory in this form leads to the quantum theory of light.

"It is at once evident that this quantum theory of light explains the photo-electric effect. A shower of photons is falling on a metal plate. The action between radiation and matter consists here of very many single processes in which a photon impinges on the atom and tears out an electron. These single processes are all alike and the extracted electron will have the same energy in every case. We also understand that increasing the intensity of light means, in our new language, increasing the

number of falling photons. In this case, a greater number of electrons would be thrown out of the metal plate, but the energy of any single one would not change.

"What will happen if a beam of homogeneous light of different color, say, red instead of violet, falls on the metal surface? As it turns out to be, the photons belonging to the color red have half the energy of those belonging to the color violet. Or, more rigorously: the energy of light quantum belonging to a homogeneous color decreases proportionally as the wavelength increases."

"We can detect individual photons and measure their energies only when they knock electrons out of the atoms. In order to effect the state of motion of the electrons, the photons must possess momentum, which should be, like that of any other particle, its mass multiplied by its velocity.

"Thus, in our new picture, light is a shower of photons, and the photon is an elementary quantum of light energy. If, however, the wave theory is discarded, the concept of wave-length (and frequency) disappears. What new concept takes its place? The energy of light-quanta! Homogeneous light contains photons of a definite energy. The energy of the photon for the red end of the



spectrum is half that of the violet end. But what is light really? Is it a wave or a shower of photons?

"There seems no likelihood of forming a consistent description of the phenomena of light by a choice of only one of the two possible languages. We have two contradictory pictures of reality; separately neither of them fully explains the phenomena of light, but together they do! How can we understand these two utterly different aspects of light?"

In 1922 a more clear-cut example of the particle-like properties of light was advanced by Arthur Holly Compton, American physicist. He demonstrated that high-frequency X-rays not only exerted pressure on the electrons but themselves were deflected in the collisions while the electrons recoiled in such direction as to account for the deflection of the radiation.

Based on Einstein's mathematical derivation of the momentum of the photon and applying the law of the conservation of momentum, the energy transfer of the *Compton effect* between radiation and matter was found to be in quantitative agreement with the results of a mechanical collision between two billiard balls. The x-ray photon clearly showed the behavior of a momentum carrying particle.

This, however, was not yet the full scope of the problem with the duality of radiation. Before any solution would emerge on the horizon for the general dilemma, the use of Planck's Theory spread over to the other departments of physics and brought up more questions than answers.

## THE QUANTIZED ATOM

With the acceptance of the quantum theory, matter was supposed to emit and absorb radiation in a discontinuous manner. This supposition brought up the question of whether this nature of energy exchange would serve as an explanation for the behavior of the electrons within the atom? At the beginning of the century the most acceptable model of the atom was based on Ernest Rutherford's experimental conclusion, that virtually all the mass of the atom is concentrated in a tiny nucleus, the volume of which is less than one trillionth of that of the atom as a whole.

Even the lightest nucleus of the hydrogen atom (called proton) is 1836 times the mass of an electron, while the nuclei of heavier elements are half a million times more massive. Normally the atoms are electronically neutral, having the same number of positively charged protons as electrons with negative charges.

Based on these conclusions, Hantaro Nagaoka, a Japanese physicist, suggested the so-called *solar model of the atom*, in which the electrons are circling around the massive, positively charged nucleus on their *Keplerian orbits* just as the planets are orbiting around the sun. According to this theory, as the electrons revolve about the nucleus, they act like oscillating charges and radiate energy of specific frequencies, corresponding to the size of their orbits. If an electron made five hundred trillion revolution per second, it would move with a very possible speed of 150 km/sec and produce a radiation of frequency within the range of the visible light.

There are, however, some fundamental difficulties with all atomic models that involve revolving electrons. One problem is with the basic assumption of Maxwell's theory, that accelerating charges constantly radiate electromagnetic waves.

Since orbiting electrons have constant centripetal acceleration, they must radiate energy and they must lose kinetic energy too.

Thus orbiting electrons must eventually spiral into the nucleus, and if this would be the case, all atoms would collapse. Obviously, this does not happen.

Another short-coming of Nagaoka's model was that it could not explain the facts of spectroscopy, that even the simplest atom, the hydrogen, which consists of one proton and one electron, radiates and absorbs light of several frequencies, giving a well-defined *discontinuous spectrum*. Thus, in Nagaoka's model the Hydrogen electron should have several unique, but not all the possible orbits. – It has been found, that the spectrums of all elements consist of more than one, but a finite number of lines in specific distances from each other. When the wavelengths of these lines were plotted in scale, some definite mathematical regularities were found .

As spectroscopy improved, several series of lines were discovered throughout the whole spectrum, which always occurred at the same positions. Thus, if the solar-model of the atom were to be improved, it must account for the fact that the electrons do not fall into the nucleus, and also explain that their radiation is not continuous but appear only at certain characteristic frequencies. This later phenomenon applied to the solar-model could mean that electrons can occupy only specific orbits in the atom.

The necessary improvement on Nagaoka's solar model was initiated in 1913 by Danish scientist, Niels

Bohr, who incorporated Planck's quantum, as the determining factor in the selection of possible electron orbits in the Hydrogen atom.

Bohr suggested that, contrary to classical electrodynamics, *electrons do not emit radiation while moving with uniform speed on a permanent orbit, but only when they pass from one stationary orbit to another*. If the quantum theory is accepted, then electrons ought to radiate only in whole quanta when converting their kinetic energy into radiation.

If a quantum of visible light is radiated by the electron, a sizable fraction of its kinetic energy has been converted all at once and it would suddenly take on a new orbit closer to the nucleus. By the absorption of a whole quantum of a given frequency, an electron could gain enough energy to jump into another orbit farther from the center. Bohr also suggested that the electron had a certain minimum orbit, which he called the *ground state*, outside of which are the *excited states* where the electron could be lifted by the absorption of an appropriate quantum of energy. With this theory the atom is said to be *quantized* and the origin of the specific characteristics of the spectral lines were successfully explained. For the simpler series of the spectral lines

the Bohr model of the hydrogen atom rendered a reasonably satisfactory description.

Nevertheless, as the spectral analysis was further refined, it was discovered that each line of the series consisted of several distinct lines lying close together. As though an electron could take, not only one, but several closely spaced orbits.

To save the Bohr atom and the basic assumptions of the quantum theory, Arnold Sommerfeld, German physicist, suggested that besides the circular orbit, that Bohr assumed, the electron might have elliptical orbits with different eccentricities and each of them would produce radiation with slightly different frequencies. Hence, from here on there were two quantum numbers for describing the position of the electrons; the *principal* and the *orbital* quantum numbers. But the spectral lines turned out to be even more complicated. The newly discovered lines that seemed to be single, split even further in a magnetic field and to account for this, a third concept, the *magnetic* quantum number had to be introduced. Finally, a fourth number had to be initiated, called the *spin* quantum number, to account for the spin of the electron about its axis. Thus, to describe all available orbits in a given *shell* of space, science had

to introduce *orbital quantum families*, (circular, elliptical and tilted) described by the principal quantum numbers and three others.

The next question was, how many electrons can be in one shell?

Austrian physicist, Wolfgang Pauli, found at this stage that in order to account for the various spectral lines of the different elements through the quantum theory, one must assume that no two electrons can have all four quantum numbers identical. This hypothesis was called Pauli's *Exclusion Principle*.

The concept of shells and *sub-shells* of the electrons around the nucleus were successful in rationalizing the periodic table, but the attempt to produce a literal picture of the solar atom got more and more complicated, and finally collapsed.

Later it became more common to discuss the problems through the concept of *energy levels* instead of orbits or shells. Thus, electrons moved from one energy level to the other and the difference between them was determined by the energy quantum, proportional to the frequency of the radiation, both emitted and absorbed.

In 1925 the German physicist, Werner Heisenberg, worked out a system whereby the energy levels of the

atoms could be written out as a set of numbers, arranged in arrays, called *matrices*. When these numbers were applied to atomic data, by the proper manipulation, called *matrix algebra*, all spectral lines of the different series could be predicted. With this approach, no actual picture of any sort was rendered or required for the atom or for radiation. The conceptual content of the atomic system had faded away completely into a mere collection of numbers. This stage of the theoretical evolution of the quantum theory is called *matrix mechanics*.

Hence, Planck's simple concept of the quantum of discontinuous energy, initially introduced to establish the analogy between radiation and the waves of ordinary discontinuous fluids, turned out to be but a complex, physically meaningless, mathematical operation within the multitudes of families of quantum numbers.

Still, this was only one side of the whole puzzle. The more perplexing other side of the problem was discovered during the same decade: Not only did light-waves sometimes display particle behavior, but in certain important experiments, material particles, like electrons and protons, demonstrated unmistakable wave-like characteristics.

## THE WAVES OF MATTER

If the Compton-effect represents a convincing evidence of the particle character of radiation, then the effects of interference, refraction and diffraction should just as clearly indicate the wave characteristics of the same phenomenon.

In 1924 Louis de Broglie made the bold suggestion that if radiation sometimes could behave as particles, maybe at special circumstances material particles could be observed to behave like waves. Making use of the mathematical relationships developed for treating photons as particles, he recommended a general expression to relate wave characteristics to material particles. He proposed that the wavelength of a so-called *matter-wave* should be equal to Planck's constant, divided by the momentum of the particle:  $\lambda = h/mv$ .

Theoretically, this equation should apply to any moving body; electron, atom, baseball, or planet. The formula shows, that the greater the mass and the speed of the particle, the shorter is its related wavelength. Consequently, the wave character of ordinary macroscopic bodies is immeasurable but in case of the small mass of the electron, the equation predicts a wavelength, which is comparable to the range of the X-rays.

A few years later Davisson and Germer in the U.S., demonstrated the existence of such *matter-waves* by producing interference phenomena through double-slit experiments using electron beams instead of light.

Not long afterwards the wave properties of more massive particles, like protons, neutrons, atoms and molecules were detected. In following research De Broglie's equation proved to be a good approximation of the experimental results and there is no reasonable doubt now that the wave-particle and particle-wave duality is a fundamental phenomenon of nature. With the experimental proof of electron interference de Broglie's matter-waves became part of physical reality and similar questions arose as those Einstein asked himself regarding the nature of his photons:

What is an electron?

Is it really a particle or really a wave? What happens with the fundamental concepts of wave-motion when they are applied to material particles? How can we understand these two utterly different aspects of a particle? Here again, we have two contradictory pictures of reality; separately neither of them fully explains the phenomena, but together they do ?!

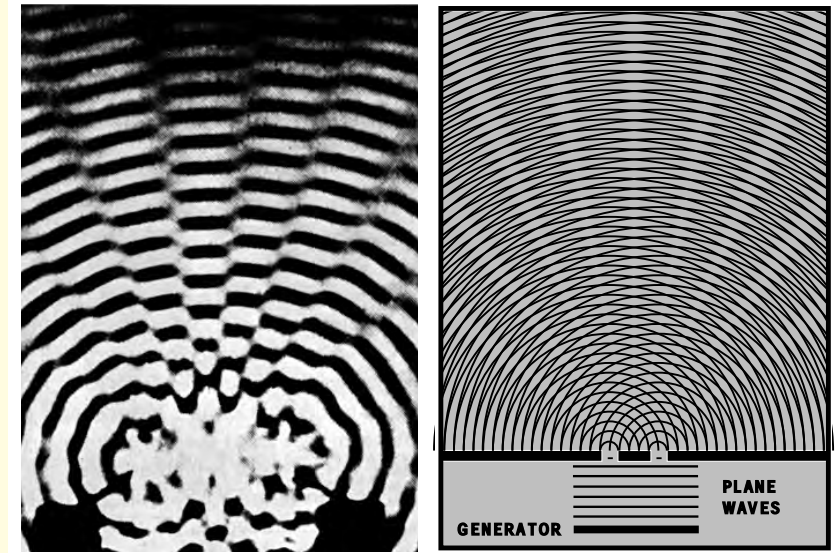
## THE RECONCILIATION OF DUALITY

In order to appreciate the extreme conceptual difficulties of a possible resolution for this perplexing duality of light and matter, one should recall the very origin of the concepts of wavelength, frequency, amplitude, phase and others, and their mathematical justification, that led in the 19th century to the unanimous acceptance of Young's wave theory of light over Newton's mechanical corpuscular theory .

Turning into that century, the proponents of the wave theory were assuming that light is also a mechanical phenomena, just like the waves of water or those of sound, consisting of alternating compression and rarefaction layers, but they are generated and propagated in the supermundane isotropic medium of the luminiferous aether.

With this, all mechanical concepts of sound waves, – like wavelength, frequency, phase, etc. – were transferred unchanged to the phenomenon of light waves.

Hence, in the century-long argument with Newton's corpuscular theory, the task was to demonstrate a specific light phenomenon, which could *only* be explained by the known concepts, mechanism and mathematics of wave-motion.



(a)

Figure 3-3.

(b)

In 1801 Thomas Young achieved exactly this goal. First he clarified the phenomenon of *interference* of the water-waves in a ripple tank. Figure 3-3 (a) is an actual photograph of the interference pattern of the water-waves. Figure 3-3 (b) illustrates a simplified diagram, showing how the generated plane waves produce independent circular ripples as they pass through the gaps, and the way they interfere with one another. When two crests coincide they augment one another and produce a combined crest twice as high as the original.

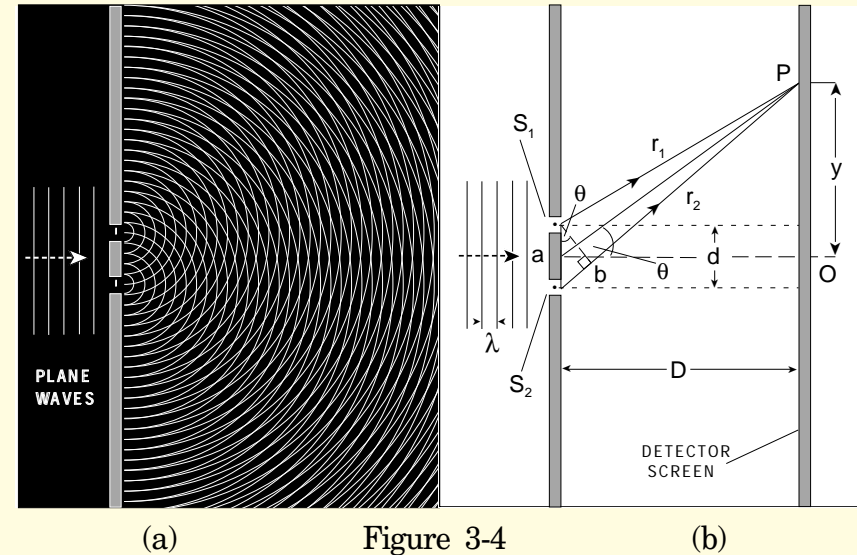
When troughs coincide they produce double depth on the surface of the water. When a crest superimposed on a trough, they cancel one another and the water is neither raised nor lowered.

As the two circular ripples are continually crossing one another, the total result is the appearance of alternate *high-wave* and *no-wave beams* radiating outward from the center point between the gaps. Certain sections of the back wall always receive high waves, others in between receive no waves at all. This is the pattern of interference.

Next, Young succeeded in producing the same phenomenon with the *waves of light*. Figure 3-4 (a) shows the diagram of his famous double slit interference experiment. From a lamp, light is passed through a filter that transmits only one of the colors of the white light with a definite frequency and wavelength. These monochromatic light-waves then pass through a collimator lens, which produces plane waves. Thus, from here monochromatic plane waves are propagating toward the next screen which contains two parallel narrow slits.

The two narrow slits act like independent sources, producing two separate spherical waves again, which

are oscillating in unison, and interfering just like the two water waves in the ripple-tank.



The light and dark bands on the projection screen prove that light waves manifest the same interference phenomenon as the ordinary mechanical waves of water. They reinforce or cancel one another, depending on their phases, just like the compression and rarefaction layers of water or sound.

Figure 3-4 (b) illustrates the mathematical proof of the wave theory of light. Wherever the rays of light from the two sources reinforce each other on the pro-

jecting screen they must be in phase with one another. This can only be the case, if the difference between the distances of each slit from the point of meeting on the screen is an exact multiple of the wave-length of the light used. By this method Young was able to calculate the length of a *single wave*. Using different color lights he found that the wavelength of red light is about twice the length of the violet light. This result agrees with the requirements of the wave theory when it is applied to the facts of refraction, dispersion and to those of spectroscopy.

Young's double-slit interference experiment and its complete mathematical justification put an end to all arguments for the corpuscular theory of light and the concepts of *wave, amplitude, wavelength, frequency* and *speed of propagation* became inseparable from the phenomenon of light.

These fundamental concepts were incorporated into the theories of electricity and magnetism and led to Maxwell's theoretical discovery and prediction that light is an electromagnetic wave propagated through the light-conveying, luminiferous, allpervading aether.

Nevertheless, at the turn of this century new experimental facts appeared in the form of the photoelectric

effect which, according to Einstein, could not be explained by the electromagnetic wave-theory, but clearly required the concentration of light energy in a particle-like manner, so that the whole energy could be absorbed by the individual photoelectrons through collision-like interactions.

But if light was made up of photon particles, and sent through a narrow slit, they should be expected to act like machine-gun bullets, moving on a straight line through the slit and reproduce the exact image of the slit on the screen between sharp shadows. Instead, photons emerge from the slits in uniquely diverging beams, just like waves, forming bright and dark diffraction fringes on the screen. Thus, photons can explain the photoelectric effects but not the phenomenon of diffraction.

Modern Physics attempts a reconciliation of this controversy by the following mathematical procedure.

According to the electromagnetic theory the intensity of illumination of the bands is given by the total energy of the oscillating electric vectors at the given point of the screen as they destructively or constructively interfere with one another. The intensity of light is given by the amount of energy crossing a unit area



per unit time at the screen. In the diffraction or interference experiments the total energy projected at any point of the screen depends on the wavelengths, phases and amplitudes of the interfering waves and can only be predicted through the mathematics of the wave theory. In order to make this method applicable to the photon interpretation the amplitude at each unit area first must be calculated by the wave theory, and then *redefined as the density of photons*, i.e., the number of photons crossing per unit area per unit time.

In other words there are two separate procedure in the calculation. First the energy passing through a unit area per unit time is calculated by the classical method of the electromagnetic theory, based on wavelength, amplitude, phase, etc.

Next, based on the photon hypothesis, this result is translated into the new language of the corpuscular theory, taking the concept of *photon density* to be equivalent with the established energy distribution in the interfering electromagnetic waves.

The mathematical transformation was achieved by a new formula representing the equivalence of the intensity of electromagnetic waves with the density of photons. Eventually, this mathematical resolution

between *wave energy* and *particle density* was linked together with de Broglie's matter-waves and by the use of a so-called *wave function*, the theory was successfully applied to the diffraction and interference phenomena, not only for the photons of light, but for electrons and other elementary particles.

By this approach of modern physics, if a beam of electrons of suitable de Broglie wavelength emerge from a slit, the density of the electrons at the surface of the photographic plate can be calculated by the wave-function and translated to electron density.

Nonetheless, even this new method did not cover the full scope of the problem. For the same way as the wave-character cannot be totally discarded in the phenomenon of light, the individuality and concentration of material particles is just as undeniable. Thus, the question rightfully presents itself: What if a *single* electron passes through the slit on its own? Would the particle spread itself over the whole diffraction pattern, as waves do, or would it strike a definite single point on the plate? Nature's direct answer to these questions is most surprising.

It is an experimental fact, that interfering electron beams produce the characteristic diffraction pattern on

the photographic plate. If the plate is replaced by a row of counters, by which the arrival of each individual electron can be recorded, the experimental result is that each electron strikes a single counter only, but it is totally unpredictable which one of them.

Surprisingly, however, after a million electrons are recorded, the distribution of electrons on the different counters turns out to be the same, whether they were passing through the slit individually or by the thousands and they do so in accordance with the diffraction pattern predicted by the de Broglie matter wave hypothesis.

Evidently, the path of an individual particle is not predictable, but the total diffraction pattern of a great number of particles is predicted by the wave-function. Even more surprising was the similar results of the interference produced by the electron-matter-waves even in Young's original *double slit* experiment. Whether it was executed by single electrons or thousands of them at a time, they have produced the same interference pattern on the screen, analogous to light, as de Broglie's wave-function predicts.

Evidently, the first slit diffracts the electron, which then must go through either one or the other slit of the

second screen, and certainly, it can not go through both of them. Still, between those slits and the projection screen (or counters) *something must interfere with something*, which augment or weaken one another, because, even arriving individually they produce the unique pattern of Young's interference. Thus, it must be assumed, that each individual electron must interfere with itself.

According to de Broglie's summation of these ideas, called by him '*the theory of double solution*': there is a continuous wave function with a solution of statistical significance, and a singularity solution constituting the physical particles under discussion.

"Particles would then be clearly localized in space, as in the classical picture, but they would be incorporated in an extended wave phenomenon. For this reason *the motion of a particle would not obey the laws of Classical Mechanics, according to which the particle is subject only to the action of forces exerted on it, without experiencing any effect from the existence of obstacles that maybe situated at some distance outside of the trajectory. On the contrary, the motion of the singularity was to be dependent on all obstacles that hindered the free propagation of the waves surrounding it and there*

would be a reaction of the wave phenomenon on the particle. And this way the appearance of interference and diffraction would be explained."(M. Jammer, *The Conceptual Development of Quantum Mechanics*, [309])

## WAVE MECHANICS

Eventually, the matter-wave hypothesis spread over to the theory of quantized atom when de Broglie succeeded in deriving Bohr's quantum conditions based on the angular momentum of the orbiting electron by applying proper boundary conditions to his electron-matter-waves in the hydrogen atom.

Figure 3-5 (a) illustrates a vibrating string clamped at both ends to rigid supports. This represents a boundary condition, which determines the spacing (nodes) and wavelength of the possible standing-waves on the string. Figure (b) shows De Broglie's approach to use Bohr's radius and angular momentum in conjunction with his matter-waves to quantize the electron orbits in Hydrogen atom. Since Bohr's radius determines the Keplerian orbit and the angular momentum, and because the matter wave of the electron is proportional to its momentum, it is assumed that an electron can only exist on certain orbits where its wavelength fits around the circumference an integral number of times.

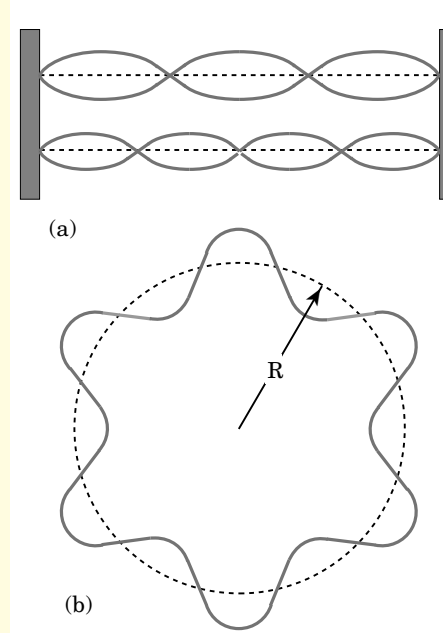


Figure 3-5.

Following this idea the Austrian, Erwin Schrodinger, interpreted the atomic structure in terms of the particle-waves, picturing the electron itself as a *standing wave circling about the nucleus*.

Schrodinger also assumed, that if the electron gains some energy, its wavelength decreases and no longer fits that orbit, and the same is true if it loses energy.

Thus, the electron must radiate or absorb energy in certain quantities that would correspond to the circumference of the next orbit where its new wavelength again must fit the requirements of a de Broglie standing wave. This smallest possible difference in the energy, fitting into two consecutive orbits was assumed to be quantitatively equal to Planck's quantum.

As for the electrons themselves, Schrodinger combined his electrodynamic interpretation of the wave function with the idea that the particles of corpuscular physics are essentially only wave groups composed from infinitely many wave functions. As he expressed his opinion:

*"There seems to be no doubt that we can assume that similar wave packets can be constructed which orbit along higher quantum number Kepler ellipses and are the wave-mechanical representation of the hydrogen atom."* (M. Jammer, *The conceptual Development of Quantum Mechanics*, 1989. [300])

Such analysis of the atomic behavior on the basis of the *Schrodinger wave equation* is termed *Wave mechanics*.

It should be noted that the mathematical predictions of Wave mechanics was in total agreement with the results of Matrix mechanics, and when applied to the simple Hydrogen atom both of them agreed with the predictions based on Bohr's solar model.

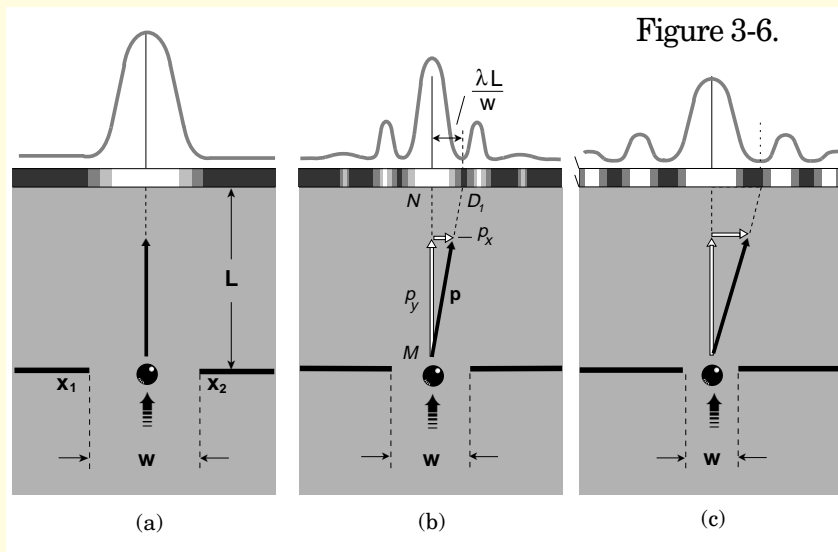
In principle, it would seem that wave mechanics offers a complete description of the atom, and however hard to grasp, it is still conceptually superior to Heisenberg's pictureless mathematical matrices.

Nevertheless in general, a complete analysis of the atom, based on wave-mechanics, turned out to be impractical even with modern computer techniques, because of the sheer difficulties of its extremely complex mathematics.

## THE UNCERTAINTY PRINCIPLE

Further attempts to resolve the wave-particle duality of light and the particle-wave duality of matter led to even more revolutionary new conceptions about the nature of the physical universe.

Pondering these perplexities Werner Heisenberg, the author of matrix mechanics, tried to resolve the problem of dualities by analyzing what exactly the concept of *particle* means. He decided that the essential characteristics of a particle are, that at a fixed instant of time it must have a definite location at a definite point in space and must have a well-defined velocity. He then asked, how it might be possible to determine experimentally these two definite quantities and came to the startling conclusion, that only either one or the other can be determined precisely. This statement is Heisenberg's *Uncertainty Principle* and the physical reason for it can be illustrated by his thought experiment on electron diffraction.



As Figure 3-6 illustrates, that in order to fix the exact position of a particle one must find its Cartesian coordinates;  $x$ ,  $y$ ,  $z$ . Consider the following attempt to determine precisely the  $x$  coordinate of the position of an electron in a diffraction experiment. If the particle passes through the narrow slit of a given width, at that instant the  $x$ -coordinate of its position must be on a point within the distance between  $x_1$  and  $x_2$ .

This point can be determined more exactly by making the slit narrower and there is no limit to the accuracy in this respect. However, as it has been found with

light, sound or water-wave experiments, when the slit is made narrower the diffraction pattern spreads proportionally wider.

Therefore, as the electron emerges from a narrower slit, it is diffracted in a more unpredictable direction and consequently acquires a more indeterminate  $x$ -component in its velocity.

*Hence, the process of determining the position of the electron with more accuracy inevitably introduces an indeterminate component in its velocity and momentum. Conversely, the uncertainty in the velocity can be reduced by making the slit wider but there is then an increased uncertainty in the position of the electron.*

Recall now, that in de Broglie's matter-wave equation the wavelength ( $\lambda$ ) associated with a particle equals Planck's constant divided by the momentum of the particle ( $\lambda = h/p$ ).

Thus, Heisenberg's uncertainty relations must also be proportional to those quantities. If the uncertainty in the position is  $dx$  and the uncertainty in the momentum is  $dp$ , then Heisenberg's uncertainty relations can be expressed as  $dx dp = + - h$ , again Planck's quantum (where '+ -' means not very different from).

Since this conclusion is drawn from de Broglie's matter-wave formula, it is applicable to all particles, including macroscopic bodies, with the difference that the uncertainty factor becomes proportionally more and more negligible as the mass and the momentum of the object increase. De Broglie's wave-function also assigns a given wavelength and some kind of oscillation to all bodies, but the greater the object the shorter is the wavelength and consequently greater the frequency of the oscillation. Thus, the straight line path of a bullet or a golf-ball *appears to be straight* merely because of their great mass and extremely short wave-length.

This is analogous to the apparent rectilinear propagation of light, due to its small wave-length and high frequency. It follows from all these, that the generalized consequence of the uncertainty principle is, that *nothing in nature can be totally at rest*.

In classical physics a solid at absolute zero temperature was visualized as an array of atoms at rest on the points of a periodically repeating lattice. This is clearly inconsistent with the uncertainty principle because if the atoms are located exactly on the lattice points there is no uncertainty in their positions and it would make the velocity or momentum of the atom infinitely uncer-

tain. This would mean that it might have any velocity between zero and  $C$  in any possible direction.

Conversely, to require that an atom shall be at total rest with a velocity exactly zero, would cause its position to be infinitely uncertain, meaning that the atom might be located anywhere in the whole universe. In order not to violate the *inviolable* uncertainty principle, theorists were forced to assume that, even at absolute zero temperature, the atoms are not permanently located at the lattice points, but roam around within a region of a given diameter which would represent the extent of the uncertainty in its position.

This would secure the validity of the uncertainty principle, but the question is how can this be correlated with the foundation of thermodynamics-dynamics and the kinetic theory of heat according to which absolute zero temperature is defined and calculated by the assumed zero kinetic energy of the atoms?!

The contemporary answer is, that when a gas cools down in a container of fixed volume, it either liquifies or solidifies before it reaches absolute zero. To prevent it from doing so the volume of the container must be proportionally increased as the temperature is lowered. Approaching absolute zero, without the condensation of

the gas, it is necessary to make the volume of the container infinitely large. Under these circumstances it is possible for the gas atom to be at rest with zero velocity, because its position can be anywhere in the infinitely large container and Heisenberg's uncertainty principle can retain its validity.

As a further illustration of this principle, consider an attempt to fix the position of an electron by shining light on it, and observe the reflected rays through a microscope.

The difficulty with this method is that the size of the electron is very small compared to the wavelength of visible light and the inevitable result is a strong diffraction effect and a blurred image. Thus the electron is not seen at an exact point with precise coordinates but its image spreads out in diffraction rings over a region which is approximately the magnitude of the wavelength of the light. Furthermore, the center of the diffraction pattern cannot be taken as the exact location of the electron. This becomes evident when the illuminating light is taken as a stream of photons. Their scattering by the electrons involves Compton-effect collisions.

When photons are scattered by an electron, in each collision, some of momentum of each individual photon

is transferred to the electron. This means that the very act of using photons to determine the position, is automatically changing the initial velocity and the momentum of the electron by an unknown and indeterminable quantity. It follows, that no subsequent observation of the path of the electron can possibly uncover what was its velocity and momentum before the first observation.

Evidently, in the micro-world of atom physics the means of observation, and the observed object are of the same order of magnitude and the disturbing factors or the magnitude of uncertainty can never be reduced below a quantity, which is comparable with Planck's quantum of action.

In the combined evaluation by any conceivable experiment there is always an uncertainty in the measured value of the position and velocity, or both. This is not due to imperfections in the design or construction of the experimental apparatus. Even with the best of those, the uncertainty would still be present. It is an unavoidable consequence of the way in which nature behaves. Moreover, this is not believed to be a consequence of unknown factors that we have not yet discovered, but rather that *the future behavior of a particle is not completely determined by its past history.*

## THE WAVES OF PROBABILITY

Through a quarter of a century of development, the final establishment of quantum theory, called *quantum mechanics* resulted from the penetrating discussions among the leading scientist. These began by de Broglie's Nobel lecture, with the question, whether Schrodinger's wave function of wave mechanics had to be taken literally or statistically. In other words, did this mathematical expression indicate that an electron in the field of a nucleus is a physical reality, which is '*smeared out*' as a matter wave, or were these waves to be interpreted as mere *probability waves*, which allowed only for a statistical evaluation of the probability of finding the electron particle in a given place?

The overwhelming majority of scientist accepted the radical probability interpretation, which amounted to a complete break with the concepts of classical physics. One important result to emerge from this epistemological revolution was the inclusion of the observer in the description of a physical phenomenon.

*By this, the dual nature of light or matter was explained as a consequence of different, mutually exclusive experimental arrangements used for the observation and for the description of the same phenomenon.*

The so-called *Copenhagen interpretation* of quantum mechanics prevails today despite many attempts to refute it. The theory was crystallized in Bohr's lecture, given in the presence of the leading physicists at the fifth Solvay Congress in 1927, as it is freely quoted from Allen and Unwin, *Physics and Philosophy*, (1958):

"This interpretation starts with a paradox: The language of classical physics is merely a refined form of the language of daily life and that is the only language we have. Any experiment in physics, whether it refers to the phenomena of daily life or to atomic events, is to be described in the terms of classical physics. The carefully defined concepts of kinematics, dynamics and electromagnetism form the language of science by which we describe all arrangements of our experiments and state all results.

"Consequently we cannot and should not replace these concepts by any others. Nevertheless, we have learned that the application of these classical concepts in describing the structure of the atoms or that of radiation creates unresolvable contradictions. We have found that the language which was so successful for three centuries of science, reached its conceptual limits when describing the duality of radiation and matter, and we



must keep this in mind while using it. We cannot and should not try to improve these concepts, but extend the description of an event where it is needed by the language of the quantum theory, with its uncertainty relations and probability functions as described by matter-waves. Therefore, the theoretical interpretation of an experiment requires four distinct steps:

"1. The description of the theory and the method of an initial measurement of the phenomenon in the language of classical physics,

"2. the translation of this experimental situation into the probability function of the quantum theory,

"3. the following up of this function in the course of time,

"4. the statement of a new measurement to be made at the new time, and a statement of that result, which can then be calculated from the probability function and expressed again in the initial language of classical physics.

*"With this method the duality of waves and particles becomes a problem of mathematical transformation. The formalism is written to resemble classical mechanics, with equations of motion for the coordinates and*

*the momenta of the particles. By a simple transformation it can then be rewritten to resemble the wave-equation for an ordinary three-dimensional mechanical wave, where this wave-function gives the amplitude of the waves resulting from diffraction or interference at any point of space. For matter-waves the same formula can be interpreted as a function which gives the diffracted electron's probability to be at any point of space. That is why, in this interpretation, matter waves are called probability waves.*

"Thus the classical conceptual possibility of playing with different *complementary* pictures of waves and particles, has its parallel in the transformation of the mathematical expressions from one into the other. To illustrate this method, consider the following simple, ideal experiment:

"(1) The Bohr-model of the atom consists of a nucleus and one or more orbiting electrons. If this description of the atom is accepted, then at least in principle, it should be possible to observe the electron on its orbit through a microscope of ideally high resolving power. In order to achieve accuracy in this measurement, the microscope should use gamma-rays with wave-length smaller than the size of the atom.

"The electron's initial position is determined when it scatters the illuminating gamma-rays into the objective lens, through which it reaches the observers retina or the photographic plate. To determine what happens to the electron when it scatters the gamma-rays, the photon concept of radiation and the corresponding Compton collision should be considered.

"(2) From this point on the language of the quantum theory has to be applied. The electron is taken as a matter-wave, the probability function is set up and the classical equations of motion is transformed into the wave-equation of probabilities.

"(3) Following up the probability function in the course of time is a mathematical procedure and the result is a combination of statements about possibilities or tendencies in the position and momentum of the electron, together with statements about the uncertainty relations, which represent our potential knowledge of the facts. It is also statistical in nature, since the wave function only predicts the probabilities of the electron to be in a certain place at a given time.

"(4) Based on the prediction of the probability function a second gamma-ray experiment has to be set

up to determine the actual position of the electron which, will again involve the uncertainty principle.

"Since the energy of the first gamma-ray photon was more than enough to knock the electron out of the atom, the second determination could only show the electron on its path receding from the atom and we can never observe more than one point of the orbit, therefore, there is no electronic orbit in the ordinary sense. Further more, quite generally, quantum mechanics cannot describe a trajectory in its classical sense, because there is no way of describing what happens between any two consecutive observations in the atomic order of magnitude."

This is then the present stage in the history of human knowledge.

According to 20th Century physics and philosophy, the potential understanding of the works of Nature through the improving rational comprehension of physical phenomena and the ever-widening logically consistent description of reality, *finally and unavoidably reached its ultimate evolutionary limitations.*

## **CHAPTER FOUR**

### **THE EPISTEMOLOGICAL REVOLUTION**

Looking at the history of science as of part of the history of ideas means seeing it primarily as a continuous attempt by men to arrive at a rational comprehension of natural phenomena, and to construct a logically consistent picture of nature.

The expansion and rapid growth of knowledge from the seventeenth century onwards, which established science as an autonomous field of human thought, occurred mainly in the field of mechanics and astronomy. There are several reasons why these two branches

of physical science were developed first, out-pacing all other branches of physics. One is that the starting point of mechanics is kinematics, the study of motion, and motion is the simplest and most universal phenomenon of both earthly and celestial observations. The direct, everyday experience with macroscopic objects and the regular motions of astronomical bodies naturally created the concepts of distance, time and velocity and suggested a differentiation and categorization of all motions by those concepts.

The observation of '*push and pull*' by muscular forces, impacts in collisions between bodies and in general every direct contact that alter the motions of material bodies suggest a most intuitively obvious and simple means of explanation for all kinds of physical occurrences. In other words, mechanical models lend themselves more readily than any others to analogies for the demonstration and clarification of how events are related in Nature.

The mechanistic mode of thought has been present in physical explanations since antiquity. From the time of Gallileo, Descartes, and Huygens the trend toward such a way of thinking expanded into an all-embracing mechanical view of the world.

The innovations of algebraic and geometric methods for calculating speed and acceleration, and the appearance of the three dimensional *Cartesian coordinate system* created the stage for the scientific shorthand of mathematics, symbolizing the intuitive physical concepts and rendering the ability for a precise description of their empirically established quantitative ratios and proportionalities.

With Descartes' and Huygens' introduction of the luminiferous aether, an all-pervading hypothetical medium, the conclusions and theories of terrestrial mechanical experiences was extended into the whole space of the Cosmos.

The phenomenon of light received its mechanical interpretation based on a direct analogy with the waves of sound as the compression waves in the aether and attempts were made to explain the regularity of the motions of heavenly bodies based on the assumed hydrodynamic characteristics of the same medium. The systematic motion of the planets were not guided by the Gods anymore, but they were quietly carried by the Cartesian aether in the cosmic vortex of the Sun, similar to the circulating fallen leaves in the eddies of a running spring.

Mechanicism has profoundly influenced philosophical and epistemological thoughts by restricting scientific modes of explanation of natural phenomena to purely causal considerations through mechanistic analogies and gradually discarding all theological speculations from the description of the physical world. The full program of mechanicism was to replace the concept of *action at a distance* all together by tracing back the cause of all natural forces to the simplest mechanism of collision and impulse between material particles.

Nevertheless, this ambitious program of mechanistic philosophy proved to be an impossible task at the level of experimental science at that time.

Instead, toward the end of the seventeenth century Newton's 'Principia' appeared on the stage and rendered the first serious attempt to construct a theory of mechanics through a systematic scientific method starting from definitions and axioms, followed by theorems and conclusions of a general nature, based on the whole body of theoretical and experimental knowledge available. Implicit in his work was an analysis of the metaphysical foundation of mechanics by clearly defining the basic concepts needed for the description of physical reality: *time* and *space*.

"I. Absolute true and mathematical time, of itself, and from its own nature, flows equably without relation to anything external.

II. Absolute space, in its own nature, without relation to anything external, remains always similar and immovable." (Principia)

Newton's work furnished most of the basic tools for the systematic dynamical approach to the physical world. The concept of inertial mass, the laws of inertia, force, acceleration, action and reaction, and that of universal gravitation implicitly contained all the essentials for the subsequent development of physics, not only in the description of earthly and celestial mechanics, but in the most general manner in all departments of natural sciences.

Nevertheless, this simple axiomatic system of mathematical ratios and proportionalities was set up between the conceptually unclear and mechanically inconceivable notions, such as the *inertial mass*, and the *action at a distance force of gravity*, and therefore it represented a total desertion of the reigning philosophy of mechanicism. Boyle, Huygens, Leibnitz and other mechanistic philosophers characterized the notions of Newton's Principia as a relapse into medieval concep-

tions, a kind of treason against the doctrines of mechanicism which already emancipated scientists from the animistic explanatory principles of scholastic physics based on the powers possessed by inanimate objects, like that of the inertial tendencies of Newtonian mass.

The reason for this severe apprehension was for the possible retrograde metaphysical influence on the further development of theoretical physics. Indeed, through the development of classical and modern physics the word '*force*' all too frequently performed a function which did not differ essentially from the scholastic concepts of qualities and powers. The same physicist, who scoffed at the description based on animistic explanatory principles, felt perfectly satisfied by the statement that a '*force*' was being exerted on a body in spite of the complete blank in his mind about the mode of this exertion. And the effect has not yet ceased to work even today, for it can be observed too often, that the pronunciation of the magic word of '*force*', or its various modern substitutions, still creates some seemingly satisfactory imitation of conceptual understanding.

To avoid any false impressions, it should be clarified here, that Newton never believed or stated that the ulti-

mate causes of his forces are essentially *unknowable*. On the contrary, his statement of not attempting to hypothesize about the origin and mechanism of the force of gravity, or the fictitious force of inertia, in no sense meant a final abandonment of the problem, or the ultimate description of the causes of the phenomena in question. He stated, that the absolute quantity of a central force, the strength of a centre of force, is merely a *mathematical concept*. When it is said a centre attracts, this is not intended to indicate the true character of the operation of the force or to describe its physical cause.

Describing the physical phenomenon of the force of gravity, one is only justified in stating, that two particles in each others presence have accelerations in opposite directions along the line joining them and vary inversely as certain invariable coefficients to be assigned to the particles, namely their masses. Acceleration is a purely kinematic magnitude and mass is a quantity determined empirically for a given material body. Therefore, the physical concept of force is merely an abbreviation of the interaction described above.

Newton declares the following points as cardinal importance in his scientific method; "firstly the reduction of all phenomena to the operation of a small num-

ber of active principles of *motion*, of which gravitation forms an instance, and secondly the hope or expectation that ultimately the causes of these principles too will not remain hidden." For him the existence of gravitation is no hypothesis, but an empirically established fact, and he looks upon it as only a matter of time before the cause and transmission of this force will be discovered. Although Newton discarded Descartes' aether-vortex hypothesis, until the end of his long life, he never quit speculating about the mechanics of "a most subtle spirit which pervades and lies hid in all gross bodies, by the force and action of which the particles of bodies attract one another."

Describing the grounds, methods, limitations and the conceptual validity of his theories, it can be stated that Newton took a stand with respect to the philosophy of knowledge laying down the foundation for the epistemological rules of classical physics.

Through the subsequent evolution of scientific thoughts, these tendencies has never been revoked or revised by Newton or by anybody else who took an active part in the construction of human knowledge. The problem of the action at a distance forces remained a temporarily accepted mystery, but the

search for a mechanistic solution for this phenomenon has never left the agenda of theoretical physics.

In its philosophical implications, this mechanistic view of the world led directly to causality and determinism. If the world is a machine, that once had been put into motion by its creator then, no matter how complex it is, in principle, every effect is the result of a cause, and itself becomes the cause of the next effect.

It is only a matter of finding the general design and laws of the machine and forming a complete understanding of the present state of the system, from which both the future and the past can be calculated for any instant of time.

The following quote is taken from Sambursky, *An Anthology of Physical Thought* [19])

"The conflicting epistemological tenets of empiricism and rationalism were brought to a practical synthesis in the course of the development of exact sciences during the last three hundred years. A survey of the history of physics since the age of Galileo and Newton shows in particular that the formation of scientific theories begins with the putting forward of hypotheses, after a minimum of empirical data has been accumulated.

Then the consequences of the hypotheses are deduced, and put forward as factual assertions to be compared with, and checked against, the experimental results.

"Thus theory and experiment constantly interact with and mutually support each other. What actually happened in the course of a long process of merging 'factual' and 'conceptual' elements into a higher unity was that the former gradually came to be seen less as '*pure facts*', immediately dependent on sense perception, and more as '*higher order facts*', the understanding of which tacitly presupposed the knowledge of simpler facts as well as an increasing theoretical element.

"The conceptual components, on the other hand, became more and more remote from the elementary abstractions of the world of commonly accepted concepts and changed into *scientific constructs* which combined the results of purely theoretical considerations with the knowledge of facts of a higher order. In brief: the synthesis of the factual and conceptual components of scientific knowledge emerged as the result of a long and gradual evolution, during which each of these components itself turned out to be the product of a synthesis of factual and theoretical elements.

"The gradual emergence of a physical picture of the world, including the scientific constructs which are already regarded as elements of physical reality in no less degree than observed facts, became more obvious from the early nineteenth century onwards when scientific observations and theoretical deductions began to support and confirm one another in fields other than pure mechanics.

"The physicist of this era succeeded in putting the phenomena of light, electricity, magnetism and heat on a consistent and systematic basis. Further, it gradually became clear that several of these partial domains of reality were interconnected, as in the linking of mechanics to heat, the fusion of electricity and magnetism, and the explanation of the essential features of light within the framework of electromagnetism. This successive fusion of previously partial pictures into one picture of increasingly universal validity appeared in itself as a confirmation of the synthetic method of physical sciences and as a kind of verification of the epistemological principles on which these sciences were founded.

"Thus it became increasingly unlikely that one of the major laws of physics could be falsified without affect-

ing the rest. Indeed, modern science is like an edifice which could easily collapse if one of its essential building stones were removed."

The most typical and demonstrative example of the power of abstraction based on mechanical analogies was the initiation and development of a theory of electricity and magnetism based on Huygens' supermundane light-conveying aether. The theory of electromagnetism was conceived through Faraday's tireless conceptual effort to draw a mechanically conceivable systematic analogy between hydrodynamic and electromagnetic phenomena by the designs of lines, tubes and fields of forces, originating from the stresses and strains in the supermundane aether medium. This most complex model of various electromagnetic phenomena was completed by Maxwell's ingenious mechanical details and their expression and incorporation into a complete mathematical system, which finally embraced light waves themselves as a small fraction of the multitude of so-called electromagnetic radiation.

Maxwell's electromagnetic equations became the complete description of the supermundane dynamics of electricity, magnetism and their various intertwined phenomena, including most everything that was



invented in the past, and exists in the wealth of today's electronics.

Through this era of unprecedented expansion of human knowledge and deepening understanding of physical reality the mechanical approach to explain natural phenomena became so deeply rooted in scientific thinking that toward the end of the nineteenth century the majority of physicists believed in the epistemological rule that a scientific theory had not been proved until its validity had been demonstrated in terms of mechanical analogies. Ironically, this very tendency created the seemingly unavoidable stumbling block in the progress of classical physics.

Faraday's giant leap of abstraction over two orders of magnitude, from macroscopic matter to ultramicroscopic aether, had never been completed. The hypothesis of the electromagnetic medium came to its final challenge; the requirement of producing a mechanical model for the aether itself. This mechanical model of the aether, which pervades macro- and micro-cosmos, had to comply with all all known natural phenomena, in all orders of magnitude.

The medium that conveys light waves through all space of the universe must also allow the unaffected

eternal motions of the stars and planets within. Furthermore, since the speed of propagation of light waves is finite, as other wave-phenomena, it should be measurable relative to the conveying medium itself. It follows, that the state of rest or the state of motion of the medium to the measuring device should also be a measurable quantity. In other words, the state of rest or motion of the aether relative to a laboratory submerged in it should be found in the variation of the speed of light when measured in different directions.

If the aether exists, this experiment would furnish an universal *aether frame of reference*, which would be then the mechanical proof of Newton's metaphysical concepts of absolute space and absolute motion.

Maxwell proposed a possible testing of the existence of such *absolute frame of reference* by proving the earth's orbital motion relative to the motionless aether through the measurements of the velocity of light in an earthly laboratory in different directions.

This test has been executed by Michelson in 1887 and has been repeated with ever increasing sensitivity, but proving no more than an *unexpected and illogical null result*. There was no trace of relative motion between the earth and the light-conveying medium.

Maxwell's followers, Fitzgerald, Lorentz and others set their goal to explain the phenomenon by the electromagnetic theory and based on the electromagnetic structure of matter.

Their basic hypothesis was, that matter is compressible and when moving relative to the aether it contracts in the ratio between the velocity of this relative motion and the velocity of light ( $\beta = \sqrt{1 - v^2/c^2}$ ). This hypothesis also explained another discovery of the 1880's, that the force needed to accelerate an elementary particle not only depends on the mass of the particle, as Newton predicted, but also on its velocity, and again in the same ratio as above. Based on the electromagnetic construction of matter, Michelson's null result and Fitzgerald contraction ratio, Lorentz derived a mathematical system to describe and explain most of the problems of this new group of phenomena. The Lorentz-Fitzgerald contraction hypothesis was the last attempt to preserve the central position of mechanics and that of the aether in theoretical physics and with it the conceptual coherency of scientific thoughts and the methods of classical epistemology. The mathematical system of this theory was later adopted by relativity under the name of Lorentz Transformation.

No doubt, this was the exact turning point not only in the evolution of physical sciences, but more generally in the evolution of human knowledge, philosophy and epistemology.

For a historical background, it should be noted here, that the upheaval of revolutionary advances were not restricted to the field of scientific thoughts. By the turn of the century the accelerating growth of knowledge in all fields of science resulted in an explosive industrial revolution and in the wake of the great success of mechanicism came a general philosophical and sociological unrest. As metaphysics lost ground in the description of Nature, the religious controlling power of the churches alarmingly dissipated, and in its place common sense, causality, determinism and materialism gained strength in the social ideologies. Meanwhile, World-war I. was in the making, and international communism spread through the world keeping steps with technology and industrialism.

One might ponder upon what parallel could be found between this stormy background and the simultaneous epistemological revolution?! For whatever reason, after three centuries of continuous and systematic development of an ever more comprehensive mechani-

cal description of the physical world, within a couple of decades of the twentieth century the majority of the western scientific establishment was not only ready to consider that something is basically wrong with the mechanistic and deterministic views of classical physics, but was also willing to accept fundamental changes in theory of knowledge totally at variance to the epistemological principles that guaranteed the successful evolution of classical experimental physics from the times of Galileo and Newton.

Where did this sudden revolution of physical thoughts lead and what had modern physics to offer as a substitution for mechanical understanding?

Consider the following excerpts from S. Sambursky: *An Anthology of Physical Thought*, [Introduction]:

"Nineteenth century physicists clung to the idea of aether tenaciously because the wave theory of light and of electromagnetism strongly suggested the aether as a medium of propagation of these phenomena. Einstein's interpretation of the failure to detect the aether (Michelson's null result) was revolutionary in many respect; by discarding the aether he implied that there was a limit to the value of mechanical models and analogies.

"Einstein's principle of relativity deeply effected philosophical and, in particular, epistemological thoughts in that it abolished Newton's fundamental metaphysical concepts of absolute space and time, which were superseded by that of the absolute magnitude of the velocity of light. Intervals of length and time became relative magnitudes, depending on the state of relative motion of observer and the observed body.

"Space itself and time itself were reduced to mere shadows and only the space-time interval between two event in the four-dimensional world was held as an invariant. The obvious philosophical conclusion was that reality was of a more abstract nature than the world of '*common sense*' made familiar through daily experience.

"The theories of pre-quantum physics, including relativity theory, were deterministic in the sense that from the state of a system at a given moment they derived mathematically its state at any other moment. The initial state of a system was determined if two independent sets of data, the positions and velocities of the bodies were known. In classical epistemology it was tacitly assumed that there were no limits to the exactness of this knowledge. Things are different, however, in the

micro-region where the means of observation and the observed object are of the same order of magnitude. The epistemological consequence of *quantum mechanics* is the revision of the concept of a phenomenon. An observed phenomenon cannot be completely divorced from the experimental arrangement.

"The events connected with the observation will always force the scientist to make an arbitrary division between observer and the observed object. The well-known duality of corpuscle and wave, or rather that of the discontinuous particle aspect and the continuous field aspect of light and matter, represents the experimental confirmation of the idea that the observer is part and parcel of the phenomenon.

"Thus, the centuries-old argument whether light consists '*in reality*' of waves or of particles has thus become meaningless.

"There is, however, an interesting parallel between the operational aspects of the conceptual revolutions caused by relativity and by quantum mechanics. If the speed of transmission of the signal assumed to be *infinite, not finite*, the classical picture of absolute space and time, and the discarded concept of simultaneity of events is restored; if Planck's quantum of action is

assumed to be *zero, but not small and finite*, the classical picture of determinism and a continuous sequence of physical events is likewise restored.

"The most prominent feature of this newest venture was the fact that science itself took the lead from philosophy when physicists, on the advent of relativity and quantum mechanics, had to look at the foundation of their subject and were *forced* to revise their epistemology of science. *In the light of the scientific world-picture which has emerged from these efforts, nobody would deny any longer the metaphysical nature of those foundations.*"

"The new concept of a phenomenon, denying as it does the existence of an 'objective' reality independent from the observer, has shed new light on the relation between physical thought and other fields of human knowledge. Niels Bohr, by coining the notion of complementarity, has drawn attention to the universal significance of the new attitude to the problem of man *versus* the outside world. His interpretation of *Heisenberg's uncertainty principle*, the mathematical expressions of the *indeterminacy* of a physical state, centered round the notion of a pair of *complementary opposites* (wave-particle), the two sets of data characterizing that state.

"(...) Bohr's contention is that this physical complementarity represents a logical extension of the classical notion of causality, and that it is to be regarded as a special case of a universal phenomenon pertaining to the world of human experience. He pointed at several pairs of complementary opposite concepts, such as thinking and feeling,... and referred to examples taken from ethics, aesthetics, epistemology and sociology, such as the problem of the *freedom of the will*, or that of *justice and love*...In the forty years of the last great theoretical breakthrough, an enormous wealth of new experimental data has accumulated in elementary particle physics, astrophysics and cosmology.

"*However, theory has been lamentably lagging behind experiment in recent decades.* Many eminent physicists of the last generation, notably Bohr and Pauli, have expressed the opinion that quantum mechanics may well be the first of many more steps, which will lead physics away from the familiar classical concepts. A major theoretical advance from here could possibly be achieved *only* through ideas involving further radical renunciations of some notions to which physicists become accustomed in the age of determinism, which was also the age of mechanical conceptions."

For an even less optimistic point of view, consider the following:

"Today the outer limits of man's knowledge are defined by *Relativity*, the inner limits by the *Quantum Theory*. Relativity has shaped all our concepts of space, time, gravitation and the realities that are too remote to be perceived.

"The quantum theory has shaped our concepts of the atom, the basic units of matter and energy, and the realities that are too elusive and too small to be perceived. *Yet these two great scientific systems rest on entirely different and unrelated foundations. They do not, as it were, speak the same language.*

"Believing in the harmony and uniformity of nature, Einstein looked for a single edifice of physical laws to encompass both the phenomena of the atom and the phenomena of outer space. The purpose of his *Unified Field Theory* was to construct a bridge between them. Its obvious minimum achievement was supposed to be, to unite the laws of gravitation, and the laws of electromagnetism within one basic superstructure of universal law.

"*The idea that there are two structures of space independent of each other, the metric-gravitational and the*

*electromagnetic,' -- Einstein observed, -- 'is intolerable to the theoretical spirit.'* A complete Unified Field Theory touches the *'grand aim of all science to cover the greatest number of empirical facts by logical deduction from the smallest possible number of hypotheses or axioms.'*

(...) Yet despite all his efforts in the last twenty five years of his life he could not incorporate electromagnetic laws into general relativity.

"But the irony of man's quest for reality is that as nature is stripped of its disguises, as order emerges from chaos, as concepts merge and fundamental laws assume increasingly simpler form, the evolving picture becomes ever more remote from experience. For there is no likeness between the image of a tree transcribed by our senses and that propounded by wave mechanics, or between a glimpse of the starry sky and the four-dimensional space-time continuum that has replaced our perceptual Euclidian space. In trying to distinguish appearance from reality and lay bare the fundamental structure of the Universe, science has had to transcend the 'rabble of the senses'. *'But its highest edifices, (Einstein has pointed out) have been purchased at a price of emptiness of content.'*

"A theoretical concept is emptied of content to the very degree that it is divorced from sensory experience. For the only world man can truly know is the world created for him by his senses. If he expunges all the impressions which they translate and the memory stores, there is nothing left. And what today's scientists and philosophers call the world of reality, the colorless, soundless, impalpable cosmos which lies like an iceberg beneath the plane of man's perceptions, is a skeleton structure of mathematical symbols. (Barnett's *The Universe and Dr. Einstein*, 1957, [109] )

## PROFIT AND LOSS

Since there is no coherent theory about the meta-physical foundation, methods and validity of modern knowledge, modern epistemology, the expected result of this revolution exists mainly in the sporadic personal foot-notes of the eminent scientists. Most probably due to the fact that the two major theoretical breakthroughs rest on entirely different foundations, executed by different methods, and described in different languages, modern epistemology cannot give an unified direction to be followed by future science.

Now, at the ending of this century of revolutions, in the absence of a unifying description of the fundamen-

tal aspects of modern physics, one might attempt to gain a general evaluation by simply drawing the bottom line of the profit and loss statement of human knowledge for this past century. However, before getting into the details of this scientific balance sheet, some very noticeable but so far practically unmentioned general aspects of modern scientific methods should be pointed out.

There was an unwritten, though universally respected epistemological method in the evolution of scientific thoughts up until the twentieth century that can be described in short as follows:

When a highly successful and widespread physical theory was opposed by some accumulated experimental evidence about a newly discovered group of phenomena in a particular field, the tendency has been first of all to try to save the theory by all means. In case of persistent disagreement with the facts of this specific field, for the sake of preserving the validity of the theory for the rest, serious attempts had to be made to re-evaluate each detail constituents of the theory that might cause this contradiction.

Sometimes the theory had to be disassembled to the faulty point, from which it could be rebuilt again

explaining all facts of its whole territory in the same language and with the inclusion of an explanation for the newest empirical facts. This relentless investigative approach was a must for the successful growth of three centuries of classical physics.

Examining one by one of the crucial problems, that triggered the epistemological revolution by modern theoretical physics, it can be found that at least five important deviations had to be committed with respect to the above described method before the first fundamental postulate of the new theories could be declared.

First, after some accumulation of opposing data in a comparatively narrow field of classical physics, comes a categorical negation of the ability of the present theory to explain the problematic phenomenon. This includes the conviction that no details of classical physics can be revised without affecting its validity as a whole.

Second; the categorical negation then extended to the general conclusion that the tools, concepts, laws, logic and language of classical physics are insufficient to describe the problematic phenomena.

Third; since there is no solution to this problem, but the classical principles must be saved for the rest of their territory, this new group of phenomena must be

isolated from the body of physics and to be described by different concepts, language and logic, which are beyond the critical boundaries of common sense.

Fourth; since the predictions of the otherwise universally successful classical theory was proven to be wrong for this isolated group of phenomena, a mathematical formula should be found to express the exact ratio for the difference between the classical predictions and the experimental facts. This formula, incorporated with classical mathematics will then render a method of transformation, which in each individual calculation will give the mathematically adjusted right predictions.

Fifth; because there is no humanly conceivable reason for this mathematical transformation, except to fit the new experimental facts, it must be raised to the level of a fundamental metaphysical assumption, which translated into the language of classical physics, becomes the first postulate of the modern theory.

Consider the two major examples: Both the special theory of relativity and the quantum-photon theory follows these exact steps. The results were, the metaphysical postulate of relativity in the form of *the absolute speed of light*, which was derived from the Michelson null result and mathematically expressed by the

Lorentz Transformation. Similarly, metaphysical quantum postulate of *the discontinuity of radiation energy* was based on Planck's quantum, established empirically and derived through the mathematical interpolation of two erroneously predicting classical equations.

There is also a sixth very important step in this modern method:

The final and general acceptance of the new hypothesis is based on the total reversal of the true procedure via the so-called correspondence principle, which states that the modern theories represent the most general form of scientific knowledge, out of which the laws of classical physics merely represent the special cases, when the velocity of motion is much less than that of light, or when the matter-wavelengths of macroscopic bodies are very small relative to Planck's Quantum. The same method can be found in all aspects of modern physics, from the major breakthroughs down to the very details of the individually designed experimental theories, all through the astonishing modern achievements of the twentieth century.

As far as the profit and loss statement goes:

The fundamental theoretical duality which has shown itself in the nineteenth century as a mechanical



problem between Newton's cosmic void and Maxwell's allpervading aether, now transformed into the admitted modern controversies between waves and photons, particles and matter-waves, continuity and discontinuity, determinism and probability.

But while originally it was a duality within the territories of classical physics, and described by the same language, now the duality spread into the two separate departments of modern theoretical physics, which however, do not communicate with one another. Thus, the old-fashion duality now is *quadrupled*.

Nevertheless, finally, in the conceptual labyrinth of *quantum mechanics*, and that of Bohr's notion of '*complementarity*' which justifies the transformation between conceptually empty and mathematically mutually exclusive statements, the problem of duality allegedly dissolved into a mathematical formalism and hence declared to be *all together meaningless*. By this time, however, it is quite difficult to distinguish between '*meaningless*' and '*meaningful*', since even meaning has different meanings in each theory.

Hence, within these few revolutionary decades we have successfully expelled from physics the 'three

frightening ghosts'; *absolute time, absolute space and absolute motion*. But we have gained an *absolute velocity for light*, which is, however, mechanically measurable and varies with the densities of different media.

We got rid of the *covariance* of electromagnetism and the *invariance* of the accelerated coordinate system, though we had to invent contracting yardsticks and ill-rhythmed clocks, shrinking and ticking by the guidance of the different illusions of different observers.

We have ingeniously escaped from the primitive notions of the mysterious *inertia* and *acceleration* by simply rotating the whole universe around Newton's bucket.

In order to free physics from the perplexing notions of light and the action at a distance force of gravity, we had to learn about the basic capability of empty space to transmit waves of nothing through nothing, and the sophisticated non-euclidian capability of the same nothing to react to the presence of matter by bending itself into different curvatures which for some unknown reasons quantitatively still depend on the mysterious gravitational mass, still proportional to Newton's inverse square-law and astonishingly enough still creates orbits according to Kepler's heavenly harmony.

We have left Descartes' mechanicism, Newton's mathematical forces, Faraday's stress and strain fields, and Maxwell's clumsy mechanical scaffolding, we have discarded logic and common-sense, left behind the outdated conceptual perception of reality, and finally in a sweeping epistemological revolution we have trashed the very hope that we can ever *understand* anything around us. – Nonetheless, we have achieved the ultimate skill of fabricating, abstract mathematical superstructures to fit any experimental curve for the sake of predicting the otherwise unpredictable, though unfortunately this final description of modern reality is forever buried in the humanly unscramblable language of empty symbols.

Only through these inevitable, bold, astonishing, modern innovations and sacrifices did we finally achieve Einstein's religiously humble goal of demolishing the infantile mechanical notion of the allpervading, luminiferous, unmentionable e - - - r.

*...Or did we...?!*

# **PART II.**

## **THE KINEMATICAL SOLUTION**

## **FOREWORD**

### POSTULATES VERSUS COMMON SENSE

"Of all the branches of physics, only thermodynamics attracts more cranks than special relativity. Is it really scientific to just dismiss them ? Should we not examine each case on its scientific merit, lest our conservatism lead us to miss out on the next scientific revolution ? No, not at all.

"The reason we can give such a flat answer is that most critics of special relativity are concerned with its inconsistency, not with the experiments that verify it. All such claims of inconsistency can be ignored, because the logical consistency of special relativity can be demonstrated. Although a physical theory is a correspondence between things in the physical world and structures in mathematics, the question of consistency is a question about the mathematical model; and, like many mathematical questions, it can be answered decisively." (W.L.Burke: Spacetime, Geometry, Cosmology [55])

It is only fortunate that classical physicists were more open minded, or less preconditioned by their own successful theories than their relativistic successors, otherwise the patent clerk from Bern would remain forever unknown, there would be no Einstein Centenarium, and professor Burke would not have the chance to write those wise words. As for the first part of the quotation, we must call Doctor Einstein to our defense, who said:

"Theoretical physics is best done by a plumber, who is not constantly pressured to justify his existence by producing scientific research, but instead can consider the most important problems." (Taylor, New Physics, 1972, [92])

The main reason, however, for including Burke's thoughts is, that the point, from which we meant to start this study is exactly what he refers to; the relationship between the theory of relativity, its mathematical model, and its experimental verification.

Here it should be clarified again that the above mentioned mathematical model was developed by Lorentz in 1888, seventeen years before the actual birth of special relativity. The hypothesis was an extension of Maxwell's Electromagnetic Theory and

based on the existence of the aether. The fundamental set of equations of Relativity is still called: The Lorentz Transformation.

In 1905 Einstein declared his basic philosophical postulates and re-derived from them exactly the same equations. Nevertheless, even within the framework of the Special Theory, the mathematical model kept Lorentz's name and the best that relativity can claim is that the mathematics derived from Einstein's postulates are equivalent to that of Lorentz's. - An objective way to find the general opinion of physicists about the subject is, to read about it from several authors.

Here are a few informative quotes :

a) Silvio Bergia, Einstein Cent. - 1979, [86]

"A really experimental decision between the theory of Lorentz and the theory of relativity is indeed not to be gained; and that the former, in spite of this, has receded into the background, is chiefly due to the fact that, close as it comes to the Theory of Relativity, it still lacks the great simple universal principle, the possession of which lends the Theory of Relativity from the start an imposing appearance." The difference in the two theories is that: "for Lorentz they are

equations of transformations which make the equations of the electromagnetic theory covariant, for Einstein, expressions of the general properties of space and time."

b) Lincoln Barnett, Dr. Einstein..., 1957, [51]

"Einstein concluded that a new transformation rule must be found to enable the scientist to describe the relations between moving systems in such a way that the results satisfy the known facts about light." (Michelson's null-result).

"Einstein found what he wanted in a series of equations developed by the great dutch physicist, H.A. Lorentz, in connection with a specific theory of his own. Although its original application is of interest now chiefly to scientific historians, the Lorentz transformation lives on as part of the mathematical framework of relativity."

c) Lincoln Barnett, Dr. Einstein..., 1957, [129]

"From his two postulates Einstein deduced a number of surprising results. The most basic one is a new set of transformation equations which allow us to write down what an observer sees when he looks at another moving coordinate system and 'vice versa'. These equations are known as the Lorentz Transfor-

mation, because it was Lorentz who first found that they could explain how it was that the speed of light was constant, though he still clung to the idea of the 'ether'. Einstein did away with the ether and obtained the same transformation in a much simpler and more basic manner."

d) Bertrand Russell, *ABC of Relativity*, 1969, [52]

"Indeed one of the main motives of this whole theory (special relativity) is to secure that the velocity of light shall be the same for all observers, however they may be moving. This fact, established by experiment (Michelson-Morley), was incompatible with the old theories, and made absolutely necessary to admit something startling.

"The quantitative laws of electromagnetic phenomena are expressed in Maxwell's equations and these equations are found to be true for any observer, however he may be moving. It is a straight forward mathematical problem to find out what differences there must be between the measures applied by one observer and the measures applied by another, if in spite of their relative motion, there are to find the same equations verified. The answer is contained in the Lorentz transformation, found as a formula by

Lorentz, but interpreted and made intelligible by Einstein."

e) Taylor, *The New Physics*, 1972, [88]

"Lorentz who put forward relations between the distances and the times as observed by persons moving relatively to each other, still believed in the existence of the ether. Even fifteen years later Lorentz still attached some value to the idea of absolute space.

"The lengths of moving objects, which appear shortened according to special relativity is identical to the contraction of lengths that was suggested by Lorentz and Fitzgerald to explain the null result of the experiment of Michelson and Morley. The agreement between this earlier suggestion and the results of Einstein's Special Theory of Relativity is certainly to be expected, since they both concern the fact that the velocity of light is independent of how it is measured.

"However, we must remember that Einstein took this result as a postulate and deduced that objects would appear to contract on moving, while Lorentz took the contraction as basic and tried to explain the constancy of the velocity of light."

f) Atkins, Physics, 1976, [464]

"A most ingenious suggestion to explain the Michelson-Morley experiment was made by Fitzgerald and elaborated by Lorentz. They suggested that, when a body moves through the ether, its length is contracted in the direction of motion.

"The atoms of a body are held together by electromagnetic forces. If the ether is the medium through which these forces are transmitted, motion through ether might modify the forces in such a way as to make the atoms move closer together in the direction of motion.

"However this possibility was excluded by an experiment performed by Kennedy and Thorndike, which was designed to counteract the predicted contraction, and still produced a null result. A possible misunderstanding of the significance of the Kennedy-Thorndike experiment should be avoided.

The point to be made is that the Theory of Relativity predicts the Fitzgerald-Lorentz contraction plus other effects (slowing clocks), whereas the Kennedy experiment proves that the Fitzgerald-Lorentz contraction alone is not adequate.

(To avoid the faulty impression, that Lorentz's theory was disproved before relativity was accepted, it should be noted that the Kennedy experiment was executed only decades later, in 1932.)

"Lorentz solved the mathematical problem of *how the laws of electromagnetism could be made the same in all inertial frames*, but it was Einstein who first fully understood the physical significance of the principle and who worked out its startling consequences."

Our point is, that if more than one philosophical interpretation can fit the same mathematical model, then the experimental verification, as such, cannot single out one of the several interpretations as a preference over the others.

The very basis of the model; the so-called Fitzgerald Ratio was constructed to fit the null-result of the Michelson-Morley experiment in general. It is a ratio between the velocity of light and the velocity of the observer which serves as a scale for the proportional difference between what is expected by the classical transformation and what is actually measured as the speed of light in the experiments. The square root one in the formula is merely an operator

which guarantees that while the velocity of the observer is small, the difference is unmeasurable, but as it approaches the velocity of light, the resulting difference approaches infinity. Fitzgerald used his formula as a factor of contraction of the measuring device in motion, to explain why there is a null-result instead of what was expected by the classical addition of velocities.

This mathematical model can be further stripped from the concepts of the velocity of light and observer, and just plainly described as a formula which assures that when quantity  $x$  increased to the quantity of  $y$ , the resulting proportion  $z$  increases *from zero to infinity*. This is the essential mathematical model that was filled with the different conceptual contents; the Fitzgerald's Contraction, Lorentz's electromagnetic theory, and Einstein's apparent contraction of rulers and slowing down of clocks. As long as any theory based on this formula merely searches for the expected but undiscoverable difference in the measurements of the speed of light, they are all logically consistent with the Lorentz Transformation.

Evidently, as for the experimental verification, nothing else has been proven but the validity of the

Fitzgerald ratio itself, which of course is totally meaningless, since it was constructed to agree with the experimental facts. Hence the experimental verification of the mathematical model represents no help whatsoever in the decision about the validity of any one of the existing theories or any others that can still be invented. Professor Burke is indeed very wrong to dismiss all arguments about the inconsistencies of The Special Theory of Relativity, based merely on the experimental verification of the mathematical model.

Nevertheless, an argument about the inconsistencies in the Special Theory would surely be futile, since discarding common-sense, Relativity left no possibility for logical disapproval.

The goal of this study is to introduce an alternate conceptual content for the same experimentally verified mathematical model. An attempt to uncover the physical meaning of the Lorentz Transformation, its relation to the other departments of Physics and to explain the classically unpredictable Michelson Null Result.

In the course of what follows, the Special Relativity, as a conceptual solution of the problem will



prove to be superfluous, in as much as, through the view here to be developed, the modern principle of relativity will neither be required for explaining the Michelson Null Result nor for the sake of unifying Theoretical Physics. Admittedly, there are some well accepted theories of certain phenomena, which support the relativistic conviction, that the only way out of the dilemma is through Einstein's postulates. Naturally, these theories will be in direct contradiction to any alternate scenario. In order to create some hesitation, in taking them as the indisputable truth, consider the following excerpts from the anthology; 'The Origin of the Solar System':

### "THE CREATION MYTHS

Speculation about the origin of the Earth and the celestial bodies is probably as old as human thinking. During the millennia which is covered by the history of science, philosophy and religion we can distinguish three types of approach to this problem.

"The first one is the theocratic-myth approach, according to which the evolution of the world was governed by gods, who created it by bringing order into a pre-existing chaos. The world was ungenerated and indestructible - as Aristotle puts it - and the

gods were part of this world and also eternal. The rise of the monotheistic religions changed this view. When one of the gods got higher status than others, he continued to increase in prestige and power until he became the Supreme Lord, the undisputed ruler of the whole world. Then it was not enough that he created the world in the sense of organizing a pre-existing chaos, he had created it all from nothing ('ex nihilio') by his will power.

### "THE MATHEMATICAL MYTHS

"With the rise of philosophy and early science, the gods became less despotic and increasingly philosophically and scientifically minded. The creation of the world and its evolution were parts of a master plan, and it was not unreasonable anymore that man should be able to understand this plan. The breakthrough in this thinking came with the Pythagorean philosophy.

"The Pythagoreans had discovered how beautiful and powerful mathematics was. They had found that musical harmonies could be explained as ratios between integers, and they demonstrated that there were five, and only five regular polyhedra.

"With such achievements it was quite natural that the Pythagoreans applied the same method to the macroscopic structure of the world. They tried to explain this in terms of simple numerical relations and in terms of logically and mathematically beautiful concepts - just like musical harmonies and geometrical figures.

"It was the task of philosophers and scientists to find what this cosmological mathematical principle was. They believed, they needed only one formula in order to understand the whole world. This approach may be called the mathematical myth, developed during the centuries into the Ptolemaic cosmology, which is impressive by its logical reasoning and mathematical beauty.

"However a comparison between this cosmology and observation led to a number of discrepancies and it was necessary to introduce a series of epicycles etc. which made the system increasingly complicated."

## EMPIRICAL APPROACH

"In the sixteenth and seventeenth century the Ptolemaic system broke down, and a new celestial mechanics was introduced. This represents the third

type of approach, the empirical approach. This was based especially on the investigations of falling bodies by Galileo and the very accurate astronomical observations by Tycho Brahe. With this breakthrough the scientific age started. The old myths, both the theocratic myths and the mathematical myths are dead forever. We live in the scientific age, the age of reason. But is this really true?"

## THE COSMOLOGICAL FORMULA

"What about the modern mathematical myths? Does the scientific community still subscribe to the Pythagorean belief that the structure of the universe could be solved by one simple mathematical formula? I am afraid that the answer is yes.

"Eddington, no doubt one of the leading astronomers of his time, claimed that the number 137 contained the solution of the cosmological problem. In his fascinating book *The Philosophy of Physical Science*, he claims that sitting in his armchair he had counted the number of protons in the universe and found it to be  $1.57477 \times 10^{79}$  or more exactly  $136 \times 2256 = 15,747,724,136,275,002,5778,605,653,961,181,555,468,044,717,914,527,116,709,366,231,425,076,185,631,031,296$ .

"Considered as a myth this is beautiful, but considered as science, it is a nonsense, and is nowadays generally recognized to be so. However, the collapse of Eddington's cosmology has not discredited the modern mathematical myths in general. On the contrary it seems rather to have acted as a fertilizer for a rich flora of mathematical myths of which some no doubt are attracted from an aesthetic point of view but none from a scientific point of view.

"One of them, the Big Bang cosmology (based on the Theory of the Expanding Universe) is at present generally accepted by the scientific community. The observational support for it, which he and others claimed, is totally obliterated, but the less there is of scientific support, the more fanatical is the belief in it. This cosmology is utterly absurd - it claims that the whole universe was created at a certain instant as an exploding atomic bomb much smaller than the head of a pin. It seems that in the present intellectual climate it is a great asset of the Big Bang cosmology that it offends common sense: *credo quia absurdum...* (I believe, because it is impossible!)"

The above quote originates from one of the most reputable anthologies on this subject, 'The Origin of

the Solar System' edited by S.F. Dermott, first published in 1976. The anthology contains the works of several eminent cosmologists and astrophysicists who had attended the meeting on the subject, sponsored by the NATO Advanced Study Institutes of the School of Physics. The specific article, that is quoted was written by H. Alfvén, Department of Applied Physics and Information Science, University of California at San Diego.

The contents and atmosphere of these remarks surely relieve one from the obligation to disprove the presently accepted cosmological theories before introducing an alternative description of the phenomena. What remains is the common sense requirement and ultimate goal of Natural Sciences and Philosophy: Obtaining an unified and universal theory of the micro- and macro-cosmos, based on the least number of fundamental assumptions, and both conceptually and mathematically capable of explaining and predicting the experimental results of the widest variety of natural phenomena.

Nothing less is the ultimate goal of the writings which follow...

## **CHAPTER FIVE**

### **UNIVERSAL ROTATION - UNIVERSAL GRAVITATION**

Rotation plays a pervasive role in the Universe on both the small and the large scales. On the small scale many of the fundamental particles, in particular electrons, protons and neutrons are found to be spinning like tops. Moreover the angular momentum of this spin is not arbitrary, but has a fixed value related to the fundamental constant of quantum mechanics, Planck's constant  $h$ .

An electron, a proton or a neutron always spin with precisely one-half a unit of angular momentum. Other particles such as the particle of light, the pho-

ton, spin with exactly one whole unit of angular momentum. When an electron is inside an atom, it revolves around the nucleus and in addition to its intrinsic spin of one half a unit, its orbital motion has an angular momentum which is always an exact integral number of basic units. When atoms come together to form a molecule, the molecule as a whole rotates with an angular momentum which is again an exact integral number of basic units. On an astronomical scale the Earth is well known to be rotating about its north-south axis once a day, producing a velocity at the equator of about 900 mph. The Earth also revolves around the sun with an orbital velocity of about 70,000 mph (30 km/sec).

The Sun itself is spinning at a rate which varies with latitude on the Sun but corresponds to about one revolution per month. There is evidence that most stars are rotating in a similar way. Many stars join together in pairs with the two members of the pair rotating around one another.

Together with the Earth, nine planets, their satellites and some asteroid belts are revolving around the Sun and each body rotates on its axis in the disk-shape formation, called the Solar System.

Our Sun is a member of a group of some hundred billion stars, called the Galaxy which is also a disk-shaped rotating system. Although it takes two hundred million years for the sun to complete a revolution about the galactic center, this requires an enormous tangential velocity of about one half a million miles per hour (250 km/sec).

The observable universe contains billions of such groups of stars, and there is good evidence that they are all in rotation. Observations reveals pairs of galaxies revolving about one another just like binary stars. There are also rotating clusters of galaxies, in various sizes, from a few members up to thousands . One of these is the so-called 'local group', which contains 17 galaxies, including our own Milky Way. All of these show the signs of rotation. It is now known that the normal state of a galaxy is to belong to clusters of different sizes. – The next and last in the order of magnitude within the observable universe is the cluster of clusters, called 'super-cluster' which is a conglomerate of the clusters of galaxies. It is quite safe to assume that these units are also in rotation around their centers of mass. The orders of magnitude in the above description of rotating units rang-

ing from the size of the electron, 0.0000000000001 cm to the size of a super-cluster, millions of light-years in diameter, which if we would attempt to write down in centimeters, the zeros after the first digit would fill up a whole book. Nevertheless there is one common characteristics to all of them ; Each rotating unit, regardless of its order of magnitude or that of its constituents, sustains some kind of autonomy with respect to the rest of the Universe. The forces from the immense external space only act upon a whole unit and only in very special cases do they effect the internal structure of one another.

If there is any epistemological validity in creating cosmological and cosmogonical theories at this stage of human knowledge, than the totally universal nature of the phenomenon of rotating systems all through space and time should outweigh all other single phenomenon with regards to serving as a fundamental assumption for such theories.

What has been described above, is not merely a bunch of unrelated discoveries from different branches of natural sciences, but seems to show a fundamental structural characteristic of the cosmos, which should be analyzed and treated as such.

It seems to us that our own order of magnitude, the solar system, falls roughly midway between the size of the elementary particles and that of the galactic superclusters. It is obviously not the first time when an optical or other anthropomorphic illusion has placed us into the very center of the Universe.

Whether the Universe is taken as finite or infinite, our center-position obviously originates from the contemporary level of the observational technology, which gives us an even penetration in all directions into the micro- and the macro-cosmos. There is than, the possibility for an infinite chain of smaller rotating units that make up the smallest we can observe, and the largest known units could be merely the constituents of the units of higher and higher order of magnitudes.

Since we know neither the internal structure of the electron, nor the hyperstructure that could exist beyond the superclusters, the possibility is not at all absurd that the rotating unit of a certain higher order of magnitude forms the internal structure of a super-electron, or that our electron's internal structure consists of galactic super-clusters of a lower order of magnitude.

Hence, the old inconceivable phrase, *infinity*, is here again; not only for space and time, but as the orders of magnitude structure of the Cosmos itself.

Nevertheless, no matter where we draw the border in this infinite chain, within that border, we are facing an autonomous Rotating Universe. The magnitude of this specific territory is quite indifferent. It can be assumed that either our laws of physics and astronomy are not affected by the external forces of the higher or lower orders of magnitude, or that they are all the same as we have established them in our limited but autonomous Rotating Universe.

In general, it can hardly be accepted that these repetitious formations of individual rotating systems were formed entirely on their own, and by pure accident. More likely, either smaller units have the inherent tendency to conglomerate into a higher order, or the internal mechanism of the larger ones bore the chance to form the smaller units. It could also be the inert character of matter, that creates rotating systems, or, the other way around, the universal mechanism of rotation is responsible for the creation of matter. Whichever is the case, one conclusion can surely be drawn from this universal phe-

nomenon: The very plausible correlation between the micro- and macro-cosmic units suggests that no theory about the Laws of Nature can be complete without describing the origin and maintenance of this universal phenomenon and the method of its propagation throughout the cosmos.

## MECHANISTIC ASTRONOMY

What do we know about the origin, the mechanism, or the possible correlation between these rotating systems? In general, human speculations about rotating system are as old as philosophy itself.

Around the year of 400 B.C., 2400 years ago, the greek Exodus of Cnidus proposed a system of astronomy, representing the motions of the celestial bodies by a combination of rotating spheres. By giving each sphere an appropriate rate of rotation and just the proper inclination of axis, he was able to reproduce approximately the complicated motions of the Sun and the planets as they revolved around the Earth.

About 140 A.D. Claudius Ptolemy worked out a geometrical representation of the solar system, that predicted the motions of the planets with considerable accuracy. He, of course, also believed in a

Geocentric Universe and it is a tribute to his genius as a mathematician, that he was able to conceive a system to successfully account for the observational facts. Ptolemy's immensely complicated hypothesis, describing how everything rotates around the Earth, was accepted as absolute authority throughout the middle ages.

Next, Nicolas Copernicus in the fifteenth century introduced his much simpler theory of the Heliocentric Universe.

This approach did not prove that the Earth was moving around the sun, but showed that the hypothesis of a moving Earth involved fewer ad hoc assumptions than the system with an orbiting Sun. Copernicus also placed the six (known) planets in their right positions in the solar system, putting Mercury nearest to, and Saturn farthest from the Sun. He also deduced the fact, that the nearer a planet to the Sun, the greater its orbital velocity.

The next great achievement in the investigation of the rotating Solar-system came through Johannes Kepler's Three Laws of Planetary Motion.

Living in the sixteenth century, Kepler's character was a mixture of a dark age mystic, and an incor-

ruptible modern scientist. His tireless effort in discovering the most basic rules of planetary motions and his theories about the mechanistic nature of the solar system makes his work the turning point in the history of natural philosophy from the Aristotelian school, toward modern science.

Not having, however, Galileo's clear concept of inertia, Kepler had not succeeded in ridding himself of the erroneous idea of Aristotle that even uniform motion requires the action of a constant force.

According to the concepts already known by Kepler from the theories of Grosseteste and Bacon about light-transmitting immaterial species, he assumed that the rotation of the sun imparts a rotary motion to these species and they represent the force that carries the planets along their orbits.

Under the influence of William Gilbert's work about magnets, Kepler outlined a magnetic theory for the celestial systems, where he assumes that all heavenly bodies are like magnets attract each other through their magnetic filaments which are concentrated in circles along the plane of the ecliptic.

These ideas already contained the seeds of both Descartes' Aether-vortex theory and Newton's funda-

mental idea of universal gravitation. Nevertheless, Kepler's most important contribution to the investigation of rotating systems came from the mystical side of his character. The religious faith in a divine harmony of Nature, expressible by mathematics, drove him on a tireless search for some kind of heavenly system, to be found in the motions of the Sun, planets and satellites. Through the examination of an immense amount of observational data and by the method of pure trial and error, he finally found the three simplest and most universal laws for the rotation of the Solar-system.

I. THE LAW OF ORBITS: All planets move in elliptical orbits having the sun as one focus.

II. THE LAW OF AREAS: A line joining any planet to the sun sweeps out equal areas in equal times.

III. THE LAW OF PERIODS: The square of the Period of revolution of any planet about the sun is proportional to the cube of the planet's mean distance from the sun.

Evidently these laws were purely empirical, they simply described the observed similarities in the motions of the planets. Kepler himself neither could connect these mathematical discoveries with his



mechanical ideas nor could he derive them from other known laws of astronomy or physics.

"Kepler's teaching provided the chief inspiration of Renee Descartes, French philosopher. His philosophy implied that bodies can act on each other only when they are contiguous; in other words, he denied action at a distance. This had the further consequence that if there is a force acting between the earth and moon, or between any bodies in space, then space could not be void. It is occupied partly by ordinary material things - air and tangible bodies; but the interstices between the particles and the whole of the rest of space, must be filled by particles of a much more subtle kind, which everywhere press upon or collide with, each other: they are the contrivance introduced in order to account for physical happenings.

"Space is, thus in Descartes' view a plenum, being occupied by a medium which, though imperceptible to the senses, is capable of transmitting force, and exerting effects on material bodies immersed in it, - the Aether, as he called." (Sir Edmund Whittaker, *Aether and Electricity*, [5])

Descartes' theory about the rotation of the solar system was also based on Aether. In his interpreta-

tion, a giant mechanical vortex formed in this medium around the sun, which caught and carried the planets with it, thus initiating a coherent rotating system with general dynamical laws of vortex motion, which governs all of the revolving units. Similarly, planets create their own subvortices, which carried their satellites.

Descartes was the founder of the strictly mechanical view of the Universe. His philosophy accepts no other explanatory principles for natural phenomena, but matter and motion. It followed from this principle that there can be no transfer of motion or force between material bodies, except through actual contact in bodily collision.

The mechanistic science of the seventeenth century reached its culmination in the work of Christian Huygens as described by the quotes below from E.J. Dijksterhuis, *The Mechanization of the World Picture*, [462]):

"Like Gassend and Descartes, he thinks, that in the physical world, motion can only be caused by motion and can only produce motion in turn. He resolutely rejects all thoughts of qualities or forces that may be immanent in matter, capable to cause action at a dis-

tance; gravity calls for a mechanistic explanation just as much as sound, heat, light, magnetism, and electricity, and he considers it his task to furnish this explanation."

"Huygens was the first to propose a geometrically and mathematically detailed wave-theory of light, based on the mechanical properties of the Luminiferous Aether.

"The idea that light is the vibration of a mechanical medium served later as the conceptual foundation of Faraday's and Maxwell's work, which led to the complete theory of electromagnetism. Huygens initiated the method of investigation of the phenomena of light-waves, magnetism and electricity through mechanical and hydrodynamic analogies. He also proposed a mechanical theory for gravitation.

"The explanation which Huygens gives for gravity is based on the idea introduced by Descartes' Aether-vortex, whirling around the earth. If among these rapidly moving particles of subtle fluid matter there are some coarser particles, which cannot follow their motion, the stronger centrifugal tendency of the former will propel them towards the centre of the earth. Huygens illustrated his theory by means of the fol-

lowing experiment: On a revolving table he placed a cylindrical vessel filled with water and in it small fragments of sealing wax, whose specific gravity was slightly greater than that of water. When the table was set rotating, these fragments moved to the sides of the vessel. When the water had attained the same angular velocity as the table, the latter was brought to a standstill.

"It is now found that the bits of wax collect near the centre. As the water carries the bits of wax along, they move in spiral paths toward the axis, but when they are prevented by horizontally stretched threads from being carried along, a bit of wax confined between such threads moves radially towards the axis."

Thus, Huygens was already aware of Galileo's concept of inertia, but in connection to rotation, he called it centrifugal force. His next step was to find, what kind of centripetal force is needed to overcome the inertial tendency of the bodies to fly off tangentially from the rotating system of the vortex.

Taking the earthly example of a stone whirling on a string, Huygens showed through simple geometry that the centripetal acceleration of a body is

directly proportional to the square of its tangential velocity and inversely proportional to the radius of the circle on which it is moving. But not having a clear idea of mass and force, he could not incorporate this result with his mechanical theory of gravitation.

Gassend, Leibnitz, Descartes, Huygens and others of that era contributed a great deal of clarity to natural philosophy and mathematics, but the principle that force cannot be communicated except by pressure or impact compelled them to provide an explicit mechanism for each of the known forces of Nature.

This task was evidently impossible for that era and still, even presently, it is much more difficult than the principal willingness to admit action at a distance as an ultimate property of matter or replacing the concept of force with the extraordinary properties of empty space.

Whittaker remarks in a footnote of 'Aether and Electricity [9] :

"It is curious to speculate on the impression which would have been produced had the spectacular spiral galaxies been discovered, before the overthrow of Descartes' vortex-theory of the Solar-system."

Nevertheless within a few decades, Isaac Newton appeared on the philosophical scene and simply cut the conceptual Gordian Knot by altogether disregarding the restrictions of mechanicism and presenting a purely mathematical theory of earthly and celestial 'mechanics'.

In his Three Laws of Motion Newton re-defined and finalized Galileo's concept of inertia correlating it with the concept of force and acceleration, clarified their conceptual relations and established the mathematical proportionalities among them. He postulates the fundamental assumption, that all material bodies exert an attractive force on one another and with the aids of Huygens' equation of centripetal acceleration and Kepler's laws of planetary motion, formulates the Law of Universal Gravitation.

Newton laid the foundations of classical physics and astronomy by rendering the complete theories of terrestrial and celestial mechanics, but before, proposing his own theory of Universal Gravitation, he refuted the Kepler-Descartes-Huygens Solar-vortex theory, based on the following argument:

"The hypothesis of vortices is pressed with many difficulties. That every planet by a radius drawn to

the sun may describe areas proportional to the times of description, the periodic times of the several parts of the vortices should observe the square of their distances from the sun; but that the periodic times of the planets may obtain the  $3/2$ th power of their distances from the sun, the periodic times of the parts of the vortex ought to be as the  $3/2$ th power of their distances.

"That the smaller vortices may maintain their lesser revolutions about Saturn, Jupiter, and other planets, and swim quietly and undisturbed in the greater vortex of the sun, the periodic times of the parts of the sun's vortex should be equal; but the rotation of the sun and the planets about their axes, which ought to correspond with the motions of their vortices, recede far from all these proportion.

"The motions of the comets are exceedingly regular, are governed by the same laws with the motions of the planets, and can by no means be accounted for by the hypothesis of vortices."

"...Still it was significant that Newton himself during his long life looked for such a mechanical explanation and tried to construct a model of an Aether whose density gradients could explain gravitation as

well as certain optical phenomena."(Sambursky : Physical Thoughts., Anthology, [305-17])

Obviously, Descartes' Solar-vortex hypothesis was far from being a scientific theory by modern standards. The theory was neither based on strict observational facts nor was it derived from some other already established laws of physics. However, from the standpoint of searching for the origin and mechanism of rotation, Descartes approached the phenomena of planetary motions as the problems of a rotating system, with a potentially coherent mechanical structure. From the same point of view, it is an important question, what alternative was offered by Newton's Theory of Gravitation to replace the central, mechanical role of the Solar-vortex?

"Newton claimed nothing more for his discovery than that it provided the necessary instrument for mathematical prediction and he pointed out that it did not touch on the question of the mechanism of gravity. However he still felt obligated to make the statement:

'...To suppose that one body may act upon another at a distance through vacuum, without the mediation of anything else...is to me so great an absurdity, that

I believe no man, who has in philosophical matters a competent faculty for thinking can ever fall into'..." (Sir E. Whittaker ; Aether and Electricity, 1962 [68])

## THE TANGENTIAL COMPONENT

It was originally Galileo's discovery, that the trajectory of a falling body can be separated into two or more entirely independent components of motion, caused by separate and independent forces.

Figure 5-1(a) illustrates this idea by the trajectory of two balls, dropped from the same height. One starts from rest, the other has an initial horizontal velocity. The two balls reach the ground in different places but at the same time, which shows that the horizontal and vertical components of motion are totally independent from one another. The same is valid for the forces that create the trajectory.

The force of gravity produces exactly the same vertical acceleration on both balls, regardless of their different initial horizontal motion. Similarly, the horizontal velocity would take the ball exactly to the same distance during the same time, regardless whether the ball is falling under the influence of gravity or rolling freely on a horizontal plane.

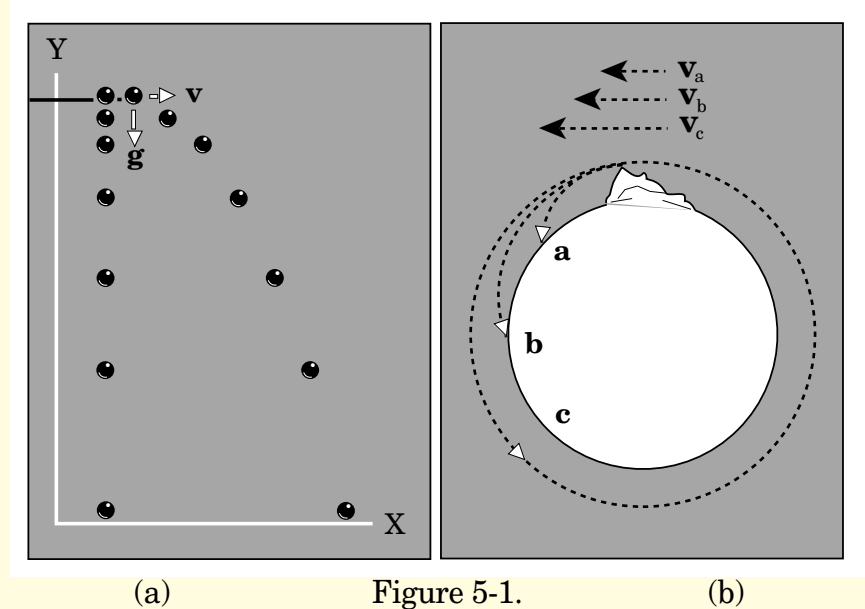


Figure 5-1. (a) Galileo's experiment with two balls falling from a height. One starts from rest, the other has an initial horizontal velocity. Both reach the ground at the same time. (b) Newton's original illustration of a cannonball's trajectory. The cannonball is launched from a cliff with increasing initial horizontal velocities  $v_a$ ,  $v_b$ , and  $v_c$ , resulting in longer and longer parabolic paths. At the top, a mountain is shown with a cannon. The trajectories are labeled 'a', 'b', and 'c'.

Finally, it illustrates, that by the further increase of the force, producing sufficiently great horizontal momentum, the cannon ball can be sent into a permanent orbit around the Earth.

The ball will continually fall toward the center of the earth because of the radial force of gravity, but it would never reach the ground, because of the horizontal, or tangential component of its momentum produced by the force of the gun-powder.

Newton wondered whether the force of attraction of the earth on the objects near its surface might extend as far as to the moon and produce the centripetal acceleration required to keep the moon in its orbit around the Earth.

This hypothesis was proven by the inverse square law of gravitation, which predicts the necessary centripetal acceleration and right magnitude of the radial component of motion for the moon to stay in orbit about the earth.

But how about the very tangential components in all these cases? They are not without significance.

Take the case of an apple, dropped from the top of a two story building. During the first second it falls radially toward the center of the earth 9.8 meters. The same time the ground of the rotating earth moves some 400 meters in west-east direction. Hence, in order to hit the ground radially under the point of release, the apple must have a tangential

component, 40 times greater than its gravitational, radial fall. For the apple the origin of the tangential component is naturally contemplated by terrestrial mechanics. Even before release, the apple was already rotating with the earth surface and shared its 400 meter/sec tangential velocity.

The cannonball had the same initial velocity as the apple, plus in order to maintain an orbit over the surface of the earth, it needed an additional tangential velocity of 8000 meter/sec

The moon is a different case altogether. Neither is there an acceptable theory to explain why the moon should share the angular momentum of the earth, like the apple or the cannon ball, nor is there any imaginable parallel for the force of the gunpowder. Nevertheless, the radial component of the moon's orbit is merely a fraction of a centimeter, while the tangential component is more than a kilometer/sec, 100,000 times greater. The same goes for the planets, greater the orbit greater difference between the two components. Where is the tangential component coming from?

Newton himself in his 'Principia' gave a negative answer to this question;

"...above the Earth's atmosphere all bodies will move with the greatest freedom; and planets and comets will constantly pursue their revolutions in orbits already given in kind and position, according to the laws above explained; but though these bodies may, indeed continue in their orbits by the mere laws of gravity, yet they could by no means have at first derived the regular positions of the orbits themselves, from those laws."

This problem has never been seriously reopened or discussed by Newton's followers. Astronomy soon became the testing ground of the mathematical theory and immense amounts of experiments have been executed, proving beyond any doubt, the validity of the Law of Universal Gravitation.

In the turmoil of this amazing success, there was no time or reason to ponder about the origin of the tangential component of planetary motion or even about the general mystery of the gravitational force.

Newton's fundamental assumption of mutual attraction took care of the origin of the radial component and if it was needed, the tangential velocities of the planets or satellites could easily be obtained by actual measurement or by Kepler's Third Law, with-

out the necessity of investigating their origin. Eventually, scientists learned not to ask questions about the perplexing concepts of the 'action at a distance' and not to wonder about other conceptual problems if they were not essential for the mathematical prediction of the phenomena.

Einstein's Theory of General Relativity also leaves this subject untouched. Replacing the action at a distance force of gravity, relativity introduces the concept of a special gravitational field in which mass effects the geometry of space around it.

In the case of the Solar system the mass of the sun causes the curvatures in space, which in turn, bend the initial, straight line motion of the planets into circular or elliptical orbits. Again, no clues about the question as to why the planets are moving, in the first place, and where the perfect tangential velocities are coming from to suit the distances and curvatures so well?! This complete lack of inquiry about the origin of the tangential momentum of the planets, suggests that in general, the presently existing theories of gravitation can have no part in the investigation of the origin or the possible mechanism of the rotating systems.

The problem, however, cannot be settled by neglecting it, since in general, wherever there is gravitation, there is also rotation and vice versa. These two seemingly very independent, universal phenomena stubbornly refuse to separate.

Consider the following, quote: (Owen Gingerich, Introduction, *Cosmology+1*, 1977)

"Given the concept of Universal Gravitation, the obvious question was; Why didn't all the stars draw themselves together into one grand fiery ball? The solution to this puzzle proved so elusive that cosmology simply went into hibernation for two centuries.

"Today, the idea of gravitational attraction leading to gravitational collapse plays a key role in our understanding of many astronomical phenomena. The sun, for example, was once an extended, rotating gaseous sphere as large as the present solar system. Warming as it shrank, it finally achieved sufficiently high temperatures, and rotational momentum, which have temporarily balanced the powerful gravitational pull.

"Our Milky Way galaxy, too, shows signs of gravitational collapse. Initially its mass was spread throughout a giant sphere. Most of the original gas,

dust, and stars has now been pulled into a rotating pinwheel about 100,000 light-years across.

"As in the formation of the solar system, rotational momentum prevented the stars from falling directly into the center of the galaxy. That is the only known reason why the stars remain distributed in a great flat plane rather than in a small central conglomeration. But what about the universe as a whole? Will it not also collapse under the inexorable gravitational tug? Newton's question has been revived to become the leading problem of cosmology today."

The obvious answer to this last cosmological question should be the same as it is already accepted for the solar system or the galaxies. The mere fact that the universe is spread throughout space, instead of existing in a fiery ball, calls for the only observed and known solution: rotational momentum, or rather the tangential component of the momentum keeps the Universe from its gravitational collapse.

The acceptance of this alternative, however, would give the central role in cosmology to universal rotation, whose origin and mechanism lies completely out of the scope of the major gravitational theories. Hence, modern cosmology rather turns toward the



mystical and adventurous Expanding Universe idea and to the all-exciting Big Bang Theory, where universal gravitation is not confused by universal rotation. Indeed, even in cases like the origin of the solar system or that of the galaxies, where Cosmology cannot neglect the phenomenon of rotation, the speculation simply starts from already rotating gas clouds.

Even so, Cosmology still runs into one of its most perplexing problems; Somehow, all heavenly bodies, satellites, planets, stars and Galaxies position themselves exactly on Keplerian orbits around the center of their system and mysteriously all of them move with the right tangential velocities, at the right distances. How and why?

Should one then simply acquiesce to the possibility that the origin of these rotating systems is pure coincidence; the result of some kind of a hit or miss, capturing procedure? That at one time, satellites, planets and stars were moving in totally random chaos, and through some cosmic natural selection, eventually most of them, were captured by a greater mass when they happened to hit the right orbit with the right speed from the right direction?! Not really.

"It is interesting to note that if two objects app-

roach each other from a distance in space, they can never capture each other into circular or elliptical orbits. Their mutual attraction will speed them up so that they pass each other with a relative speed greater than their mutual velocity of escape, and they will swing away from each other again." (George Abell: Exploration of the Universe, [61])

The first step toward clarifying this situation is to find the point in the development of the Theory of Universal Gravitation, where it lost sight of the fact, that the sun and its planets are a system and not an accidental gathering of heavenly bodies.

## CHAPTER SIX

### CELESTIAL MECHANICS

#### CONCEPTS AND MATHEMATICS

In its final form the Law of Universal Gravitation states that the force between any two particles having masses  $m_1$  and  $m_2$  separated by a distance  $R$  is a mutual attraction acting along the line joining the particles. The magnitude of this force  $F$ , is directly proportional to the product of the masses and inversely proportional to the square of the distance between them.

$$F = G \frac{m_1 m_2}{R^2} \quad (6.1),$$

where  $G$  is the *Gravitational Constant*, whose value depends on the units of mass, distance, and force used, and has to be determined by laboratory measurements of the attractive force between two material bodies of known masses.

It has been established, that if metric units are used,  $G$  has the numerical value  $6.67 \times 10^{-8} = 0.000000667 \text{ gr} \times \text{cm}/\text{sec}/\text{sec}$ . Once this value is established, it can be used to determine the gravitational forces between any pair of particles.

This simple equation expresses the whole concept of Newton's Theory of Universal Gravitation and due to the ratio between force and distance, it is commonly called, *The Inverse Square Law*.

Most contemporary physics or astronomy studies emphasize the conceptual triumph and a mathematical approval of the Theory of Universal Gravitation for deriving Kepler's mystical and purely empirical laws from its fundamental assumptions. Since Kepler's laws clearly reflect the observational facts, their mathematical derivation is equivalent to observational approval. It is also suggested by these texts, that Kepler's mystical approach finally gained conceptual understanding in its Newtonian interpretation.

Nevertheless, such description of the situation, neither complies with the historical facts, nor with the logical sequence of deductions, that lead to the final form of Newton's fundamental equation.

As Fred Hoyle, one of the inventors of the famous *Steady State Universe* of modern cosmology remarks in his book, *The Frontiers of Astronomy* [27]:

"Usually in astronomical texts, the inverse square form of the law of gravitational force is stated as an *axiom*. Then reversing the original procedure, Kepler's third law is deduced from it. This, however, is not the way the pioneers of astronomy proceeded. In fact it has happened exactly the other way around. They started with Kepler's laws of planetary motions and derived the information for the gravitational force from that."

As it will be seen, the clarification of this fallacy is quite significant for the investigations of the origin and mechanism of rotating systems. It is not a matter of who gets the credit for being more fundamental, but something much more important. The problem with the present approach is, that once the mystery of Kepler's Laws were explained away by Newton's more fundamental theory, they were placed on the shelves of the historical archives of knowledge as a closed file, which

very likely, never will be opened up again for further discussion.

However, if Hoyle's statement was true, then Kepler's Laws were the more fundamental statements and, although they are still mysterious, potentially those laws could be the ones that contain more fundamental information about the origin and mechanism of the solar system, or even for those of universal rotation in general.

In order to evaluate Hoyle's statement, consider the following chronological description of the derivation of the fundamental concepts and mathematics of the Theory of Universal Gravitation. The philosophical stage has been set for Universal Gravitation in the knowledge accumulated through centuries, but the main ingredients for the derivation of Equation 6.1 came from three major sources.

a) Kepler third law of planetary motion states the fact, that there is a definite and simple correlation between the orbital velocities and distances of all planets in the Solar system.

*The square of the period,  $P$  divided by the cube of the radius,  $r$ , is a constant for all planets.*

$$\frac{P}{r^3} = K \quad \text{or} \quad P^2 = Kr^3 \quad (6.2),$$

where  $K$  is a constant of proportionality whose value depends only on the units used to measure time and distance. Once  $K$  has been found through one example (say, Earth's Period and its distance from the sun, one known quantity and  $K$ , it will render the other for any body revolving in the solar-system.

If the Earth's distance from the sun is taken as the astronomical unit of length and its period of revolution, the year, as the astronomical unit of time, than  $K$  equals to one, and therefore

$$K = \frac{P^2}{r^3} = 1 \quad \text{or} \quad P^2 = r^3 \quad (6.3).$$

Measured in astronomical units, the square of the period for each orbiting body equals the cube of its distance from the sun.

b) The conceptual foundation of Newton's Terrestrial Mechanics originates from Galileo's fundamental concept of inertia. In their final form, in Newton's 'Principia' *inertia*, *force*, *mass*, *acceleration*

and their mathematical relations are stated in the Three Laws of Motion.

I. Every body continues in its state of rest, or of uniform motion in a straight line, unless it is compelled to change that state by forces impressed upon it.

II. The change of motion is proportional to the motive force impressed, and is made in the same direction of the right line in which the force is impressed.

Newton defines force,  $F$  as an agent, capable of causing acceleration,  $A$ , in face of the opposition of inertia, which occurs in the direction of the force, directly proportional to the magnitude of the force and inversely proportional to the amount of the inertial mass,  $m_i$ , the magnitude of the inertial resistance of the body:

$$A = \frac{F}{m_i}, \quad \text{or} \quad F = m_i A \quad (6.4).$$

III. To every action there is always opposed an equal reaction; or, the mutual action of two bodies upon each other are always equal and directed to contrary parts.

c) In connection with his mechanistic theory of gravitation, Huygens was the first who attempted to describe the *centripetal force* that must be exerted on a planet in order to keep it on a circular orbit.

Analyzing the earthly example of a stone, whirled around on a string, he found that the measurable quantities in this case are the velocity of the stone and the length of the string, which is the Radius of the circle.

In Huygens' work the concept of *velocity*,  $v$  already represents both the speed and the direction of motion of a body. All changes in the velocity of a body is called *acceleration*,  $A$ .

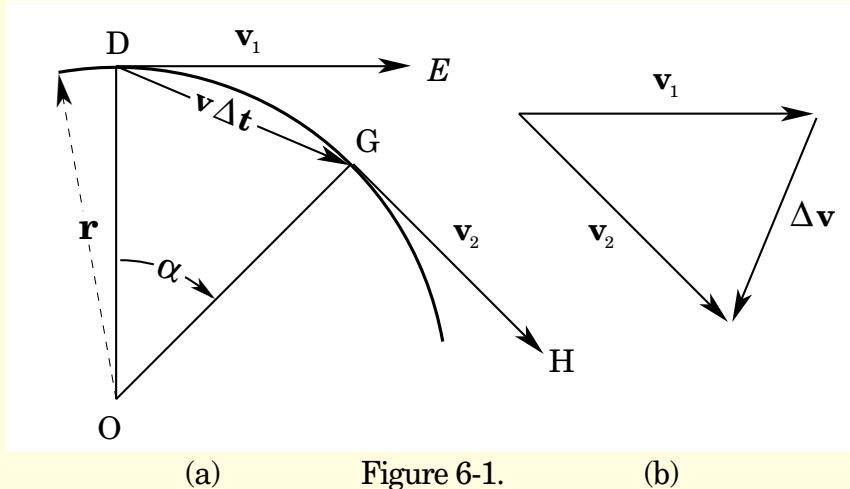


Figure 6-1.

If the string would break at any time, the stone would fly off on a straight line, tangential to the circle, in the direction  $DE$ . After a brief interval of time, however, by the force of the string, the stone was

kept on a circular path and it is now at a certain distance along the arc of the circle at  $G$ , having a direction of  $GH$ .

If this interval of time,  $\Delta t$  is considered to be very short then the arc can be taken as approximately equal to the length of the cord between  $D$  and  $G$ . Since distance equals velocity times time, the length of the cord equals  $v\Delta t$ . Although the speed of the stone still equals to  $v$ , its direction changed toward  $GH$ , thus the stone has accelerated; for it did not continue to move along the direction  $DE$ , on a straight line.

When the acceleration is only a change in the direction of the motion, it can be represented in a vector-diagram, as in Figure 6-1 (b). The initial velocity had a magnitude,  $v$  and a direction  $OA$ , the new velocity has the same magnitude, but its direction has changed to  $OB$ . The vector representing  $v$  has turned through an angle,  $\alpha$  (alpha) at  $O$ .

Thus the magnitude of the directional acceleration is represented by the angle,  $\alpha$ , or the direction and length of the resultant vector  $AB$ . It can be seen that triangle  $ODG$  (Fig.6.1a) and triangle  $OAB$  (Fig.6.1b) are exactly similar and the angle,  $\alpha$  is the same in both.

The acceleration of the stone is its change of velocity  $\Delta v$  per second  $\Delta t$ , therefore there is a simple proportion between  $\Delta v / v$  (from triangle  $OAB$ ) and  $v\Delta t / r$  (from triangle  $ODG$ ).

$$\frac{\Delta v}{\Delta t} = \frac{\Delta v}{v} \quad (6.5a)$$

From this it follows, that the centripetal acceleration can be expressed by

$$A_c = \frac{v\Delta t}{r} = \frac{v^2}{r} \quad (6.5b)$$

Hence, Huygens concluded that the directional acceleration of the stone or any other body on a circular path is in direct proportion to the square of its tangential velocity and in inverse proportion to its distance from the center. Beyond this geometric argument, however, another factor also takes part in the experiment; the *weight* of the stone.

It is evident from everyday experience that a heavier object swung around, requires more strength to hold from flying off the circular path than a lighter one. Thus, Huygens further concluded that the magnitude of the central force needed to keep the stone in the circle

(the tension on the string) must also be directly proportional to the mass,  $m$  of the stone. Therefore

$$F_C = m \frac{v^2}{r} \quad (6.5c)$$

In the case of the whirling stone, the centripetal force,  $F_C$  is directly proportional to the weight of the stone times the square of its velocity and inversely proportional to the radius of the circle.

It should be noted here, that Huygens' simple concept of weight became more sophisticated in Newton's terrestrial mechanics. It is the result of the mutual attraction between the earth and a body that produces weighing differences. The earth exerts the same force on all bodies, but a larger stone weighs more than a smaller one because it exerts a proportionally greater force on the earth.

These were the basic historical ingredients, ready for Newton to create his system of celestial mechanics.

Applying these laws and concepts to the motions of the celestial bodies, Newton arrived at the following conclusions: According to the law of inertia, in the absence of the action of external forces all material bod-

ies continue to move with uniform speed in a straight line. If the planets are moving on a circular orbit, they must suffer a *constant acceleration* under the influence of a *constant force*.

Since all planets revolve about the sun, it must be the one that exerts a constant force on them.

Starting with Huygens' result, the following is a typical mathematical description of the development of Equation 6.1. (Abell, Exploration of the Universe [55]).

$$F_C = \frac{mv^2}{r} \quad (6.5d).$$

"Using the result of the last section, we find that the centripetal force that the sun must exert upon a planet of mass  $m_p$  moving with speed  $v$  in a circular orbit of radius,  $r$  is

$$\text{"force} = \frac{m_p v^2}{r} \quad (6.6).$$

" Now, the period,  $P$  of the planet, that is the time required for the planet to go completely around the sun, is the circumference of its orbit,  $2\pi r$  divided by its speed, or

$$P = \frac{2\pi r}{v} \quad (6.7a)$$

"Solving the above equation for  $v$ , we find

$$v = \frac{2\pi r}{P} \quad (6.7b).$$

"On the other hand, from Kepler's third law, we know that the square of the period of a planet is in proportion to the cube of its distance from the sun. Because the sun is observed to be almost at the center of the planet's orbit, that distance is very nearly the radius of the orbit,  $r$  and we have

$$P^2 = Kr^3,$$

Combining the last two equations, we find

$$v^2 = \frac{4\pi^2 r^2}{P^2} = \frac{4\pi^2 r^2}{Kr^3} = \frac{4\pi^2}{Kr} \quad \text{or } v^2 \approx \frac{1}{r} \quad (6.7c),$$

where the symbol ' $\approx$ ' means '*proportional to*'.

"If we substitute the above formula for  $v^2$  into the one expressing the sun's centripetal force on the planet, we obtain

$$\text{force} \approx \frac{m_p}{r^2} \quad (6.7d).$$

*"The centripetal force exerted on the planet by the sun must therefore be in proportion to the planet's mass and in inverse proportion to the square of the planet's distance from the sun."*

Evidently, Hoyle's statement is clearly justified.

The inverse square law of the centripetal force has been derived from the equations of Huygens and Kepler even before Newton's mutual attraction of the gravitational force was introduced. In fact, it can be seen that even the insertion of the mass of the planet is not necessary at this point, since the same result would be reached from merging only the equations of Huygens and Kepler.

Huygens' Equation 6.4b is based on the definition of velocity and acceleration and states in purely kinematical terms, that any point moving on a circular path performs centripetal acceleration, which is directly proportional to the square of the velocity of the point and inversely proportional to the radius of the circle. This statement is entirely independent from the dynamic concept of mass.

Kepler's Third Law, Equation 6.3, brings into the derivation the characteristic period-distance relation, which exists in the solar system. This proportionality between the tangential velocities of the planets and their distances from the sun is also entirely independent from the concept of mass.

Therefore, based on the two purely geometrical statements of Huygens and Kepler, the centripetal acceleration of a point can be expressed without the mass of the planet. Hence, the most general form of the inverse square law, is a mathematical statement about the specific centripetal acceleration of all revolving bodies in the solar system, and regardless of their masses:

$$A_C \approx \frac{1}{R^2} \quad (6.7e).$$

If the centripetal acceleration is physically produced in face of the opposition of the inertial mass of a body, say that of a planet, then the concept of inertial mass and the concept of centripetal force should enter into the equation.

Only at this stage of the derivation, aside from the already established geometrical inverse square relation of Equation 6.7e, the centripetal force must also be



directly proportional to the magnitude of the mass of the planet,

$$\text{force} \approx \frac{M_p}{r^2} \quad (6.8a).$$

From here on the derivation can introduce Newton's dynamic assumption of mutual attraction.

Using of the sun's mass and repeating the previous procedure, based again on Kepler's formula the derivation this time establishes the acceleration of the sun around the planet:

"According to Newton's third law, however, the planet must exert an equal and opposite attractive force on the sun:

$$\text{force} \sim \frac{m_s}{r^2} \quad (6.8b),$$

where  $m_s$  is the mass of the sun"(...) "therefore the attractive force between the two has the mathematical form:

$$\text{force} \sim \frac{m_s m_p}{r^2} \quad (6.8c).$$

"For Newton's hypothesis of universal gravitation to

be correct, there must be an attractive force between all pairs of objects everywhere, whose value is given by the same mathematical formula as that above between the sun and a planet.

"Thus the force,  $F$  between any two bodies of masses  $m_1$  and  $m_2$  and separated by a distance  $d$ , is

$$F = G \frac{m_1 m_2}{d^2} \quad (6.1)"$$

This is the final form of Universal Gravitation, which, -- as Hoyle stated, -- has been obviously derived from the equations of Huygens and Kepler.

Nevertheless, the derivation proceeds to re-state Kepler's third law including Newton's addition of mutual attraction. With the aid of the concept of the *center of mass* and with some mathematical operations a new form of Kepler's third law is presented:

$$(m_s + m_e) P^2 = R^3 \quad (6.9a)$$

"Newton's version of Kepler's third law differs from the original in that it contains a term involving the sum of the masses of the two revolving bodies."

"However (...) the sun has a mass of about 300,000 times that of the earth. Thus the combined mass of

the sun and the earth, or that of any other planet is for all intents and purposes, is no different than the mass of the sun itself. Then in the combined system,  $m_1+m_2 = m_1$ .

"Thus if we apply the equation Newton derived to the mutual revolution of the sun and a planet and choose astronomical units for the units of time and distance, and the solar mass for the unit of mass, then Newton's equation reduces to

$$m_s = 1; (m_s + m_e) = 1; (m_s + m_e)P^2 = P^2; P^2 = R^3 \quad (6.9a)$$

in agreement with Kepler's formulation of the law."

## KEPLER'S FORMULA

Let us now reconstruct, what happened with the terrestrial mechanical concepts of mass and force and the fundamental assumption of mutual attraction in the course of the derivation.

First the planet's mass has been inserted in order to establish the magnitude of the centripetal force needed to keep it on its orbit. A few steps later, however, the mass of the planet was declared to be insignificant and therefore the centripetal force could either not be in proportion to that mass or it must have been zero. Thus, the equation expressed nothing more than the

Huygens-Kepler centripetal acceleration and the dynamic concepts of mass and force were meaningless at that stage.

In the next step, introducing Newton's mutual attraction, the mass of the sun was inserted, this time in the role of the secondary body in order to find its own centripetal acceleration about the planet and the force exerted on it. But the magnitude of the sun's acceleration was also declared to be insignificant, since it was caused by an insignificant force exerted on it by an insignificant mass.

Evidently, the end result of  $m_1+m_2 = m_1$  is, that the total mass belongs to the dominant body, the sun and the total acceleration belongs to the secondary body, the planet.

Hence, the derivation is back where it started from, replacing Kepler's original *mathematical* constant by the *mechanical* constant of the *mass of the sun*, determining the magnitude of the *non-mechanical force* that produces the centripetal acceleration of the planets.

It is evident that from the beginning till the end of this procedure nothing else was known and nothing else was learned about the relationship between sun and planets, but the facts embodied in Kepler's three

laws of planetary motions and the mathematics derived from them together with Huygens' concept of centripetal acceleration.

No doubt, that Universal Gravitation works in every two-body problem in the universe. It also works in cases of the perturbations of the planets when their orbits do not exactly fit the predictions of Kepler's Laws. – Seemingly, Universal Gravitation explains away the Keplerian mysticism and conceptually simplifies the phenomenon by unifying earthly and celestial mechanics. In fact, however, in each and every case, in all two body problems, universal gravitation reverts back to the Huygens-Kepler acceleration formula to establish the magnitude of the dynamical quantities of the mass of the dominant body and from that the magnitude of force exerted on the secondary one.

"Our only means of measuring the masses of astronomical bodies is to study the way they react gravitationally with other bodies. Newton's derivation of Kepler's third law, which includes a term involving the sum of the masses of the revolving bodies is most useful for this purpose." (Abell, *Exploration of the universe* [66]).

It is obvious that Kepler's mystical harmony has not been replaced by some truly conceivable explanation, but by a mechanical mystery of the action at a distance force, which is for some unknown reason proportional to a factually unmeasurable quantity of the mass of the dominant body.

The choice of analogies offered, to help grasp these ideas are not too sensible either: there are the primitive concept of muscular effort of push and pull, the whirling stone on a string or rather on a rubber band, the more scientific approach of the gravitational field, which is only perceptible when a material body accelerates in it, and the most modern hypothesis of the inherent capability of matter to produce non-Euclidian geometry in empty space...

Is any one of these concepts less mystical and more conceivable than Kepler's Harmony ?

But beyond the obvious confusion, there is a definite negative effect of this method on future advances. In the course of the dynamical metamorphosis, a totally unrecognized value of Kepler's Third Law was also explained away; The only factual knowledge ever obtained about the correlation between universal gravitation and universal rotation is expressed in this law.

The simple proportionality between the tangential velocities of the orbiting bodies and their distances from the center of the rotating system. This is the essence of Kepler's third law, which has been melted into the mathematics of Universal Gravitation without transferring its conceptual content.

As far as it is known today, our solar system consists of nine planets, thirty one satellites, some asteroid belts and an unknown number of comets, all of which revolve around the sun like clockwork, on *Keplerian orbits*. Imagine now a different solar system, with a million asteroids revolving around their sun, resulting in a great non-solid rotating disk, with all its members orbiting around in different distances with different tangential velocities. Some of them even revolving around one another.

Chaos ? Not at all.

Once a single example is established; the Period of revolution of one member and its distance from the sun were measured, Kepler's Formula renders a dynamic map of the the whole system:

$$\frac{P^2}{r^3} = K \quad \text{or} \quad P^2 = Kr^3 \quad (6.2),$$

*The square of the Period divided by the cube of the radius is a constant for each member of the whole rotating system.* – Since  $P = 2\pi r / v$

$$P^2 = \frac{4\pi^2 r^2}{v^2} \quad \text{and then} \quad 4\pi^2 r^2 / v^2 = Kr^3 \quad (6.10a),$$

multiplying both sides by  $v^2$  gives  $4\pi^2 r^2 = Kr^3 v^2$  and dividing both sides by  $Kr^3$  gives  $4\pi^2 / Kr = v^2$ , therefore

$$v = \frac{2\pi}{\sqrt{Kr}} \quad (6.10b)$$

If time and distance are measured in astronomical units (both the period and the distance of the example = 1), then the constant of proportionality,  $K = 1$ , hence

$$v \approx \frac{1}{\sqrt{r}} \quad (6.11)$$

*The tangential velocity of any orbiting body in this rotating system is inversely proportional to the square-root of the radius of the orbit.*

Hence the full recognition of Kepler's third law creates a new concept in celestial mechanics: *Rotational Gravitation*,.

Because of the masses of all secondary bodies are insignificant, all orbits are taken as perfect circles. Therefore, the force responsible for the dynamic nature of the system has two components; a) the tangential component, which is represented by a vector, directed at a right angle to the radius and its instantaneous velocity is inversely proportional to the square-root of the radius; b) the radial component is represented by the constant centripetal acceleration of the same vector, (Huygens-Newton) which is inversely proportional to the square of the radius.

As controversial as this statement sounds, these are the conditions that a complete theory of Rotational Gravitation must fulfill.

## CHAPTER SEVEN

### ROTATIONAL GRAVITATION

#### THE CONCEPT OF A FIELD

"A basic fact of gravitation is that two masses exert forces on one another. We think of this as a direct interaction between two particles, if we wish. This point of view is called *action at a distance*; the particles are interacting even though they are not in contact (Newton's choice).

"Another point of view is the field concept which regards a mass particle as modifying the space around it in some way and setting up a gravitational

field. The field, therefore, plays an intermediate role in our thinking about the forces between two mass particles.

"According to this view, we have two separate parts to our problem. First we must determine the field established by a given distribution of mass particles; and secondly we must calculate the force that this field exerts on an other mass particle placed in it.

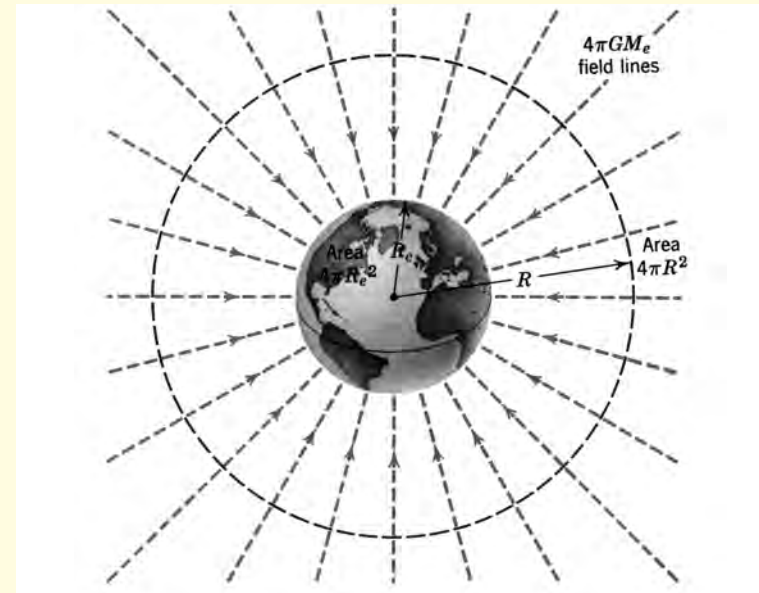


Figure 7-1

"For example, consider the earth as an isolated mass. If a body is now brought in the vicinity of the earth, a force is exerted on it. This force has a definite direction and magnitude at each point in space. The direction is radially inward to the center of the earth and the magnitude is  $mg$ . We can therefore, associate with each point near the earth a vector  $\mathbf{g}$  which is the acceleration that a body would experience if it were released at the point in question.

"The field concept is particularly useful, in fact, indispensable, for understanding electromagnetic forces between moving electric charges. It has distinct advantages, both conceptually and in practice, over the action at a distance concept. The field concept was not used in Newton's days. It was developed much later by Faraday for electromagnetism and only then applied to gravitation.

"Subsequently this point of view was adopted for gravitation in the general theory of relativity." (Resnick-Halliday: Physics, 1978 [339])

"Imagine a rapidly flowing trout stream containing several whirlpools that dimple its surface.

"A complete description of the flow could be obtained by giving the velocities of the water at each

point in the stream. The velocity of a small sample of water located at  $P$  could be given as three vectors in a Cartesian coordinate system:  $V_x$ ,  $V_y$  and  $V_z$ . The resulting description of the flow might be referred to as a velocity field.

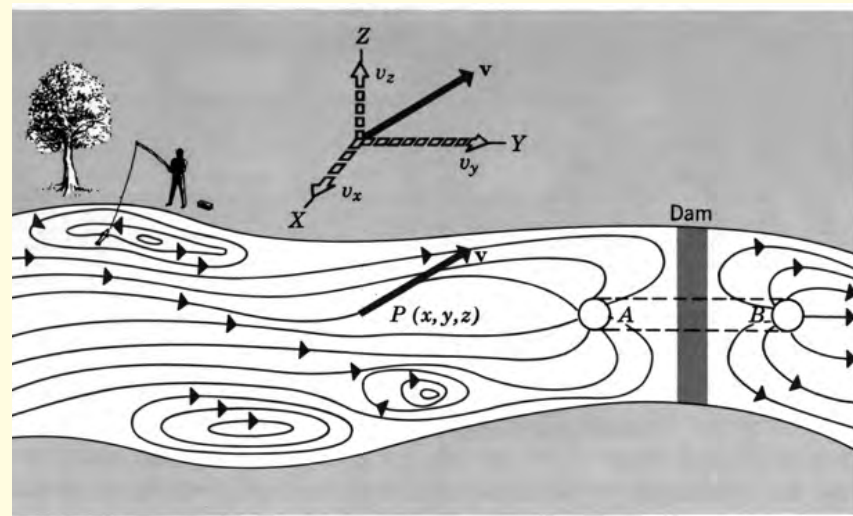


Figure 7-2

"A pictorial representation of this velocity field is obtained from the stream-lines. Each stream-line represents the path of a small sample of water as it flows down the stream. In the vicinity of each whirlpool the water is moving in circles. Each

whirlpool produces a dimple on the surface of the water. This dimple is a highly localized entity, which can move over the surface of the stream in the same way as an elementary particle moves through space. However, there is no material body located at the dimple. It is merely a point at which the stream-lines behave in a peculiar manner.

"This suggest to us an extreme swing of the pendulum in our attitude toward describing the universe. Now the emphasis is placed on assigning properties to all points in space so that it is filled with various fields, whose action is independent from the fact whether there is anything to move or not. On the other hand an elementary particle could be merely a point in space at which a field behaves in a peculiar way. In the case of a whirl-pool the stream-lines go round in circles permanently. Another possible situation, which is perhaps more akin to an elementary particle, occurs when the stream-lines all converge on a point.

"Suppose that a dam is built across the stream and the flow is taken under the dam by a narrow tunnel below the bed of the stream, starting at point A, some distance upstream of the dam and emerging at

a point B, some distance downstream of the dam. The stream-lines all converge upon A and then diverge from B. The behavior of the stream-lines at the vicinity of A and B is similar to the behavior of a gravitational or electric field in the vicinity of an elementary particle." K. R. Atkins, Physics, 1976 [263]

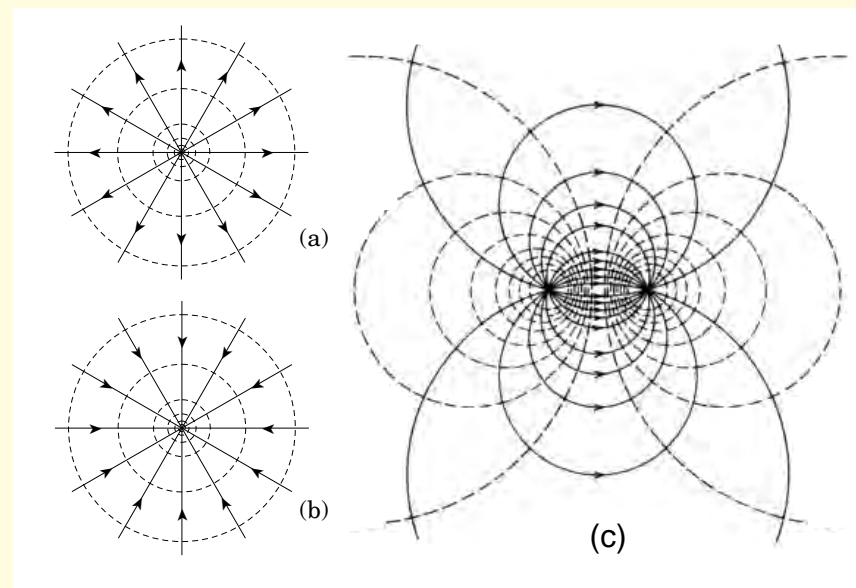


Figure 7-3

Part (a) of Figure 7-3 illustrates the field of flow of a *linear source*. All stream-lines are directed radi-



ally outward. The field of flow around a *linear sink*, (b) is the same as the source except for the direction of the flow, which is directed radially inward to the sink. For a linear source and a linear sink, with the same strength and slightly separated, there is a combined field, called *linear dipole flow*, (c).

## THE IDEAL GAS

The observational facts, expressed in Kepler's first and second empirical laws require the action of a force in the solar system whose magnitude is proportional to the inverse square of the distance from its origin. Only such force can oppose the *fictitious force of inertia*, guarantee the permanence of elliptical orbits, and the acceleration and deceleration of the planets in agreement with the law of areas. Then the formula of Kepler's third law sets the angular velocities also proportional to the distances from the center of the rotating system. This is the formula that describes the general clockwork, not only for the solar system but for the phenomenon of universal rotation in all orders of magnitude.

So far neither classical and modern physics nor astronomy and cosmology made any serious attempt to fill these laws with some conceivable conceptual

content. Instead, it has been loosely assumed to be justified by their derivation from the law of universal gravitation which, as Newton himself declared, was merely a mathematical theory with no conceivable explanation.

Moreover, there are good reasons to believe, that this conceptual vacuum in the very foundation of our description of nature is one of the main sources of the present mathematical perplexities lingering over all departments of modern physics.

In the following an alternate hypothesis will be presented combining Newton's universal gravitation and the fully recognized third law of Kepler's planetary motion; a first draft of a kinematic description of the phenomenon of *Rotational Gravitation*;

This discussion involves the re-evaluation of most of the laws and concepts discussed above and the building of a new conceptual understanding from the bottom up. Consider carefully and step by step the following train of thoughts:

In order to explain the empirical laws of Thermodynamics through the concepts and mathematics of Newton's mechanics, physicists worked out an atomic and kinetic theory of gases. Taking the simplest

approach to describe the molecular mechanics of macroscopic phenomena like temperature, diffusion, pressure and wave-propagation, they introduced a hypothetical medium of an *ideal gas* with some simplified characteristics.

The gas is monatomic, its molecules are single atoms of a pure element. All of its constituents are equal in mass and size and they are in ceaseless random motion. As a distinction from real gases, in an ideal gas there are no dynamic interactions between the atoms. No gravitational, electromagnetic or other *action at a distance* forces are in effect between the atoms and therefore all changes in the perfectly random isotropy of the gas come from external kinematic impulses. These local disturbances are propagated throughout the medium by no other means but through the impacts between the atoms in their *collisions*.

Hence, an ideal monatomic gas can be visualized as a collection of submicroscopic spheres, impenetrable to one another and separated by distances much larger than their diameters. The atoms of this gas are in rapid motion on straight lines, with uniform velocity until they rebound from the wall of the con-

tainer or collide with one another. They are in complete random motion; meaning, that *on the average at any given time the same number of atoms are going in one direction as in any other direction*.

Although the distance between the atoms are also completely random, there is an average *collision-free path* between interactions, which is determined by the macroscopic density of the gas and the average velocity of the atoms. Since no forces are acting between the atoms and the collisions are perfectly elastic, there is no internal friction and the only form of energy of the gas is the *kinetic energy of motion*. Consequently, in an ideal gas, all statements of the kinetic theory and the laws of Newton's mechanics are valid.

## THE INVERSE SQUARE LAW OF GEOMETRY

In accordance with the above, imagine a great room filled with an ideal gas, which is homogeneous, isotropic and globally motionless. The basic macroscopic characteristics of the gas is that the pressure it exerts on objects submerged in it, and the propagation of local disturbances from point to point, are uniform all through space. The changes in this isolated system is suitable for comparatively simple mathe-

mathematical description and mechanically conceivable by the pure and sensible concepts of motion, impact and collision. It is also assumed, that the dimensions of the room are great enough, so that it can be taken as infinite, therefore the reflections of the disturbances from the walls can be neglected.

Consider now, that at the middle of the great room there is a small balloon which suddenly expands and creates a short pulse of compression in its vicinity. Depending on the extent and speed of the expansion, there will be a layer of certain thickness in the gas next to the balloon with a greater than average density and consequently, a greater than average pressure. Within this layer of compression the average collision free path of the atoms will be shorter and the number of collisions per unit volume will increase. As a result the layer will exert a pressure on the next layer and in turn the next and the next. As the gas is compressed, work is done, and is stored as potential energy in the medium. As the disturbance propagates, this energy is transmitted through space.

The pulse, like all disturbances in an isotropic medium, will travel outward from the source in the

form of a growing spherical shell. The *intensity* of such disturbance, just like that of sound, is measured by the amount of energy passing through a unit area per unit time.

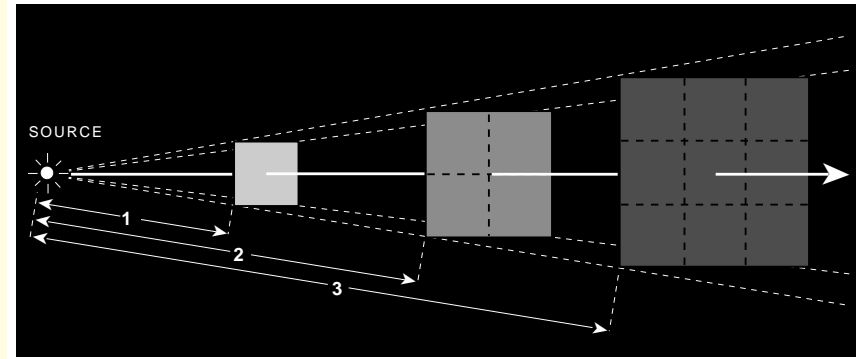


Figure 7-4.

As the illustration shows, that the intensity of the pulse at different distances from the source is determined by the fact, that the surface of a sphere is increasing in direct proportion to the square of the radius and as the pulse travels outward, the initial energy dissipates over greater and greater areas.

The surface area of the sphere is  $4\pi R^2$ .

If  $E$  is the initial energy of the disturbance at the source, and the intensities at two different distances

are  $I_1$  and  $I_2$  and the radii of the different spheres are  $R_1$  and  $R_2$ , then

$$\frac{I_i}{I_2} \approx \frac{E/4\pi R_2^2}{E/4\pi R_1^2} \quad \text{or} \quad I \approx \frac{E}{R^2} \quad (7.1).$$

Hence, the intensity of the pulse is directly proportional to the initial energy and inversely proportional to the square of the distance from the source.

This *inverse square law* is valid for the intensity of sound-waves and light waves or other electromagnetic radiations and for any other kind of disturbances, propagating in an isotropic homogeneous medium. Whether these disturbances are defined by the concepts of the kinetic theory, or those of Newton's mechanics, or described by the field concepts of the electromagnetic theory, they all obey the same inverse square law which simply originates from the spherical propagation of the local density disturbances.

All these are resulting from the isotropy of the medium and from the geometrical fact that *the surface area of a sphere is directly proportional to the square of its radius*.

Next, consider the reciprocal; a pulse of rarefaction, created by a sudden *decrease* in the volume of the balloon.

As this happens, depending on the extent and the speed of the contraction of the balloon, there will be a layer of certain thickness of rarefaction, representing a smaller than average density and a smaller than average pressure.

This layer of rarefaction represent a deficiency of density or negative pressure in the vicinity of the balloon into which a number of atoms from the next layer can emigrate without opposition. This in turn creates a decrease in the density in that layer, and that in the next to it. Consequently, like any other disturbance, this pulse will also propagate outward from the source in an expanding spherical shell of rarefaction, a negative pressure, the intensity of which is also decreases according to the inverse square law.

Now, instead of the contracting balloon, let us introduce a small pipe erected into the middle of space, with an opening, covered by a small sphere of porous substance. The pipe is connected to a vacuum pump.

At first consider a sudden and short switch on and off the pump. The result is the same as that of the sudden decrease of the balloon. A rarefaction pulse propagates outward from the sphere and its negative pressure decreases with distance according to the inverse square law.

The periodical repetition of the switching, produces a train of pulses in which rarefaction layers and initial density layers alternate in expanding spherical shells. Each rarefaction shell represents a negative pressure, the magnitude of which depends on the shell's distance from the center.

Next the cycle of the switching can be gradually shortened approaching an infinite frequency of pulses, or a continuous train of pulses. This is equivalent to a constant production of rarefaction around the porous sphere, which in turn is analogous to the concept of fluid-dynamics, called a *linear sink*.

It follows, that the continuous operation of this sink creates a density deficiency in the medium whose magnitude is *directly proportional to the capacity of the sink and inversely proportional to the square of the distance from the sink*.

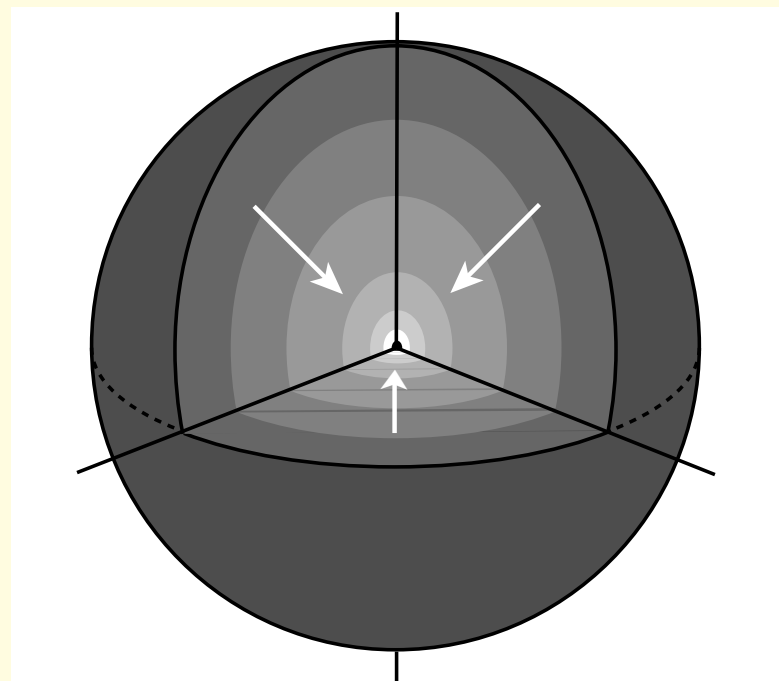


Figure 7-5.

From a macroscopic point of view, there is also a three dimensional radial flow of the gas toward the center of the room to replace the volume of gas, that is continuously withdrawn by the sink. This could be visualized as some kind of radial wind blowing from all directions, whose speed is directly proportional to

the extent of rarefaction in the medium and therefore also inversely proportional to the square of the distance from the sink.

This kinematical description of the operation of a three dimensional sink bears undeniable analogies with the kinematical results of the operation of the action at a distance force of gravity.

In the first place, since there is an increase in the instantaneous velocity of the radial winds as they approach the sink, each small portion of the medium must undergo constant acceleration, just like a test particle would do as it fell freely from a great distance under the influence of the increasing magnitudes of gravitational attraction of a massive body. This analogy reflects the whole of space influenced by the force of gravity and the Newtonian mathematics of the inverse square law.

In the second place, the analogy is also perfectly extendible to the modern concept of the gravitational field of a given region. Assume the existence of a foreign particle comparable in size and mass with the particles of the ideal gas and movable by the pressure of the radial winds.

If this particle now brought to the vicinity of the sink, a force is exerted on it. This force has a definite direction and magnitude at each point in space. The direction is radially inward to the center of the sink and the magnitude is inversely proportional to the square of the distance.

We can associate with each point near the sink a vector  $\mathbf{s}$ , which is the acceleration, that the particle would experience if it were released at the point in question ... the emphasis is placed on assigning properties to all points in space representing a field, whose action is independent from the fact whether there is anything there to move or not.

Hence, an operating sink submerged in ideal gas is both conceptually and mathematically equivalent to a solid body surrounded by a gravitational field. The important difference is, that while the gravitational field is a mere mathematical convenience, the ideal gas can be physical reality.

## THE CONSTANT FORCE OF GRAVITY

It is an experimental fact, that a body released from rest in the vicinity of the Earth, gains the same speed in each second of free fall, 9.80 m/sec. Its total

speed at the end of the second second is 19.60 m/sec, at the end of the third second is 29.40 m/sec, and so on. Such gaining of speed represents a *uniform acceleration*, and according to the second law of motion, this requires the action of a *constant force*.

Newton declared in the 'Principia' that his theory is merely a mathematical system and does not speculate about the possible mechanics of the force of gravity, or that of the constancy of such force. At the time, this was quite a turn against the reigning mechanistic philosophy, but because of the great success of his mathematics, Newton's approach was eventually unanimously adopted by the scientific community.

Today, after three centuries of practice of not asking questions, nor of expecting comprehension of nature, the uniform acceleration under the influence of the constant force of gravity seems to be just as self-explanatory as the impulsive force between two billiard balls in the collision.

Nevertheless, in the mechanicism of sixteenth century, philosophers were neither satisfied with the mystery of the origin of gravity nor with its mechanically inconceivable constancy. Before the complete

acceptance of Newton's purely mathematical theory, prominent philosophers made several valuable attempts in designing mechanical models for a potential comprehension of the constant force of gravity.

Isaac Beeckman, Dutch physicist in collaboration with Descartes, in the 16th century discovered first that the distance travelled by a falling body is proportional to the square of the time intervals. Hence, before Galileo and Newton, Beeckman was already aware of the *uniform acceleration* of the freely falling bodies and was also the first to assume that gravity is a *constant attractive force*.

In order to tie these concepts together with the mechanistic philosophy, he formulated his theory based on the following ideas : The speed of the motion of a body, once it has been generated, continues unchanged as long as no external force destroys or reinforces it. This assumption was the first formulation of the concept of *inertia*, which was later completed by Galileo and Newton.

As for uniform acceleration, Beeckman further assumed, that gravity acts in such a way that at certain intervals of time it gives, as it were a *jerk of pull*

on the falling body. If the *same strength of pull*, is repeated at regular intervals, the same amount of new velocity is being accumulated in the motion of the body. Assuming a great but not infinite frequency, as the time interval between each pull approaches zero, the force of gravity, or that of the periodical jerky pulls approaches the concept of a continuous action; a *constant force*, which in turn produces *uniform acceleration*.

With the help of this model, Beeckman indeed arrived to the right mathematical result, giving a close to final description of free fall. He also described inertia, and gave a potential explanation of how a high frequency *periodical impulsive force* can give the *illusion* of the constancy of gravity and the resulting uniform acceleration.

Nevertheless, Beeckman's theory was refused by the era, because the *jerky pulls of attraction* still represented a kind of non-mechanical *action at a distance force*, which therefore could not be accepted by mechanicism.

Around the middle of the same century, when Galileo's principle of inertia had already been recognized, Giovanni Alfonso Borelli, Italian physicist and

astronomer, made an attempt to replace Beeckman's action at a distance force with something more tangible. He agreed with the assumption that gravity is made up of *periodical, impulsive forces*, whose frequency approaches infinity. But instead of Beeckman's jerky pulls, he compares gravity to *the impulsive actions of quickly tapping small hammers, which continuously accompany the falling body*.

Each individual tapping adds the same amount of impulse and speed to the motion of the body and this accumulative process results in uniform acceleration.

Both Borelli and Beeckman adopted the idea of a great, but not infinite frequency for their periodical force instead of the mechanically inconceivable constancy, and assumed the accumulative process of a great number of individual *impulses* in action. Borelli's other new point of view was that the collision-like impulsive force of the tapping of the little hammers were acting from the opposite direction than Beeckman's attractive force, producing the same *centripetal acceleration*, but by pushing from the outside instead of pulling from the direction of the center of the massive body. With this, he relieved the



theory from the non-mechanical concept of the attraction from a distance.

Nevertheless, the hypothesis presents some other problems. Borelli's little hammers are to accompany the falling object regardless of its constantly increasing speed. If each tapping imparts the same units of extra speed to the body, the hammers must accelerate with it, or have a much greater initial velocity than the body and in the same direction, which they transfer in each tapping. They must also be very small compared to any material particle, otherwise they would soon accelerate them on their own speed. They must also fill all space around the body, which suggests the existence of an all-pervading medium.

Considering all the above, it can be seen, that Borelli's theory not only brings up all the mechanical problems involved in the concept of the simple sounding *constant force of gravity*, but also offers a possible solution to all of them, including an early suggestion of the *Kinetic Theory of Gases*, which was to be formulated only two centuries later.

There is indeed a kinematic solution for Borelli's theory, if the assumption is admitted that the hammers are the constituents of a medium, being every-

where in space, moving with great, but not infinite, radial velocity toward the center of the massive body. These supermundane particles of the flowing medium constantly tapping and accelerating everything that gets in their way. How else can all the perplexities of this universal phenomenon be brought within human comprehension, if not by the assumption, that gravitation is a flow of a medium toward the center of the mass, and carries all objects with it.

This mechanical process of the acceleration of macroscopic bodies is, indeed an every day experience wherever a fluid in flow carries a foreign object submerged in it. Think of a river, that accelerates a heavy log unto its own velocity by the *periodic, impulsive force* of the immense number of water molecules colliding with the slow moving solid body, like little hammers tapping on it with immense frequency.

Should this simple phenomenon be judged as the act of a mysterious *constant force* or merely as the insufficiency of our senses to record the frequency and recognize the periodicity?!

Borelli's hammers truly exist as the atoms of the kinetic theory of all fluids as they are hammering

the wall of a container or any solid body submerged within. If this hammering is random and isotropic from all directions, it creates the macroscopic effect of *kinetic pressure*. If the fluid itself is in global motion, superimposed on their random motion, all hammers possess an excess kinetic energy in that specific direction and by their immense number, they uniformly accelerate and carry all foreign bodies in their way. Thus, in order to solve the perplexing mechanism of the constant force of gravity, Borelli gave a close to perfect description of a seemingly constant, but actually a high frequency, periodic, impulsive force. The same force, that has been simulated in our analogy through the effect of a sink, operating in the isotropic ideal gas.

Let us now assume, that somewhere in the space of the great room a small soap bubble is produced. Its existence is determined by the balance between the internal and external pressure of the gas, and the cohesive forces acting in the soap film. Assume further, that as it suddenly appears at a point in space, it should be at rest relative to the non-operating sink. In a motionless, isotropic medium the pressure exerted on an object is also isotropic. Pressure is a

vector quantity which is always *normal* to the surface of the object. Therefore, the force exerted on the sphere of the bubble from every direction is exactly counteracted by a pressure directed against the opposite point of the sphere. Thus, in a motionless gas, the *net force* exerted on the soap bubble is zero and it can be considered *at rest relative to the isotropy of the medium*.

Once the sink starts operating and the first rarefaction pulse reaches the bubble the isotropy of the pressure on its wall ceases to exist. Due to the negative effect of the pulse, there is a smaller pressure exerted on the bubble from the direction of the sink, than from the opposite direction. This directional pressure difference represents a net force; a tendency to move the bubble toward the sink, that is, to produce acceleration.

This is the net centripetal force that can be represented by the vector  $\mathbf{s}$ , which has the same magnitude at any point of the surface of a sphere of a given radius and directed from every point radially inward to the sink. It is evident, that this description is mathematically equivalent to Newton's concept of gravitational attraction. If the capacity of the sink is

measured by the number of atoms,  $n$ , withdrawn from the medium per unit time and the mass of each atom is  $m$ , then the *capacity of the sink*,  $S$  is,  $S = mn/sec$ . It follows, that the two equations describing the centripetal force,  $F_c$ , in the two different phenomena are identical.

$$F_c = G \frac{m}{R^2} \text{ or } K \frac{S}{R^2}$$

where  $G$  and  $K$  are constants of proportionality, depending on the unit of time and length used. The magnitude of gravitational mass is comparable to the capacity of the sink, the centripetal force is *directly proportional to either and inversely proportional to the square of the distance from the center*.

It should be emphasized here, that the *inverse square law*, expressing the effect of the sink, has not been derived from empirical facts, as Newton had achieved his Law of Universal Gravitation from Kepler's empirical formula. This law is constructed conceptually from the isotropy of the propagation of disturbances in an isotropic ideal gas together with the geometrical axiom, that the surface area of the sphere is proportional to the square of its radius.

It can be expected, that, if Newton was able to derive his inverse square law from Huygens' centripetal acceleration and Kepler's formula, the reciprocal procedure should also be possible. From the geometrical inverse square law of the sink, with the aid of Huygens' equation, one should be able to derive the formula of Kepler's third law of planetary motion?!

At this stage of the analogy, however, the centripetal force of the net negative pressure, just like Newton's force of gravitation, only renders the vertical component of planetary motion and Kepler's formula still means nothing more than before; an incomprehensible mathematical wonder.

Nevertheless, in the following extensions of the analogy, it will be shown, that there are well known and well understood phenomena in Nature which can conceptually tie together the kinematics of the sink and the mathematics of Kepler's formula.

## THE VORTEX

In analyzing an orbit or the trajectory of a body in free fall, Newton's theory of universal gravitation completely separates the forces responsible for the vertical and horizontal components of the motion.

He only discusses the force of gravity as the cause of the radial acceleration and leaves the initial tangential component of the orbits to be an effect of unknown causes. The modern concept of the gravitational field inherited this one dimensional view. Figure 7-1, the illustration of the earth's gravitational field is a typical example, where the lines of force are straight lines, directed radially toward the center of the earth, with the complete negligence of the earth rotation.

This method of description can be taken either as the result of an optical illusion, coming from disregarding the rotation of the frames of reference of the earth or that of the sun, in which the phenomenon is described, or the deliberate dismissal of this part of the problem, as indifferent from the stand-point of the mathematical analysis.

For the sake of simple analogy, the same approach has been taken in the above ideal-gas thought-experiment, which lead to the description of a straight line radial flow toward a sink from all directions. In this picture the kinematical tendency of the acceleration of the soap bubble had been found mathematically equivalent to the effect of the accel-

eration caused by a gravitational field around a massive body.

The analogy was based on the Newtonian simplification; neglecting the tangential component of force and motion. The fact, however, is, that there is no such thing as a permanent three-dimensional *radial flow* into a sink, but it is always accompanied by rotation just like gravitation itself.

Consider two common earthly examples of rotational systems; the great storms, like the cyclones and tornados, and the miniature rotating system of the draining water in the kitchen sink.

In the case of the storms, it has been found by observations, that whenever a great mass of air heats up over a suitable terrain on the earth's surface, it rises and leaves a low pressure area behind. Next the surrounding colder air starts drifting radially towards this area and winds come into existence, blowing from all directions toward the low pressure center. Naturally, the momentum of these winds cannot dissipate when they finally reach the center. The first result of this radial rush of air from all direction is, that in the central area the low pressure changes over to high pressure and a core of dense air forms,

which bounces back the still oncoming winds. But behind the first layers of the winds there are great masses of air still moving toward the center and push the rebounding air sideways. No doubt, *the only possible kinematic balance in this situation is rotation, where the linear momentum of the inward flow is transformed into angular momentum.*

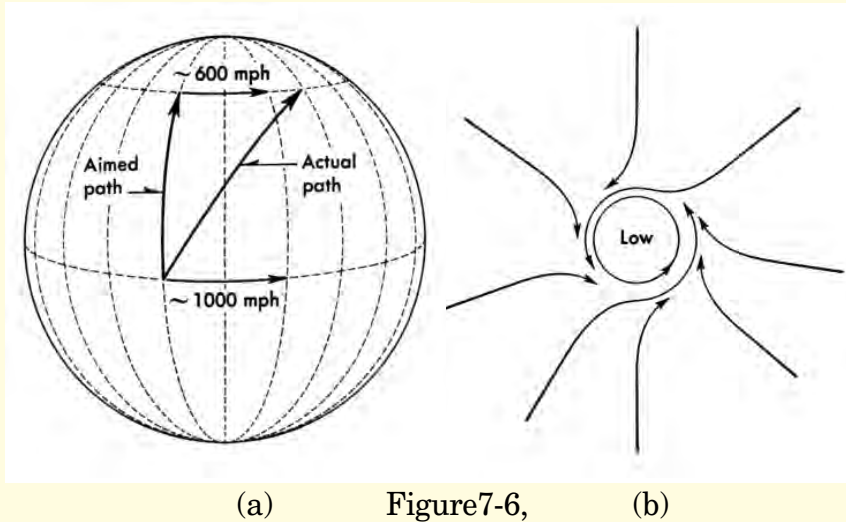


Figure 7-6,

(b)

The question of the *direction of rotation* could be left coincidental, but in certain cases, maybe in more than presently known, the decisive factor in the direction of rotation has been found to be the influ-

ence of an *already existing rotation in a higher order of magnitude*.. In case of the great storms, this higher order is represented by the earth's rotation, and the result is called the *Coriolis effect*.

Any object moving freely over the surface of the rotating earth appears to be deflected to the right in the northern hemisphere and to the left in the southern hemisphere. Figure 7-6. (a) shows the path of a projectile, which is fired directly to the north from the equator and therefore shares the earth's angular velocity of 410 meter/sec eastward.

As the projectile proceeds north, the circumference of the globe gets smaller under it, and has a lower velocity than at the equator. The result is, that the projectile moves in a curved path relative to the ground, veering off toward the east. Because of the same effect, the winds of a cyclone also tend to veer off to the side, but in this case, at the same time the mass of air is continuously *attracted* by the low pressure area (b).

Thus, instead of blowing radially into the center, the winds begin to circle around the area, producing the circular motion of a great mass of air. This happens in the clockwise direction in the northern and

counter clockwise direction in the southern hemispheres (c). Once this pattern is formed, it has a tendency to grow. The core begins to flatten out to a ring, which rotates like a solid body. It transfers its angular momentum by friction at the edges and produces greater and greater rings, concentric to the '*eye of the storm.*' The system gradually gains angular momentum and perpetuates its own existence. Tropical cyclones can attain diameters of 100 to 500 miles, with wind velocities up to 300 mph, and their life times are often measured in several days.

Theoretical hydrodynamics, initiated in the 18th century, named this phenomenon a *circular vortex* and established some of the basic rules about its origin, nature and mechanism.

In general, a vortex is defined as a mass of fluid in which the flow is circulatory. A thorough analysis of fluid flow, attributed to Hermann Helmholtz has produced the following laws governing vortex flow:

1. The strength of a vortex is constant along the filament.
2. The identity of the fluid in a vortex does not alter during the life of the vortex.

3. Filaments have no ending, they are either closed paths, or their ends extend to infinity.

"From the above rules, it follows that the filaments in a circular vortex must form closed rings, in which always the same particles are present. It is clear from this symmetry that the speed of the particles at every point of a circle is the same, and their velocity is tangential to that circle, which is exactly counteracted by the static pressure of the outside layers.

"This must be the case, since any radial component of the velocity would entail a net flux across the rings, which would make the center of rotation either a *source or a sink.*

"Hence, in a circular vortex, the induced velocities at the extremities of oppositely directed radii are of the same magnitude but in the opposite sense, so that the mean velocity of the fluid within the vortex is zero. Thus, if a circular vortex of small radius is placed in a motionless fluid, it will stay at rest relative to the isotropy of the medium, and when placed in a field of flow, it will 'swim with the stream' like a material substance, carrying its vorticity with it.

"More over the vortex cannot disappear, for it has been proved that rotational motion is permanent.

"It follows, that when in the actual cases the vortex rings do dissipate, the internal friction of the fluid must be the cause. In a non-viscous fluid a circular vortex, once formed, remains in existence indefinitely." (L.M. Milne - Thompson, Theoretical Hydrodynamics [79])

"In the Theory of Aerodynamic Circulation a mass of air in rotary motion is said to be in circulatory flow, if its velocities at various radii from the center are of the proper magnitude to induce *radial equilibrium* of the circulating mass. Considerations of the requirements for equilibrium consists in balancing *centrifugal forces against static pressures*, derived from Daniel Bernoulli's theorem and results in the specification that the velocity of a particle must be inversely proportional to its radius from the center of rotation ( $1 / R$ ).

"Air in this condition is described as a *free vortex*." (Van Nostrand's Encyclopedia, 1976 [49]).

The example of the kitchen sink represents an entirely different kind of circulatory flow. In this case the vortex develops around a sink, which consumes the water and there are some important differences between the two types of vortices.

On the one hand, it was established above, that the circular vortex is made up of *closed rings whose particle content does not change in time*. This means, that no *radial flux* exists inward or outward through the circular vortex. Each small portion of the medium, therefore stays on the same orbit and moves with constant tangential velocity.

This radial equilibrium is maintained by the balance between the centrifugal force of the rotation and the centripetal force of the static pressure of the external isotropic medium. In the case of a cyclone the in-blowing winds represent the centripetal pressure and when they cease to operate, the circular vortex gradually dissipates, simply because of the unbalanced centrifugal tendencies.

On the other hand, there exists a different kind of circulatory flow. Two examples of that are the vortex in the kitchen sink and the vortex described by the thought experiment in the ideal gas. These are circulatory flows developing around a sink as it continuously withdraws a certain volume of fluid. The resulting density difference produces a *constant radial flux* of the medium toward the sink across the whole vortex.

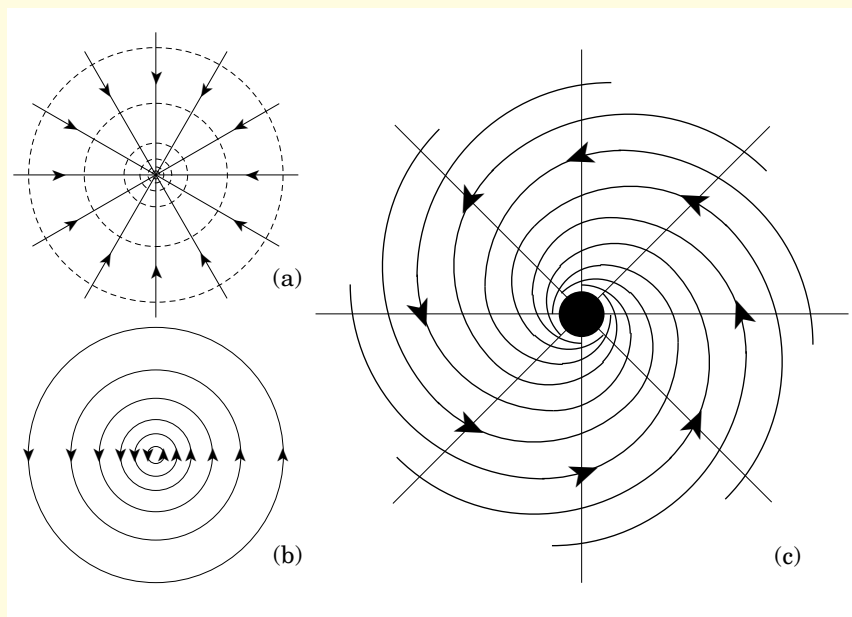


Figure 7-7

It follows, that no closed vortex-rings could develop in this type, but the paths of the particles in the fluid are circles of continuously diminishing radii. Thus, each small portion of the medium moves on a separate *spiral channel* with increasing tangential velocity as it approaches the center. Eventually, all the particles caught in such vortex will be consumed by the sink.

Theoretically the territory of the vortex is infinite, but its effectiveness to accelerate particles ends at a distance in space where the centripetal effect of the sink combined with the isotropic pressure of the external medium are less than the force needed for the centripetal acceleration of the spiraling orbits of the atoms. In fluid-dynamics such a rotating system is called a *spiral vortex*. In this analogy it is more clarifying to use the name, *sink vortex*.

The schematics of Figure 7-7 show a sink (a), a circular vortex (b) and the combination of the two; a sink vortex (c).

Of course, the number of spiral stream-lines in Figure 7-7 (c) is merely a convenient choice of the artist. In a fully developed spiral vortex, like the water vortex in the sink, there are an immense number of spiral stream lines, winding gradually inward to the drain.

Each layer of the water, practically each row of the atoms can be visualized as a continuous stream-line forming the same shape of spiral from the edge of the vortex all the way into its center, as it is illustrated by [Figure 7-8](#).



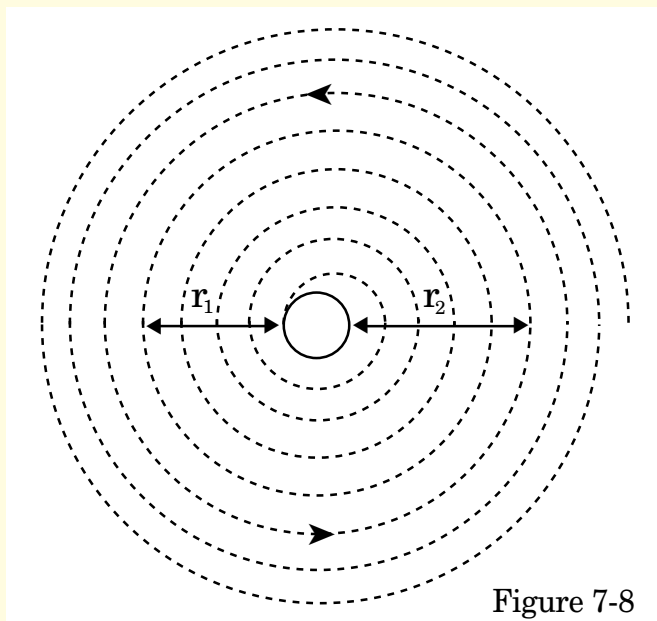


Figure 7-8

It should be recalled here, that the effect of the sink is first of all a localized disturbance in the isotropic medium. The resulting constant rarification is propagated through the fluid according to the *inverse square law*. It follows, that the extent of rarification in each individual spiral channel also obeys the same law. It is evident, that both conceptually and mathematically the sink vortex is distinctly different from the circular vortex.

Since the theoretical development of hydrodynamics only started around the beginning of the 18th century, it is not clear, what kind of vortex Descartes had in mind two centuries earlier for his solar-vortex theory.

However, Newton explicitly states in the 'Principia', that his refutation of Descartes theory was based on the mathematics of the circular vortex:

"(a) The speed of an ether particle in the vortex varies inversely as its distance from the sun ( $1/R$ ).  
 – (b) The period of revolution of such a particle varies directly as the square of its distance from the sun ( $P = (1/R^2)$ ). (c) This result contradicts Kepler's third law ( $P^2 = KR^3$ )."

As it will be shown in details in Appendix I, the mathematical analysis of the inverse square law of the propagation of disturbances in a rotating medium reveals, that the orbital velocity of a mass-particle in the Aetherial sink-vortex is inversely proportional to the *square root of the radius*,  $1 / \sqrt{R}$ ; in agreement with Kepler's formula. The understanding of Appendix I, however, requires the reading up to the end of Chapter Eleven.

This result suggests the *inherent kinematic function of the sink vortex*, which combines both the centripetal force of universal gravitation by the radial component of the flow and the unknown force represented by Kepler's third law as the tangential component of the spiral. Hence, combining the laws of universal gravitation and universal rotation, the law of the sink-vortex gives the law of *Rotational Gravitation*.

Another important facet of the analogy is, that the Coriolis Effect is also assumed to be responsible for the direction of rotation of the vortex formed in the kitchen sink. This miniature rotating system also turns clockwise in the northern, and counter-clockwise in the southern hemisphere of the globe.

To recognize the improbability of a permanent, straight-line radial flow toward a sink, note the infinitesimal magnitude of the Coriolis Effect in this case, since it originates from the different angular velocities of the surface of the earth between the altitudes of the northern, and southern borders of the kitchen sink.

Considering all the above, it is not only reasonable but rather compelling to conclude, that *rotation*

*is an inescapable kinematic consequence of the operation of a sink in an isotropic medium.*

An idea should be inserted at this stage:

The torque that creates the vortex in the kitchen sink and in the atmosphere originates from a larger order of magnitude, through the Coriolis Effect of the rotation of the earth. In the case of the origin of our solar system, the Coriolis Effect could be produced by the rotation of the galaxy and the ultimate cause of any rotation could be the differential rotation of the Universe!?



Figure 7-9. NGC 3031 (M81), face-on view of a spiral galaxy.

As a visual aid for all of the above, it should be worth while to ponder a bit over the following pictures, illustrating the various vortices of different phenomena.

To Sir Edmund Whittaker's pondering on the direction of science if the spirality of nebulae would have been discovered before the overthrow of Descartes' vortex theory, we might add, what impulse would have been created by the image of a modern satellite picture of a hurricane. .

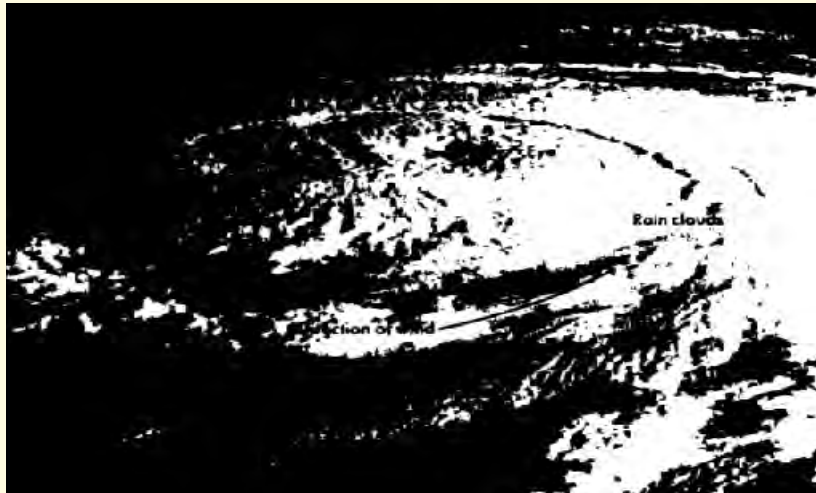


Figure 7-10.

A satellite picture of Hurricane Elena, 1985.



Figure 7-11.

- a) A satellite view of a double hurricane.
- b) A double whirlpool galaxy.

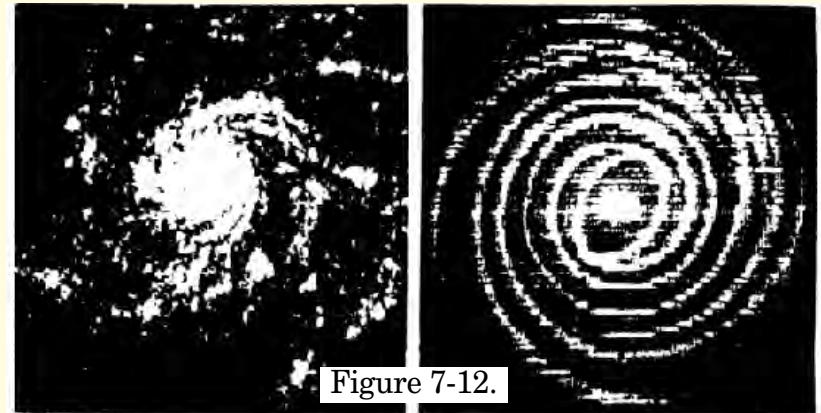


Figure 7-12.

- a) NGC4622, face-on view of a spiral galaxy.
- b) A synthetic optical photograph of the Milky-way.



Figure 7-13.  
M51 whirlpool galaxy with its companion.

It is, indeed, difficult to accept, that some of these phenomena can not be imagined without the acceptance of the kinematic of rotation of a *real medium*, while some others are simply believed to be a manifestation of the accidental gathering of various chunks of matter under the mysterious influence of their mutual attraction, acting at infinite distances through the mathematical abstraction of gravitational fields in *totally absolutely empty space*.

## CHAPTER EIGHT

### THE KINEMATICS OF THE THREE LAWS OF MOTION

Up to this point, with the aid of the ideal gas analogy, the following ideas have been developed:

In the isotropic medium of an ideal gas all locally induced disturbances, periodical or continuous, are propagated outward in expanding spheres with a speed, related to the density of the medium and the average speed of its constituent units. A sink operating in this medium, can be taken as the generator of a continuously reproduced disturbance, having a

negative effect on the average density of the medium. This in turn results in a net force of pressure toward the sink, which is directly proportional to the capacity of the sink and inversely proportional to the square of the distance from it. The local withdrawal of a constant volume of the gas results in a radial flow toward the sink from all directions. The velocity of this flow is greatest close to the sink and falls off with distance according to the inverse square law.

The space around the sink simulates the gravitational field surrounding a massive body, as it is generally described within the rotating frame of reference of that body.

In this analogy the constant centripetal force of gravity is simulated by the net pressure directed toward the sink and transferred through the periodic impulsive force of the individual particles of the general flow. It follows, that any foreign particle, comparable in mass to the atoms of the gas, is carried by the medium and accelerated toward the sink. For all intents and purposes, this directional force, exerted on a foreign body by the atoms with immense but not infinite frequency, should be taken as being a *constant force*, just like the force of pressure.

There is also an inevitable kinematic procedure acting through the head-on collisions of the radial flows, eventually creating a circulatory flow around the sink. The linear momentum of the radial flows transform into the angular momentum of rotation.

The circulatory flow, generated around the sink, is called a *sink-vortex*, and its kinematics can be derived mathematically from the geometric inverse square law of propagation of disturbances, together with Huygens equation of centripetal acceleration. Consequently, it is mathematically equivalent to Kepler's third law of planetary motion and therefore agrees with the observational facts. Within the sink-vortex the individual atoms, or any particles movable by them, are carried on a spiral path toward the sink with *instantaneous tangential velocities inversely proportional to the square root of the distance from the center*. (See App. I. for mathematical derivation.)

Such a description of the gravitational phenomenon requires a break from the Newtonian rotating frame of reference, in which only the radial component is realized. For example, the Earth's gravitational field should be observed in the frame of reference of the Sun or that of the Galaxy or from the

isotropic space of the Universe. Then it becomes evident that the radial and transversal components of gravitation are inseparable.

A sink, operating in an isotropic medium with a resulting flow-pattern of a sink-vortex can be taken as a plausible kinematic simulation of the common origin for both the tangential components of universal rotation and the radial components of universal gravitation. These two, together, result in the universal phenomenon, which shall be called *Rotational Gravitation*.

The two counter parts of the analogy, gravity and sink-vortex, originate from two separate departments of physics and from entirely different conceptions, however, they are mathematically clearly equivalent.

Nevertheless, this simplified kinematical simulation of the constant force of Rotational Gravitation merely represents the capability of a flow pattern to carry comparable bodies in a manner similar to a gravitational field. The extension of this analogy to include the simulation of the uniform gravitational acceleration will involve Newton's grand scheme of correlating terrestrial and celestial mechanics.

In order to simulate uniform acceleration as a result of the constant force of the sink-vortex, all concepts and mathematics of the Three Laws of Motion must be simulated in the ideal gas, within the laws and concepts of the Kinetic Theory of Gases.

## FREE EXPANSION

Systematizing the vast variety of the possible motions of bodies, Newton constructed the following three laws of mechanics:

(1) *Inertia* is the inert property of all bodies to move on a straight line with uniform speed, unless an *external force* acts upon them.

(2) *Acceleration* produced by a force is proportional to the strength of the force and takes place in the direction of the force.

(3) *Action* and *Reaction* are a pair of equal and opposite forces, that always exist together.

The quantitative relationships between these fundamental concepts are as follows:

*FORCE* = inertial mass  $\times$  acceleration

*ACCELERATION* = force / inertial mass

*INERTIAL MASS* = force / acceleration

The extent of our weak comprehension of these concepts is clearly expressed by the following quote from Van Nostrand's Scientific Encyclopedia, 1976; Laws of Dynamics, [1612] :

"The first Law states, that bodies of matter do not alter their motion in any way except as a result of forces applied to them. It is quite conceivable that Newton's interpretation of 'force' was the primitive concept which we all have, based on the muscular effort, and he regarded this statement as the expression of a natural law connecting force with motion.

"On the other hand, he may have recognized in this first law, as we now do, an objective definition of force, namely, that which is capable of altering bodily motions in the face of the opposition called inertia whose nature is even *now not fully understood*."

Nevertheless, as the above equations show, these basic concepts of mechanics are inseparably inter-related, and a successful kinematic simulation of them must deal, not only with the individual concepts, but with their specific relationships as well.

Newton describes the *force of gravity* as an inert, unexplainable property of matter, acting through immense distances without contact or conceivable

means of transmission. Similarly, Newtonian *inertia* is another inert property of all bodies of matter; a still not fully understood *inanimate resistance* against any change in the state of their motion.

In the foregoing, by the thought-experiment in the great room it was shown, that an operating sink-vortex in an ideal gas can successfully simulate the effects of the inert properties of gravitational mass and that of the force of gravity. Now, we may inquire, if there is any way to simulate on the microcosmic scale of an ideal gas the so-called *fictitious force of inertial resistance* ?!

First, however, a possible confusion involving the mechanical role of the vacuum pump in the simulation should be clarified.

In order to realize that the pump does not represent an external mechanical force, which in any way accelerates the atoms of the ideal gas, let us replace it with the existence of another room filled with a gas of much lower density than the room of the experiment. This set-up, through the known thermodynamic phenomenon of *free expansion*, will produce the same results as a pump without any involvement regarding the concept of *force*.

"A process of much theoretical interest is that of 'free expansion'. This is an adiabatic process in which no work is performed on or by the system. Something like this can be achieved by connecting one vessel which contains gas to another evacuated vessel with a stopcock connection. When the stopcock is opened, the gas rushes into the vacuum and expands freely. That is, the initial and final internal energies of the system is equal in free expansion." (Halliday-Resnick: Physics, [490])

Hence, instead of the vacuum pump, there is now an extended isolated system of two rooms; *A* and *B*, initially filled with different densities of gases and connected by a small pipe with the porous sphere, reaching into the middle of the space of room *A*, as it was described before. When the sink opens the gas escapes through the pipe, from the room of higher pressure *A*, to room *B*. The volume of gas per unit time escaping from *A* depends on the cross section area of the pipe (the capacity of the sink), and the density difference between the two compartments. Since the process is adiabatic, there is no change in the temperature of the gas or in the average velocity of the atoms.



"Gases expand indefinitely when released, not because of repulsion between the molecules, as formerly supposed, but because the molecules are in rapid motion and do not stop unless they collide with something. Air is not *forced* out through a tire puncture; only those air molecules pass out which in their aimless wanderings, happen to encounter the opening. Molecules also pass in from the outside; but since there are several times as many per unit volume inside as outside, many more pass out than in. The rapidity with which this takes place only emphasizes the speed of the molecules and the relative insignificance of the *internal friction* opposing it." (Van Nostrand: Sci.Enc. - Kinetic Theory, [1428])

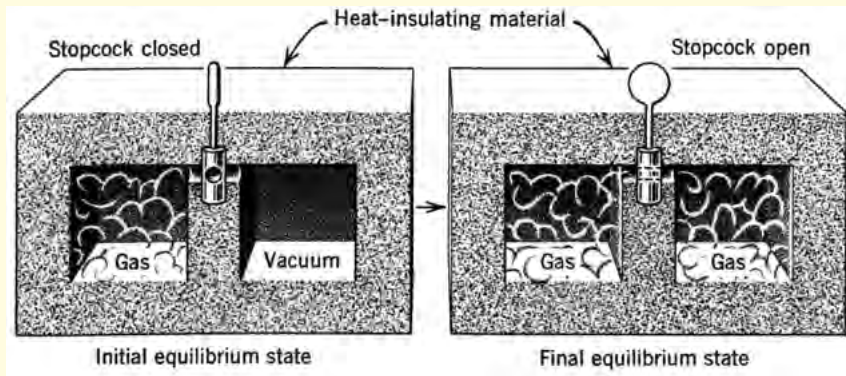


Figure 8-1

Putting all these pieces together, it turns out that in the sink analogy of gravitation, there is no such thing as a *force* in action in terms of Newton's mechanics. Since there is no change in the total energy of the isolated system of the two rooms, there can be no external or internal force in action in the process of free expansion.

But the Kinetic Theory of gases was constructed to work by the laws of Newton's mechanics and if there is no force in action in an isolated system, there is no cause for acceleration either.

Indeed, a closer analysis of the motion of the individual atoms reveals, that in fact, there is *no change in their uniform velocity* through the whole process of free expansion. The macroscopic phenomenon of the *accelerated* flow toward the sink is merely an optical illusion, which can be explained by considering the kinematic events taking place between the two rooms filled with gases of different densities.

For the sake of simplicity, let us assume that the sink is simply a round hole in the wall between the two rooms, operating with a fast moving shutter. Starting with the closed position, gases A and B are completely separated, they are both isotropic, homo-

geneous and in equilibrium. The atoms are moving with the same average velocity in both side in complete randomness, but they have different densities and therefore different total kinetic energies. Say, that gas  $A$  is 10 times denser than gas  $B$ , it also has 10 times greater kinetic energy both per unit and total volumes. The density difference can also be expressed by stating that the atoms of gas  $B$  have an *average collision-free path* 10 times longer than that of gas  $A$ .

This difference also means that at any given time, 10 times more  $A$  atoms go in any given direction, than  $B$  atoms, and therefore 10 times more collision happens on the surface of the shutter facing room  $A$  than that in room  $B$ . Now, recall the case of the punctured tire and realize, that upon the sudden opening of the shutter, on the average, only one of each 10  $A$  atom will collide with a  $B$  atom and rebound, back into room  $A$ , the other nine will be able to continue to move freely into the space of room  $B$ . It is evident from this picture, that none of the atoms accelerate or decelerate, but simply gain space, being able to move further in the same direction with the *same uniform velocity*. In other words

going into room  $B$  the collision free path of the  $A$  atoms are lengthening, while in room  $A$ , next to the sink the  $B$  atoms rebound much sooner than before, thus their collision-free paths are shortening.

This process then affects both media layer by layer and, as it was described before, it represents a continuous disturbance, propagating spherically into both rooms; in the form of rarefaction in  $A$  and condensation in  $B$ .

## THE CENTER OF OSCILLATION

In order to fully comprehend this *non-accelerating* process, based on the fundamental assumptions of the Kinetic Theory, consider first the simpler Newtonian field with the purely radial flow of the medium and some further generalizations.

The assumed existence of an average collision-free path can be extended by combining it with another general concept of randomness, namely, that in an isotropic medium at any given instant the same number of atoms are moving in every possible direction. Hence, within a given interval of time, each atom moves an equal collision-free distance in every direction. In three dimensions this can be represent-

ed by a *collision-free sphere* for each atom, the radius of which equals the collision-free path. *On the average* means here, that the frequency of the random oscillation is so immense, that within any crude, macroscopic time interval the atoms not only move in all possible directions, but even this full cycle is repeated great number of times.

Hence, when an atom collides within or beyond the border of its sphere or when some wander away from its initial position, it averages out by the great numbers and becomes negligible, compared to the total statistical isotropy of the medium. The *collision-free sphere* can be described by the three rectangular Cartesian coordinate axes (x,y,z); in this case they represent six vectors of equal magnitude, the six components of all possible directions of the motions of an atom. Within this sphere each atom moves on a straight line with uniform velocity, until it collides with another atom, on the border of their neighboring spheres, where they both rebound into their own territory.

Thus the motion of each atom can be considered as an *omni-directional oscillation*, whose center-point can be called, *the center of oscillation*. The diameter

of the sphere represents the *amplitude* of the oscillation and the velocity of the atoms divided by the length of the diameter, gives the *frequency of the oscillation*. These hypothetical collision-free spheres do not change their positions or their shapes, as long as the density and the pressure around each atom is isotropic, that is; as long as the medium, as a whole, is motionless.

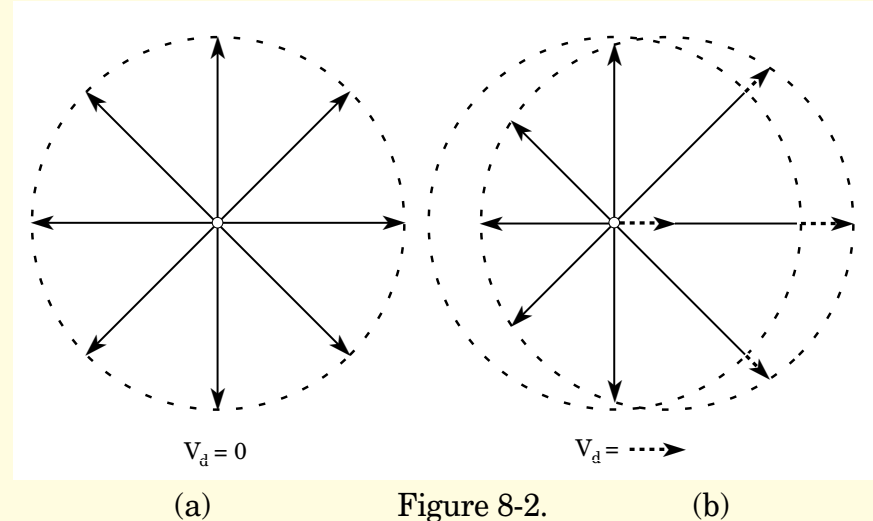


Figure 8-2 (a) shows six vectors, enclosed in a collision-free sphere, representing the random oscillation of a particle in an isotropic, motionless medium.

In the case of an operating sink, however, the local disturbance of the withdrawal of the atoms eventually destroys the isotropy of the whole medium. The atoms in the immediate vicinity of the sink are able to move radially further toward the sink, than in any other direction. The initially isotropic oscillations of these atoms become *lopsided*. Their centers of oscillation *begin to drift* and the collision-free spheres become elongated into spheroids with their major axes,  $x$  pointing toward the sink, (b).

Evidently, the atoms in the next layer of the medium experience a similar freedom in their motions toward the sink, but to a smaller extent, since the extra space left by the first layer is divided among the greater number of atoms of the second layer.

Similar is the case for each consecutive layer.

The result is a *drift* of the center of oscillation of each individual atom toward the sink. This drift velocity,  $V_d$  of the atoms (b) is increasing as the atoms and their spheres of oscillation approach the sink. In this respect there is a global acceleration of the gas, but obviously without any change in the uniform velocity of the atoms. The drift, which is *super-*

*imposed* on the initial random motion of the atoms, is proportional to the extent of the rarification of the medium, thus again, directly proportional to the capacity of the sink and inversely proportional to the square of the distance from it.

For future references, one more step of generalization is needed. From the theory of Free Expansion, where the total kinetic energy of the system is constant, together with the concept of isotropy, it follows, that the total kinetic energy of each individual atom also remains the same even in the case of a drift, superimposed on randomness.

Consequently, as the oscillation of a drifting atom takes up more space in the direction of the major axis of the spheroid, the minor axes are shortening in the same proportion. In other words, when the collision-free-sphere is elongated into spheroids of various eccentricity the *volume contained in the different shapes remains constant*. This concept will be useful later in connection with Bernoulli's constancy of the combined kinetic and dynamic pressure of an ideal fluid.

It has been stated in the first part of the simulation, that the rarification of the medium due to the

sink is inversely proportional to the square of the distance and therefore it produces a *radially accelerated* flow toward the sink. However it is now clear that this acceleration of the flow is a macroscopic illusion, simply mistaken for the lopsided oscillations of the atoms and the consequent drifting of the centers of oscillation with a uniformly increasing *contiguous* radial flow.

All this of the above had been described in Newton's rotating frame of reference, where the tangential component of the rotating gravitational field is neglected. Leaving now this frame and recognizing the rotation of the flow-field, we can conclude that all the above is valid for the motions of the atoms in the sink-vortex, except the velocity vector of their drift is not radial, but always tangential to the spiral stream-lines of the vortex.

According to the analogy, in a gravitational field a certain magnitude of potential energy can be assigned to every point. When a body of matter is released from rest at that point it experiences uniform acceleration, and according to Newton's second law, this uniform acceleration requires the continuous action of a force, that is, a *constant force*.

In the flow-field of the sink-vortex it has been found that the atoms of the gas do not change their velocities in free expansion toward the sink, The negative potential energy of any layer of the medium is represented by a deficiency of pressure from the direction of the center of the vortex, which in turn results in a net force of pressure toward the sink. Kinematically speaking, this unbalanced pressure at any point in the field of the vortex only means that more atoms are moving with their average uniform velocity toward the sink, than in any other direction.

A successful simulation of the uniform gravitational acceleration in the ideal gas, this net pressure, without the acceleration of the atoms, must be found kinematically capable of acting in the face of the opposition of the inertial resistance of mass as a constant impulsive force with great but not infinite frequency.

**MOMENTUM = KILOGRAM × METER / SEC**

Having an approximately clear kinematical simulation of the constant force of gravitation, the next step should be to simulate the product of this force; the uniform acceleration, which is produced against

the resistance of the inertial mass of a test-particle when released from rest in a gravitational field.

Nevertheless, gravitational acceleration in free-fall is not the clearest process to familiarize the concept of inertia because of the problematic subject of the equivalence of inertial and gravitational mass, which results in the same acceleration of all bodies regardless of their different inertial masses. Therefore, it is more practical to follow the historical route and the general educational approach to describe the concepts of mechanics.

*Inertia* is defined by Galileo and Newton as *the inert property of all material bodies, to resist any change in their state of motion*. In the absence of the action of an external force a body moves with uniform velocity on a straight line.

*The state of rest* is taken as a special state of motion, where the velocity of the body is zero.

*Acceleration* is any change in the state of motion of a body, whether it is only an increase or decrease in speed, or only a change in direction.

The magnitude of the change in the state of motion, that is, the acceleration, is *directly proportional to the magnitude of the force and inversely pro-*

*portional to the inertial mass* of the body. A greater inertial mass needs a greater force for the same acceleration than a smaller mass. Also, if two bodies are moving with the same velocity, the one with the greater inertial mass requires a greater opposite force to stop it. The same is true for the case when two bodies have equal masses but one has a greater velocity than the other.

In classical mechanics, from Descartes on, these relations were described by the concept of the *amount of motion*, which arises from the velocity and the quantity of mass conjointly.

In the modern language of mechanics the 'amount of motion' is called *momentum*. It is a vector quantity produced by the multiplication of the vector quantity of the velocity,  $\mathbf{v}$  by the scalar quantity of mass,  $m$ . The symbol  $\mathbf{p}$  is used to represent the momentum vector;  $\mathbf{p} = m\mathbf{v}$ . In the 'Principia' the second law of motion is expressed in terms of *the rate of change of momentum* of a body, which is proportional to the resultant force acting on the body and it is in the direction of that force.

The *principle of the conservation of momentum* states, that regardless of the interactions between

bodies of different masses, moving with various velocities, the total momentum of *an isolated system* does not change in time. That is; the total quantity of masses multiplied by the total velocities of all bodies, is a *constant*.

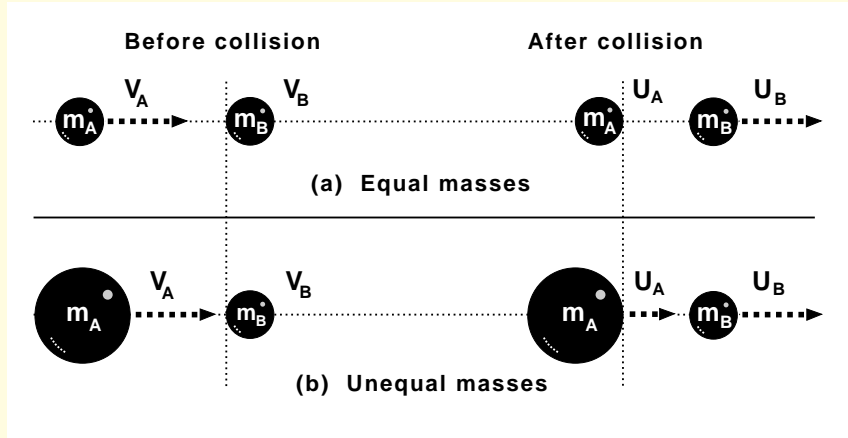


Figure 8-3.

Consider the simple elastic collision between two solid spheres of *equal inertial masses*. (Figure 8-3). They are positioned on same line going through their centers. Before collision body  $m_A$  is moving from left to right with a velocity,  $V_A = 10 \text{ m/sec}$ .

Body  $m_B$ , is at rest, its velocity,  $V_B = 0$ . In the collision between equal masses, the bodies simply

exchange their velocities. While  $m_A$  stops dead,  $m_B$  moves away with the total initial velocity,  $10 \text{ m/sec}$ . If their velocities after collision are  $U_A$  and  $U_B$ , then  $V_A + V_B = U_A + U_B$  since after collision  $U_A = V_B$  and  $U_B = V_A$ .

In this special case of an isolated system of equal masses, the *total velocity is also conserved*:

$$\text{Before collision : } V_A + V_B = 10 \text{ m/sec}$$

$$\text{After collision : } U_A + U_B = 10 \text{ m/sec}$$

The essence of Newton's second law and the conservation of momentum is, that the acceleration of the bodies are not only directly proportional to the force, but also inversely proportional to the magnitude of their inertial masses.

Therefore, as Figure 8-3 (b) shows, if  $m_A$  is  $20\text{kg}$  and  $m_B$  is  $10\text{kg}$ , the total velocities after the collision will not be conserved, but differ from the initial velocities. The  $20\text{kg}$  of  $m_A$  will not be completely stopped by the  $10\text{kg}$  mass of  $m_B$ , but it will only lose half of its velocity and continue to move in the same direction with  $5 \text{ m/sec}$ . The same time  $m_B$  will move away from the collision with the total initial speed of  $m_A$ ,  $10 \text{ m/sec}$ .

The principle of the conservation of momentum states, that the product of each mass times its velocity, that is, the total momentum of the system remains the same after collision.

$$(m_A \times V_A) + (m_B \times V_B) = (m_A \times U_A) + (m_B \times U_B) \quad (8.1)$$

By knowing the initial velocities and the final velocity of one of the bodies, this principle makes it possible to calculate the final velocity of the other body. If A's velocity decreases in the collision to 5 m/sec, the magnitude of the final velocity,  $U_B$  can be found as follows:

$$U_B = \frac{m_A(V_A - U_A)}{m_B} = \frac{(20\text{kg})(10\text{ m/s} - 5\text{ m/s})}{10\text{kg}}$$

$$U_B = \frac{20\text{kg} \times (5\text{ m/s})}{10\text{kg}} = \frac{100\text{kg} \cdot \text{m/s}}{10\text{kg}} = 10\text{ m/s}$$

Total velocity before:

$$(V_A + V_B) = (10\text{ m/s} + 0\text{ m/s}) = 10\text{ m/s}$$

Total velocity after :

$$(U_A + U_B) = (5\text{ m/s} + 10\text{ m/s}) = 15\text{ m/s}$$

Momentum before:

$$(20\text{kg} \times 10\text{ m/s}) + (10\text{kg} \times 0\text{ m/s}) = 200\text{kg} \cdot \text{m/s}$$

Momentum after:

$$(20\text{kg} \times 5\text{ m/s}) + (10\text{kg} \times 10\text{ m/s}) = 200\text{kg} \cdot \text{m/s}$$

Obviously the total velocity of the isolated system has changed in the collision, but the total momentum has been conserved. – This is one of the most fundamental laws of physics and has been experimentally verified beyond any doubt.

## A NON-INERTIAL SYSTEM

Descartes believed that the *total amount of motion* in the universe is conserved. Now, in classical and modern physics it is believed that the *total momentum* is the eternal quantity.

Nevertheless, since the concepts of inertia and force are still not clearly understood, it is also unclear, what the concept of momentum could represent in physical reality.

Adding apples and oranges together can make some sense, calling the resulting sum fruits, but what could be the meaning of the product by multiplying them with one another ?!



What can be this '*amount of motion*' that wants to preserve itself, and how can inanimate chunks of masses *resist* a *forced* change in their momentum ?!

As we have seen in the analysis of the gravitational force, the nature of kinematic simulation is such, that the Newtonian concept first must be disassembled to a point where it means nothing more than the clearly kinematic concept of *motion*. Then, based on the underlying kinematic process, it has to be rebuilt to its full meaning.

Let us first recognize, that the concept of inertia, force, acceleration and momentum, or their Newtonian relation to one another is completely unnecessary and useless in a system of bodies, where all constituents have equal masses. Whether the bodies are atoms of the same element, or ball bearings, or uniform bowling balls, as long as they interact only through the impulsive forces of one-to-one collisions, and exert no other actions on one another, the only necessary concepts are; motion, direction and speed, that is, velocity. In an isolated system of sufficiently great number of equal masses, there is no cause for a change in the total motion of the bodies during collisions. *On the average* they are all moving,

going into, and coming out of the collisions with the same speed in totally random directions.

The total velocity of the system is evenly distributed among its members; each one represents one unit of motion and on the average at any instant in any considerable volume, the same number of units moving in every directions. Evidently, such a system is *non-inertial*, there is no reason to create the anthropomorphic assumption that material bodies *resist* the change in their state of motion, or to invent a force which acts in the face of the opposition of the *fictitious force of inertia*.

In this system a moving body represents a unit of motion, nothing more, nothing less.

Since all units of the system are of equal masses, the concept of momentum is superfluous and when the bodies interact, via collision, they merely exchange or mix velocities.

Here the Newtonian concept of force means the mere transference of motion. Since the internal structure of the members of the system, do not affect their interactions, the transference of motion is totally elastic and instantaneous, thus the concept of acceleration is also foreign to the system.

Consequently, *both the concepts of force and acceleration revert back to the pure concept of motion.*

In a *non-inertial system* like an ideal gas, the most general conservation law is *the conservation of motion*. Thus, this system can be fully described by the concepts of *length and time* and the third fundamental Newtonian dimension of the *inertial mass*, becomes unnecessary.

In the following a kinematic simulation of the Newtonian concepts of inertia, force, momentum and acceleration will be attempted, showing the origin of these concepts, their conceptual relationships and the unavoidable necessity for inventing them.

Consider then an isolated, system of uniform ball bearings in weightlessness, somewhere in space, acting in every respect as an ideal monatomic gas. Assume that the all over size of this cloud of ball-bearing-gas is much greater than the experimental volume thus its peripheral expansion is negligible. Also assume that the members of the system are moving with an *average velocity of 10cm/sec, in totally random directions*. As long as they only interact with one another, and only through collisions, the system is non-inertial, meaning that during all inter-

actions the total initial velocity in the system is conserved. In this non-inertial system, inertia, force and acceleration means nothing more than motion, and the transference of motion.

Imagine now, that in this non-inertial *ideal gas* of ball bearings, two units are somehow bound together into a double-ball. This joining of the two units can be illustrated by an imaginary axis  $Q$ , which goes through the centers of both balls which are sliding on it without friction. The length of this  $Q$ -axis is three times the diameter of a ball and has a stopper on each end by which *the motion could be transferred from the front to the end of the group, and vice versa*.

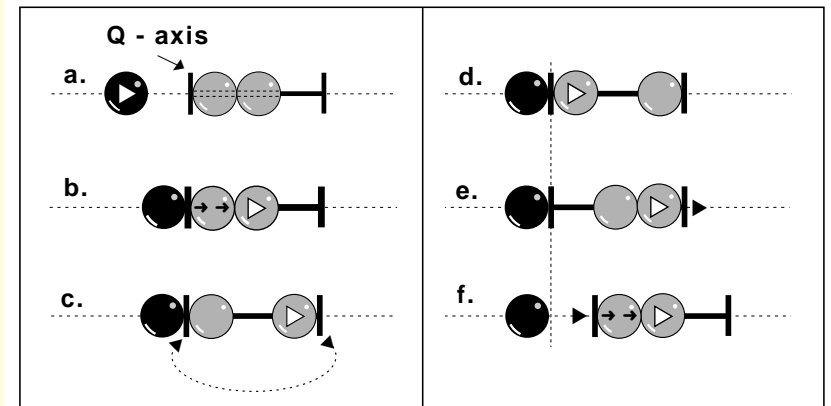


Figure 8-4.

This device of the Q-axis is assumed to have total rigidity and negligible mass. In the following thought-experiment the Q-axis should simulate the concept of an elastic force, binding two or more balls loosely together. In more general terms, the Q-axis simulates cohesion, the tendency of keeping the connected parts of matter within a limited distance.

For the sake of comparison, a larger group of five balls should also be assembled with a Q-axis whose length is six times the diameter of a ball.

Let us call a single ball *A*, and the double ball *Group/B*, and the five connected balls, *Group/C*.

Since it would be impossibly complex to follow the motion of these groups among the totally random motions of all the other balls, consider a greatly simplified situation in one dimension.

It is a common example of elastic collisions, that a moving ball collides with one of equal mass, at rest. Upon impact the moving one stops and transfers its total velocity to the other. This can be taken as the basic example of all collisions, since the frame of reference of the observer can always move such a way, that one of the bodies is in a state of rest relative to the observer.

Another well known simple example of elastic collisions is when two equal masses move with the same velocities in opposite directions on a mutual axis. In a head-on collision, they simply exchange directions and move away in the opposite directions with exchanged speeds. Restricting the system to these simplified events only, the Q-axis and all motions are one dimensional, and the direction of motions coincides with the line going through the centers of the balls.

Figure 8-5 illustrates the consecutive snapshots of the horizontal movements of three isolated groups: the single ball *A*, *Group/B* and *Group/C*.

On snapshot (a) ball *A* and both groups are considered to be at rest touching the vertical line, *0* representing zero centimeter at the time -0.1 second. With the three additional black balls, *X*, *Y* and *Z*, already moving from left to right ( $\Rightarrow$ ), each group on its own dotted line represents an isolated system with one unit in motion and 10cm/sec initial velocity.

Snapshot (b) shows the situation one tenth of a second later, at time=0. The moving black balls *X*, *Y* and *Z*, each collide with their own groups. *X* hits the single ball *A*, transfers its total velocity and stops.

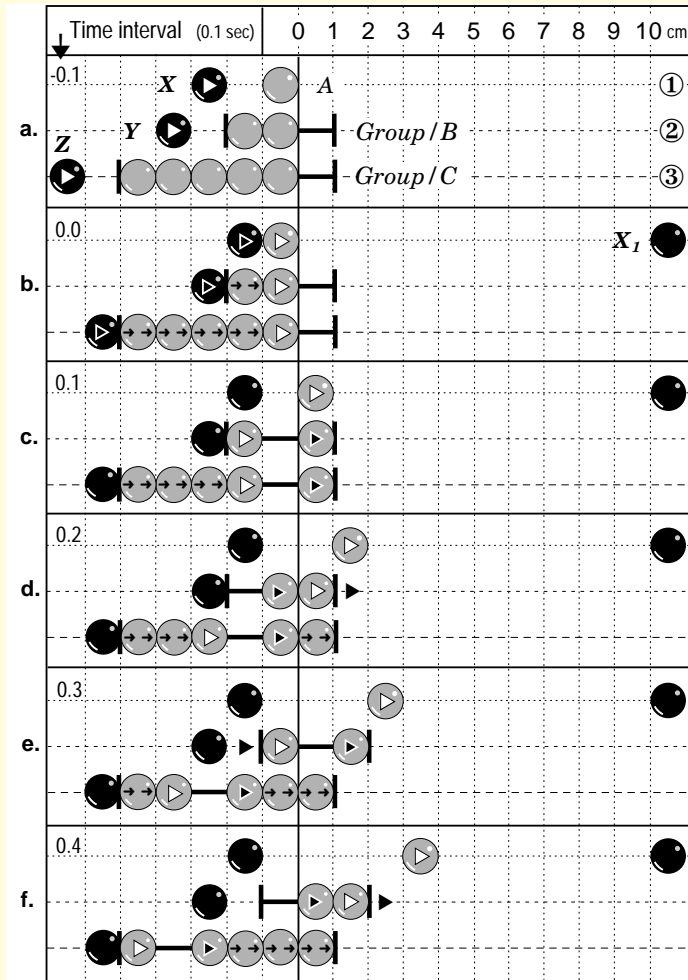


Figure 8-5.

The single ball, A moves away with a uniform velocity of 10 cm/sec to the right.

Evidently, without cause, there is no change, in the state of motion of the single ball A, thus, from here on it moves undisturbed along a straight line with uniform velocity to the right, while X is at rest at the point where it was stopped by the collision. In this case, before and after the interaction, the total velocity of the system remains the same; 10 cm/sec.

On the second dotted line Y hits the first member of *Group/B* and on the third line Z hits the first member of *Group/C*. Since the balls in both groups are touching one another, upon the collisions with Y and Z, the velocity is instantaneously transferred over to the last ball of the group to the right, which is free to move. In both groups, this last ball inherits the initial velocities of Y and Z, while those are stopped at the point of the collision.

Counting from left to right, in *Group/B*,  $B_2$  is moving and in *Group/C*,  $C_5$  is moving. Both of them are sliding freely on their Q-axes with 10 cm/sec, representing the total velocity of their systems at this instance. In snapshot (c), however, at the end of the first tenth of a second, they both hit the right end

stopper of their Q-axes. In the case of *Group/B*,  $B_1$  is hit from the back by the left-end stopper and through that it inherits the total velocity of  $B_2$ , while  $B_2$  is stopped by the impact. The same happens in *Group/C* where  $C_5$  stopped by the Q-axis and transfers the motion to  $C_1$  which instantaneously transmits the motion through  $C_2$  and  $C_3$  to  $C_4$  which is free to move toward the right with the total velocity of the system. And so on and on... The rest is self-explanatory, as Figure 8-6 shows, the snapshots from (g) to (l), taken in one tenth of a second intervals.

If the length of the field is 10 cm and the initial velocity is 10 cm/sec, the single ball,  $A$  with its continuous motion reaches the end of the line in one second. At line 10  $A$  collides with  $X_1$  at rest, transfers its total velocity to that unit, and itself stops. During the interactions the total velocity of this isolated one unit system was conserved.

However, as it can be seen, during the same time interval *Group/B* only moved half of the distance, 5 cm, and therefore it will take two seconds for this system to reach the end of the field. *Group/C* moved only one fifth of the whole distance, 2 cm, so it will reach the end in five seconds.

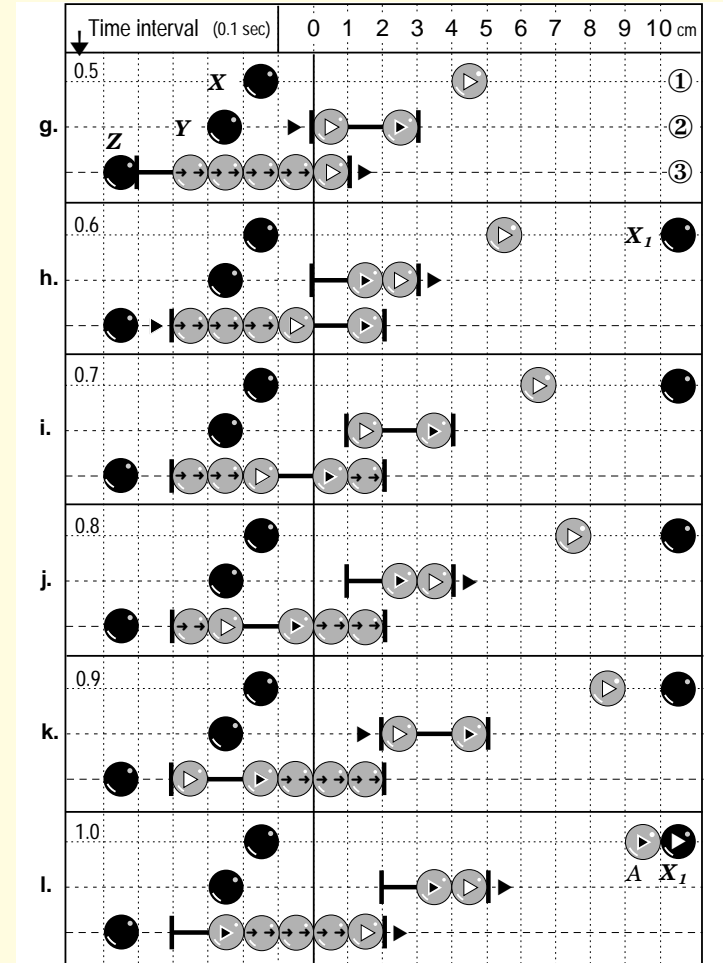


Figure 8-6.

It is evident that in all systems at every instant the total velocity was always 10 cm/sec. All members of the groups, *when they moved*, carried the total initial velocity. One of them was always in motion, but that did not change the position of *the group*, as such, in space. – The group itself was at rest part of the time. Namely Group/B was at rest half of the total time and Group/C was at rest four-fifth of the total time. This means that Group/B had only 5 cm/sec total velocity and Group/C had only 2 cm/sec velocity. If there was a Group/D, consisting 20 balls, it would only move in one twentieth of the total time, at the end of every two seconds, and it would take 20 seconds to reach the end of the field, thus its *group velocity* would be 0.5 cm/sec.

From this scenario it is evident, that there is a definite relationship between the initial velocity  $V_i$ , the number of balls,  $N$  in the group, and the group-velocity  $V_g$ : *The group-velocity is directly proportional to the initial velocity and inversely proportional to the number of balls in the group.*

$$V_g = \frac{V_i}{N} \quad (8.2).$$

Now, we have two different ways to look at the same situation : On the one hand, we can measure the velocity of *each moving ball separately* in each system and conclude, that in all isolated non-inertial systems, at any instance during the interactions, *the total velocity is conserved*. On the other hand, we can measure the velocities of the groups, and then it becomes evident that the initial velocity is immeasurably buried in the velocity of the group, and the law of the conservation of velocities is not valid anymore. In order to uncover the initial velocity, that was imparted to the group, we must multiply the group-velocity by the number of balls in the group:

$$V_i = N \times V_g \quad (8.3)$$

But if each ball represents one unit of mass, then the total number of balls  $N$  represents the total mass of the group and this total mass multiplied by the velocity of the group is equivalent to the Newtonian concept of *momentum*. – Thus  $V_i$ , the initial velocity of one unit of motion in this case, represents the initial momentum of the group, which has been conserved through the interactions. *This, then is the actual kinematical reason, why Newton's multiplication of mass with velocity works.*

Let us assume that each ball bearing is 1 gram. The single ball *A* represents one unit of mass, *Group/B* combines 2 units and *Group/C* 5 units of mass. *X*, *Y* and *Z* each represents 1 gram mass in motion. In each isolated system, at the beginning only 1 ball was in motion, having a velocity of 10 cm/sec. Hence the total initial momentum of each system was  $1\text{gr} \times 10\text{cm/sec} = 10\text{gr} \times \text{cm/sec}$ . *A* carried the total momentum of *X* all the way through and at the end of the field put  $X_1$  into motion bearing the same momentum. The initial momentum of *Y*, however, was dispersed among the members of *Group/B* and resulted in the momentum of  $2\text{gr} \times 5\text{cm/sec}$ , also equal to  $10\text{gr} \times \text{cm/sec}$ . The initial momentum of *Z* was dispersed in *Group/C*, resulting in  $5\text{gr} \times 2\text{cm/sec}$ , also equal to  $10\text{gr} \times \text{cm/sec}$ . The total momentum of each system was  $10\text{gr} \times \text{cm/sec}$  in every instance during the interactions, thus *the momentum of each isolated system was conserved*.

We can also conclude, that in the above examples, the initial 'one unit of motion', like that of *X*, *Y* or *Z*, produced different group-velocities, which were proportional to the number of units in the groups, thus *N* is equivalent with the Newtonian concept of iner-

tial mass, representing a kind of *resistance* to motion which is directly proportional to the magnitude of *N*. The same time  $V_i$ , the initial velocity of the unit of motion, imparted to the group can be taken as one unit of Newtonian force ( $\text{gr} \times \text{cm/sec}$ ).

So far only one unit of force was transferred to each system and therefore Newton's concept of acceleration did not enter into the simulation. However, just as a unit force can be *dispersed* among a group of units, momentum can also be accumulated from the repetition of the impulses of individual unit forces, periodically imparted on the same group.

This will result in different group velocities and momenta, proportional to the number of impulses per unit time, that is, the *frequency* of the impulses,  $f = \text{gr} \times \text{cm/sec/sec}$ .

Through the concept of the Q-axis the snapshots of [Figure 8-7](#) shows how *Group/C* can accumulate more than one unit of velocity under the influence of an *impulsive, periodical, constant force*.

In Newton's mathematics, acceleration equals the rate of change of velocity;  $\text{cm/sec/sec}$  :

$$\text{FORCE} = \text{mass} \times \text{acceleration}; \text{gr} \times \text{cm/sec/sec}.$$

At time -0.1 all members of Group/C are at rest, while a row of units of force are moving from left to right on the horizontal axis of of the group.

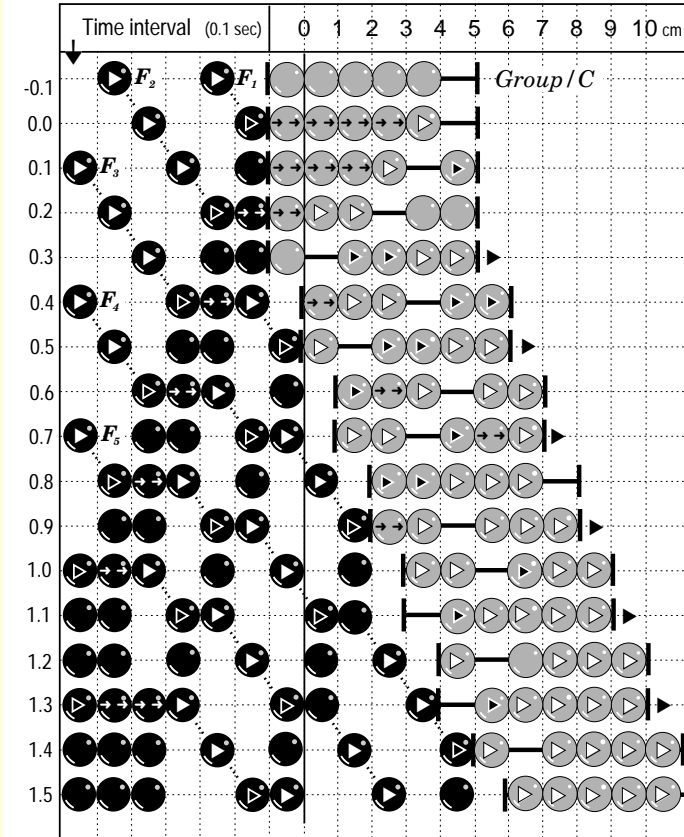


Figure 8-7

Each unit of force is 1 gr. mass, moves 10 cm/sec and they follow one another in three ball diameter distance, which means, that at any vertical line, one unit passes through in each 0.33 second intervals ( $3.33\text{gr} \times 10\text{cm/sec/sec}$ ). Hence, the frequency of the periodical impulsive force is 3.33 cycle/sec.

The first unit of force,  $F_1$  hits  $C_1$  of Group/C at zero second. As before, this one unit of motion is instantaneously transferred through  $C_2$ ,  $C_3$  and  $C_4$  to  $C_5$ , which is free to move. The unit transferring the first impulse stops in the impact. At the end of 0.1 second  $C_5$  hits the right end stopper of the Q-axis which transfers the impulse through  $C_1$ ,  $C_2$  and  $C_3$  to  $C_4$ . If nothing else happened, Group/C would move, as before, with a uniform group-velocity of  $(V_g = V_i/N)$  2 cm/sec. Meanwhile, however, the second unit of force,  $F_2$  moved closer and by the end of 0.2 second it puts the first force unit back into motion, which hits  $C_1$  again. Hence, with this impulse, already two units of Group/C is moving simultaneously. This in turn means that at this rate the group velocity should be  $(20\text{gr} \times \text{cm/sec})/5 = 4\text{cm/sec}$ . – And so on...

As the consecutive snapshots show, at every 0.3 second interval Group/C accumulates another unit



of motion and by the end of 1.2 seconds all five members are in uniform motion, thus the whole group has been accelerated to the magnitude of the initial velocity of 10 cm/sec.

From this experiment, several conceptual parallels can be drawn between the workings of these groups and Newton's concepts of mechanics :

a) The last example clearly shows, how the Newtonian *force* changes the state of motion of a body and produces the *acceleration* in the direction of the force. The acceleration is directly proportional to the magnitude of the force; that is, the velocity of the unit of force, and the number of units colliding with the body per unit time,  $\text{gr}\times\text{cm}/\text{sec}/\text{sec}$ . The force is *constant* and the acceleration is *uniform* if the force is *periodical*, that is, if the same number of force units hit the body per second. The acceleration is *inversely proportional to the amount of inertial mass* of the body; that is, the number of units in a group connected elastically by the Q-axis.

b) Based on the above, other experiments can be designed. For instance, let us say that *Group/C* is moving with constant velocity of 10 cm/sec, meaning that all units are moving simultaneously. At the

right end of the field, on the same line of motion five individual units ( $x_1$  to  $x_5$ ) are placed at rest, at equal distances from each other. This situation is the reciprocal of the procedure in [Figure 8-7](#). The single units at rest represent units of a retarding force, or a *resistance*. They are included in the isolated system, whose total initial momentum is the momentum of *Group/C*,  $5\text{gr}\times 10\text{cm}/\text{sec} = 50\text{gr}\times\text{cm}/\text{sec}$ . After the first impact between *Group/C* and  $x_1$  single unit,  $C_1$  stops and  $X_1$  is set into motion with 10 cm/sec. At this stage *Group/C* gave up  $10\text{gr}\text{-cm}/\text{sec}$  momentum and retained  $40\text{gr}\times\text{cm}/\text{sec}$  momentum, its group-velocity therefore decreased to  $(40\text{gr}\times\text{cm}/\text{sec})/5\text{gr} = 8\text{cm}/\text{sec}$ . However, the total momentum of the system remains the same:  $(40\text{gr}\times\text{cm}/\text{sec}) + (10\text{gr}\times\text{cm}/\text{sec})$ . As  $X_1$  moves to the right, it collides with  $X_2$  and stops. Next *Group/C* catches up with  $X_1$  and loses another unit of momentum.

It follows, that during five consecutive collisions with the singles, *Group/C* is gradually decelerated to zero velocity by the constant resistance of the single bodies. Meanwhile, the total momentum of the isolated system,  $50\text{gr}\times\text{cm}/\text{sec}$ , was imparted to five single units, each inheriting  $10\text{gr}\times\text{cm}/\text{sec}$  momentum,

thus the total momentum of the isolated system was conserved.

c) Suppose now, that two groups are positioned on the same axis of motion. *Group/C*, as before, moves with a group-velocity of 10cm/sec, *Group/B* stands still at the right edge of the field. The initial total momentum of the isolated system is equal to the momentum of *Group/C*, 50gr×cm/sec. From the previous examples all consecutive collisions can be traced and a final result can be deduced. After two collisions between the groups, both units of *Group/B* will be in motion representing 20gr×cm/sec momentum and 10cm/sec group-velocity. At the same time *Group/C* decelerates, two of its units stop in the impacts, and therefore move with  $(30\text{gr}\times\text{cm}/\text{sec})/5\text{gr} = 6\text{cm}/\text{sec}$  group velocity. As it can be seen, the total momentum of the isolated system has been conserved;  $(20\text{gr}\times\text{cm}/\text{sec})+(30\text{gr}\times\text{cm}/\text{sec}) = 50\text{gr}\times\text{cm}/\text{sec}$ . but the total initial group-velocity increased from 10cm/sec to 16cm/sec. Where did this excess motion come from?

Not knowing the internal workings of the Q-axes, there would be no other answer than; this is one of those mysteries of inertia.

d) So far, all examples were collisions between resting and moving masses and in one dimension, but the same idea can be extended to singles or groups moving in opposite directions with equal or different speeds colliding head on or off-center.

Since momentum is a vector quantity, by somewhat more elaborate examples, it can be shown, that in the one-to-one interactions of an isolated system, where momentum remains the same, not only the product a mass times speed, but mass times direction is also conserved.

In other words, the basic rule of the kinetic theory, that at any given time the same number of balls are going in any one direction in a *non-inertial system* also has its parallel in an inertial system.

It follows that, in principle, the groups of the Q-axes can be extended into three dimensions and into unlimited sizes, the kinematic nature of inertia, force and acceleration, and all derived Newtonian mathematical concepts remain the same in three dimensions and they can still be explained through the one-to-one collisions of classical mechanicism.

At this point we may recall Maxwell's favorite representation of three-dimensional electromagnetic

cohesional forces through ball-bearings connected to one another by spiral springs to picture the elasticity of the fields. We would call them the *Q-springs*.

No doubt, all ingredients are now available for the simulation of the *constant force of gravity*, and its resulting phenomenon of *uniform acceleration in free fall*.

Next, let us attempt to incorporate these kinematic simulations for the sake of a better description of the complex kinematics of Kepler's formula and with it, the complete kinematics of *Rotational Gravitation*.

## **CHAPTER NINE**

### **THE LAWS OF PLANETARY MOTION**

In the discussion of the sink-vortex, we have succeeded in deriving Kepler's formula from the inverse square law of the propagation of disturbances in an isotropic medium. From this, followed the equation for the instantaneous tangential velocities of the portions of the spiraling medium in the sink-vortex;

$$V \propto \frac{1}{\sqrt{R}} \quad (9.1)$$

This equation can be derived from Newton's Law of Universal Gravitation with the simplification of

assuming circular orbits, and it agrees with the formula of Kepler's third law;  $K = P^2 / R^3$ .

However, Kepler's first and second laws do not allow this simplification. In agreement with the observational facts, these laws state that the planets are moving on elliptical orbits with the Sun at one of the focuses and accelerating and decelerating in such a way that a line drawn from the Sun to the planet sweeps out equal areas in equal times.

The following quote from a contemporary astronomy text represents a typical description of the derivation of Kepler's first law from Newton's Universal Gravitation :

"Kepler's laws of planetary motion are empirical laws, that is they describe the way the planets are observed to behave. Kepler himself did not succeed in finding more fundamental laws or relationships from which his three laws of planetary motion would follow. On the other hand, Newton's three laws of motion were proposed by him as the basis of all mechanics. Thus it should be possible to derive Kepler's laws from them. Newton did, in fact, show that the motions of the planets, as described by Kepler, followed from his fundamental postulates.

"Consider a planet of mass  $M_p$  at a distance  $R$  from the sun moving with a speed  $V$  in a direction at right angles to the line from the planet to the sun. The centripetal force needed to keep the planet in a circular orbit is :

$$F_c = M_p V^2 / R.$$

"Now suppose the gravitational force between the planet and the sun happens to be greater than the force given by the above equation. (*This can only happen if the planet moves slower than it should on its orbit. Why?*) Then the planet will receive more acceleration than is necessary to keep it in a circular orbit and it will move somewhat closer to the sun. As it does so, because of its increased speed and its decreased distance from the sun, a greater centripetal force is required to keep it at a constant distance from the sun.

"Eventually a point will be reached at which the gravitational force is insufficient to produce enough centripetal acceleration to keep the planet from moving out away from the sun. Thus the planet will move outward as it rounds the sun until it has reached its original position, where the gravitational force is again greater than it is needed for the circular centripetal acceleration, and the process is repeated. Thus we see *qualitatively*, how a planet may follow an elliptical orbit."

(Abell, Exploration of the Universe, [60])

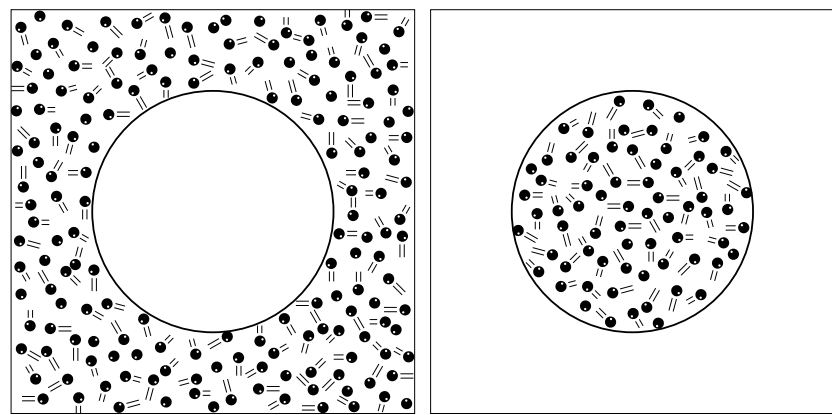
Evidently, this '*derivation*' of Kepler's first law is not only an example of the total neglect of the origin of the tangential components of the planetary motions, but it also uses this ignorance to make the *insufficient* tangential components responsible for the elliptical orbits of all planets.

Nevertheless, now with the aid of the kinematical descriptions of the Newtonian concepts of *constant force, inertia and acceleration*, it seems possible to render a sensible simulation for Kepler's empirical laws of planetary motion.

Thus, by some stretching of our imagination, let us picture the following: Somewhere in space, in total weightlessness there is a great cloud of isotropic, ideal gas of ball bearings stripped from all action-at-a-distance forces among them. In completely random motion, they interact only through one-to-one collisions. Each ball represents one unit of velocity and one unit of mass, thus in this *non-inertial*, isolated system all rules and assumptions of the Kinetic Theory, and its extensions executed earlier, are valid.

Deep in the cloud there exist an empty Sphere, say, a hundred times larger in diameter than the size

of the individual balls, but having such a thin wall, that its inertial mass is exactly equal to the mass of one unit. Hence, the collisions between the sphere and the balls are exactly equivalent to the one-to-one collisions between the balls. Let us call this concept the *Q-sphere*.



(a)

Figure 9-1

(b)

Since time is infinitely divisible, it can be assumed that no two collisions in the system happen simultaneously. Therefore, in each collision a single ball transfers its total motion to the sphere, which then moves in the direction of the impulse with uniform velocity on a straight line until it receives a new

impulse from another ball. Evidently, under the constant bombardment of the surrounding gas, the Q-sphere performs a distinct *omni-directional oscillation*, whose amplitude and frequency is determined by the density of the gas, the surface area of the Q-sphere and the velocity of the balls.

Considering that, in the absence of an external disturbance the gas of ball bearings is isotropic, the center of oscillation of the Q-sphere is in the state of rest relative to this isotropy.

Now, let us introduce a sink somewhere in the cloud, through which a given volume of the gas is being withdrawn from the medium per unit time. As a result, the familiar *radial winds* come into existence, blowing toward the sink from all directions.

At this stage, no matter where the Q-sphere is located, it receives an unbalanced pressure on account of the rarefying effect of the sink and by the resulting *drift of the centers of oscillation* of the balls. The excess pressure of the gas in the direction of the sink represents a net centripetal force, acting through *one-to-one* collisions between the individual balls and the surface of the Q-sphere.

It follows, that each impulse toward the sink, unbalanced by one from the opposite direction, creates a lopsidedness in the initially isotropic oscillation of the Q-sphere, and the center of oscillation of its own also begins to drift toward the sink.

Considering the comparatively great surface area of the Q-sphere, it engages in a much greater number of collisions than any individual ball. Therefore, in proportion to its size, the frequency of its oscillation is higher and its collision-free path is shorter than those of the unit balls. Being, however, merely one unit of mass, the smaller amplitude and greater frequency evens out, and the Q-sphere simply drifts with a velocity characteristic to its distance from the sink and equivalent with the drift-velocity of the neighboring individual balls.

It should be remembered, as it was established earlier, that in the macroscopic accelerating flow of the ideal gas, actually none of the atoms are accelerating, but simply on account of the rarefaction and the lengthening of the collision-free path, they are able to move for a longer period of time toward the sink than in any other direction. In such system, the only continuous motion and velocity is the motion

and velocity of the individual atoms. Everything else is merely a drift of the center of the oscillation of the atoms or in this case, that of the sphere.

Next, let us fill up the Q-sphere with the right number of ball-bearings, say 100, and assume that this will make an internal gas of the same density as the external one. The balls inside are moving in complete randomness, with the same speed, and interacting with the inside wall of the sphere through perfectly elastic collisions.

In general, the Q-sphere with the enclosed gas, represents the same restrictions on the motions of the *group* of internal balls as the Q-axis produced in Group/C; a kind of elastic force, binding a number of balls loosely together within a fixed volume of space.

Taking the external gas away for a moment, it can be seen, that the internal gas also generates an omni-directional oscillation of the Q-sphere on its own account. In the absence of an external disturbance, this internal gas and its effect on the inside wall is also isotropic, therefore it tends to keep the center of oscillation of the sphere in the state of rest relative to the internal isotropy. Figure 9-1. (b).

Putting the whole picture back together, it follows first of all, that the frequency of the oscillation of the Q-sphere is doubled from the external and internal collisions.

On the average, under the equal external and internal pressures the Sphere would still be in the state of rest relative to the isotropy of the gases. However, the *net centripetal force* of the sink and the resulting unbalanced excess external collision from one direction tends to off-set the equilibrium.

But the Q-sphere is not free to move anymore with the external flow as a single unit. Each unbalanced external collision is absorbed by one of the internal balls and then, through the averaging effect of the randomness, it is dispersed throughout the whole internal gas, just as in the dispersion of motion in the examples of the Q-axis. In the case of Group/C one unit of net force was dispersed among the five balls and the resulting drift-velocity was equal to the initial velocity of the ball divided by the number of units in the group. Since the unbalanced collisions do not represent a change in the speed, but strictly in the direction, the net force on the Q-sphere also acts in *one dimension* only.

Hence, aside from the very details, the same end result can be expected here as in the case of the Q-axis. The *constant net centripetal force* is equal to the sum of the periodical unbalanced external collisions in the direction of the sink per unit time.

The *inertial resistance* of the Q-sphere against the change in its state of motion arises from the constant dispersion of the units of *directional force* throughout the internal gas. The acceleration of the Q-sphere is directly proportional to the constant periodical impulsive force, and inversely proportional to the number of units of the internal gas, within which the impulsive force disperses.

Each ball inherits an increasing share of the external drift, which in turn, affects the oscillation of the sphere. Thus the total drift-velocity of the center of oscillation of the Q-sphere toward the sink gradually increases. In other words, *under the influence of the constant net force, in the face of the opposition of inertia, the Q-sphere is uniformly accelerating.*

There is, however, an important difference between the kinematics of the Q-axis and the Q-sphere. On the one hand, the collisions in the Q-axis-experiment were arranged in such a way, that the transfer-



ence of motion was instantaneous through the balls touching one another; the impulse of an external ball on Group/C was transmitted through four balls in a row and put the fifth one into motion at the very same instant.

On the other hand, in the internal gas of the Q-sphere the balls are in random motion with an average collision-free distance between them, thus the transference of motion from each unit to the other takes a distinct time interval, which depends on the density of the gas and the velocity of the units. Consequently, the dispersion of the *net force-vector* throughout the internal gas is a *function of time* and therefore the drift-velocity of the Q-sphere is always *lagging behind* the drift-velocity of the neighboring gas, that tends to accelerate it.

It follows, that the transmission of any change in the drift-velocities between the external and internal gas, both in speed and direction, is also a *function of time*. It should be noted here, that in Newton's second law, force is expressed as *the rate of change of momentum* and in this simulation, while the Q-sphere undergoes uniform acceleration, it also accumulates momentum.

Recall now the decelerating process of Group/C. Similarly, if the drift of the medium would suddenly slow down, speed up, or change direction, the drift of the Q-sphere would tend to continue with its initial speed and direction until its own *momentum* will be gradually dispersed in the external medium. Again, the process of dispersing the momentum through one-to-one collisions is also a function of time.

For a macroscopic analogy consider the following:

You are standing on a low bridge above a river holding a balloon filled with water. When you let it go, it has zero horizontal velocity, while the river flows with considerable speed. As the balloon submerge into the river it will not instantaneously inherit the flow, but accelerate only gradually from zero up, and finally at a given time will it reach the speed of the river.

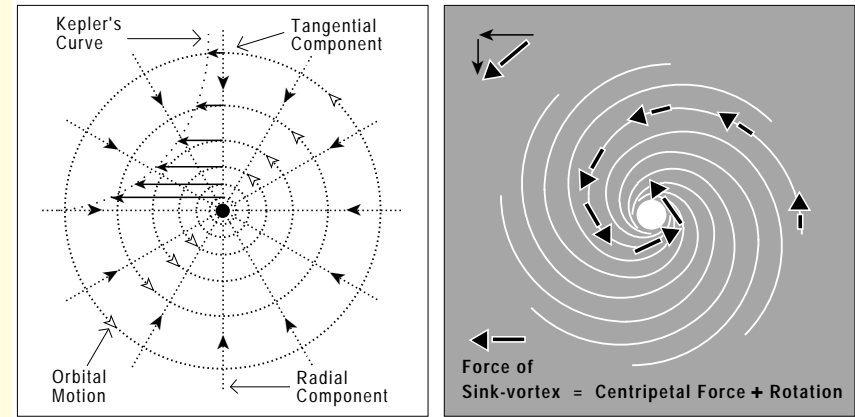
Imagine now, that you could look at this procedure with such a powerful microscope that shows each molecule of the river water, and the balloon and also those of the internal water. Based on the Q-sphere concept, you can conclude, that all river-water molecules have a drift velocity superimposed on their isotropic random motion. The process of acceleration

is the transmission of this excess momentum by one-to-one collision with the molecules of the balloon skin and through them to those of the internal water. The water-filled balloon will flow with the river only when each one and all of the molecules of this system inherited a unit of drift velocity from one of the molecules of the river. This is the kinematics and time dependency of acceleration produced by a constant force.

Going back to the Q-sphere and the sink, consider now, that the existence of the radial winds is merely a temporary effect of the sink. Ultimately, the kinematics of any gravitational system evolves into the rotation of a sink-vortex, where *both the radial and tangential components* of motion are set by the inverse square law of the propagation of disturbances.

Let us now assume that the Q-sphere is positioned in the state of rest at a distance from the sink where the gradual expansion of the vortex motion just begin to effect the isotropy of the medium. As before, the center of oscillation of the Q-sphere starts to drift, however in this case not only radially, in the direction of the sink, but also almost perpendicularly

to that, in a direction tangential to every point of the *spiral channels* of the vortex.



(a) Figure 9-2 (b)

Figure 9-2 shows a schematic comparison between the vector components of the theory of universal gravitation and those of the force of the sink-vortex. a). In Newton's theory the planets are moved by two independent forces, acting perpendicularly to each other; the initial tangential momentum of the body (horizontal vector) and the radial, centripetal force of gravity. In the case of the sink-vortex the medium is twisted into an immense number of spiral paths through which, from the very edge of the vor-

tex, each unit of the medium is moving toward the sink with gradually increasing drift-velocity and on an orbit of diminishing radial distance, that is, on a spiral.

From these points it follows, that unlike Newton's centripetal force, which points directly toward the center and requires a independent tangential momentum in order to form a circular orbit, the force of the sink-vortex acts in the direction of an in-winding spiral, and is represented *by a single force vector* which combines both the tangential and centripetal components of the spiraling motion. Evidently, both the speed and the direction of this vector are constantly changing.

These factors lead to the conclusion that the spirals of the sink vortex ought to create a greater centripetal acceleration, than what Huygens' equation prescribes as necessary for a circular orbit. If there was no other factor involved in the kinematics of the orbits, then all planets and every body, including the Q-sphere of our experiment would follow a spiral path and eventually unavoidably be pulled into the sink. As we have seen, however, the acceleration of a body, in the face of the opposition of its inertia, is a

function of time, and therefore it always lags behind the magnitude and the direction of the force.

With this in mind, it becomes clear, that the *directional acceleration* of the Q-sphere carried in the spiral path of the sink-vortex cannot keep up with the constantly changing speed and direction of the *rotating medium*..

In other words, just like the speed of a body in free-fall lags behind the speed of the gravitational stream, there is a similar *time-lag* in the *directional acceleration* of the Q-sphere, relative to the *directional acceleration* of the *spiraling medium*.

This 'lagging behind' simply means, as [Figure 9-3](#) illustrates that the Q-sphere, accelerated by the constantly changing force-vector of the sink-vortex, *gradually derails from the in-winding spiral stream of the medium and overshoots toward the less steep and slower moving outer threads of the vortex.*

But from the logic of the kinematical situation it follows, that the Q-sphere is affected two different ways while crossing over the spiral paths. The outer threads of the spiral, being slower, decelerate the Q-sphere but the same time still force it to turn more toward the sink.

Hence the Q-sphere decelerates in speed and accelerates in direction simultaneously. As a result, eventually it again fits into the curvature and the speed of one of the outer spiral paths, swimming with it temporarily, until the whole process starts all over again.

From the spiral nature of the sink-vortex, it follows, that no orbit around the sink can have a center in the simple way as circular vortex does. Thus, the two radii leading to two opposite points of the spiral are always different in length. This geometrical character of the vortex combined with the above described inertial overshooting of the Q-sphere inevitably results in an elliptical orbit around the *eye of the sink*. Further more, it can be also be seen, that due to the constant acceleration and deceleration of the Q-sphere and for the different speeds of the spiral paths at different distances from the sink, the radius of this forced elliptical orbit of the Q-sphere, or an analogous inertial unit, like a planet, sweeps out equal areas in equal times.

Hence, in the environment of the hypothetical *ideal gas*, by the fundamental rules of the Kinetic Theory, a definite conceptual understanding has

been presented for the concepts of Newton's Mechanics and for the empirical fact stated in Kepler's Three Laws of planetary motions.

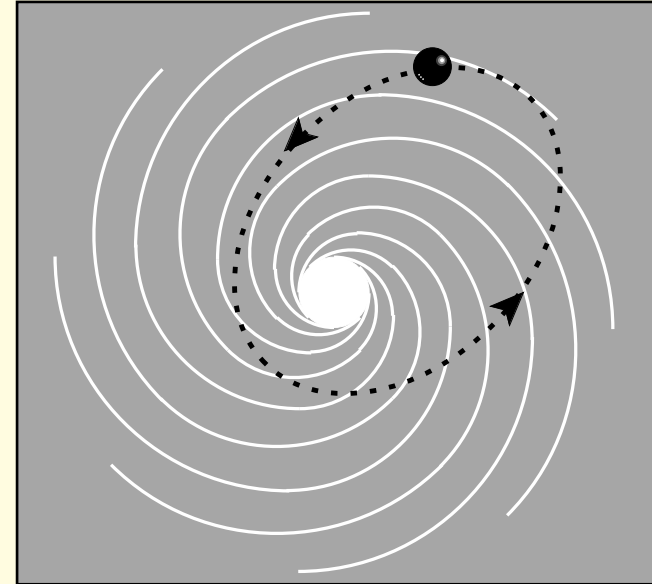


Figure 9-3

The task remaining in this subject is to establish the plausibility of a *universal medium* to replace the hypothetical ideal gas and then uncover the causality and the kinematical plausibility in that medium for the formation, evolution and maintenance of a gravitational sink-vortex.

## **CHAPTER TEN**

### **THE ALL-PERVADING AETHER**

Introducing his Special Theory of Relativity in 1905, Einstein declares his conclusion:

"All our attempts to make ether real, failed. Our attempts to discover the properties of the ether led to difficulties and contradictions. After such bad experiences, this is the moment to forget the ether completely and to try never mention its name.

"We shall say: our space has the physical property of transmitting waves, and so omit the use of the word we have decided to avoid.

"Our only way out seems to be to take for granted the fact that space has the physical property of transmitting electromagnetic waves, and not to bother too much about the meaning of this statement.

"The next position which it was possible to take up in face of this state of things appeared to be the following; the ether does not exist at all." (Einstein-Infeld: *The Evolution of Physics*. [176])

Twenty years later, in the introduction of General Theory of Relativity, Einstein recalls and corrects his last conclusion, now declaring quite the opposite:

"More careful reflection teaches us, however, that the Special Theory of Relativity does not compel us to deny ether. The electromagnetic fields appear as ultimate, irreducible realities, and at first it seems superfluous to postulate a homogeneous, isotropic ether-medium, and to envisage electromagnetic fields as states of this medium. But on the other hand there is a weighty argument to be adduced in favor of the ether hypothesis. To deny the ether is ultimately to assume that empty space has no physical qualities whatever. The fundamental facts of mechanics however do not harmonize with this view.

"In order to be able to look upon the rotation of a system, at least formally, as something real, Newton objec-

tivizes space. Since he classes his absolute space together with real things, for him rotation relative to an absolute space is also something real. Newton might no less well have called his absolute space ether. What is essential is merely that besides observable objects, another thing which is not perceptible, must be looked upon as real, to enable acceleration and rotation to be looked upon as something real.

"It is true that Mach tried to avoid having to accept as real something which is not observable by endeavoring to substitute in mechanics a mean acceleration with reference to the totality of the masses in the Universe in place of an acceleration with reference to absolute space. But inertial resistance opposed to relative acceleration of distant masses presupposes 'action at a distance'; and as the modern physicist does not believe in action at a distance, he comes back once more to the ether, which has to serve as medium for the effects of inertia.

"But this conception of ether, to which we are led by Mach's way of thinking differs essentially from the ether as conceived by Newton, Fresnel and by Lorentz. Mach's ether not only conditions the behavior of inert masses, but is also conditioned in its state by them.

"Mach's idea finds its full development in the ether of the General Theory of Relativity. According to this theory, the recognition of the fact that 'empty space' in its physical relation is neither homogeneous nor isotropic, compelling us to describe its state by ten functions has, (the gravitational potentials of General Relativity) I think finally disposed of the view that space is physically empty.

"Recapitulating, we may say that according to the General Theory of Relativity space is endowed with physical qualities; in this sense, therefore, there exists an ether.

"According to the General Theory of Relativity space without ether is unthinkable; for in such space there not only would be no propagation of light, but also no possibility of existence for standards of space and time (measuring rods and clocks), nor therefore any space-time intervals in the physical sense.

"But this ether may not be thought of as endowed with the quality characteristic of ponderable media, as consisting of parts which may be tracked through time. The idea of motion may not be applied to it." (Albert Einstein: Aether and Relativitätstheorie (1920). Shmuel Sambursky, Physical Thought - Anthology [496])

Hence, ether has been reinstated to full force by its arch-enemy, Einstein, except the very last remark, inserted obviously to save the already accepted postulates of the Special Theory.

This theory presented here is based rigidly and rigorously on the existence of the all pervading ether and the concepts and ideas of the kinetic theory of matter. Accordingly, the name of the theory is *AETHRO-KINEMATICS*, where the spelling, *A-E-T-H-E-R* marks the tendency to redefine the universal medium by starting over from the era of Descartes, Gassend, Huygens, Leibnitz, Lorentz and others.

From the age of firm conviction that the human mind, which has evolved in a mechanical world, can only comprehend nature through mechanical pictures, or cannot comprehend it at all! In this realm of mechanicism the action at a distance is unthinkable and the only conceivable transmission of motion from one body to another is through collision, by actual contact; motion can only be caused by motion, and can only produce motion in turn.

*KINEMATICS* stands as a distinction from kinetics, mechanics and dynamics which were founded on Newton's conceptually imperceptible mathematical pro-

portionalities. *Kinematics is a branch of physics which deals only with the abstract motion of geometrical points without any regard to forces or inertia.* For some clarity, we might add that one of the characteristics of geometrical points is that in order to distinguish one from the other, they cannot overlap each other; that is, *they are impenetrable to one another*, just like the atoms of an ideal gas. Dealing with abstract motion is dealing with continuous displacement in space in a given frame of reference. As we have found through our previously discussed thought-experiments in the *non-inertial system* of the ideal gas, the only continuous displacement is the random motion of the individual atoms, moving on a straight line, with uniform velocity. This motion, however, is indeed abstract, since it is only detectible and measurable through the random averaging process of the macroscopic state of motion of the medium and no speed or direction can be assigned to any one individual unit at a given time.

Through the same process, in the motionless ideal gas, the *collision-free path* assumed to be equal in all directions, forming *collision-free spheres* for each atom and therefore their motion can be taken as an *isotropic omnidirectional oscillation*, the center of which is in the

state of rest, relative to the global isotropy of the medium. The result of any local disturbance is a layer-by-layer deformation and restoration of the collision-free spheres whose effects are propagated outward from the origin in the form of concentric, expanding spheres with the average speed of the atoms. The global movements of the medium results from a continuous local disturbance, like a sink or source, which steadily deforms the collision-free spheres.

A macroscopic flow of the medium is executed through the drifting of the centers of oscillation of the individual atoms. The drift-velocity of these global movements toward the source of disturbance (or away from it) is proportional to the extent of the local disturbance and to the inverse square of the distance from its origin.

As we have shown in the foregoing, all Newtonian concepts of earthly and celestial mechanics and similarly the mysterious mathematics of Kepler's Laws can be simulated and explained through the kinematics of an isotropic, homogeneous ideal medium.

In *AETHRO-KINEMATICS*, Aether is taken as an all-pervading ideal gas in the ultra-microscopic order of magnitude and we call its constituents, the Aethrons,

which are conceptually equivalent to the atoms of an ideal gas; *geometrical points of impenetrability to one another*. Aethrons are the ultimate units of motion and for describing the various phenomena of nature, they do not need to exert any action-at-a-distance forces on one another and therefore they don't need to possess any internal structure that could be the subject of further speculation.

Hence, if Aether is accepted as an ideal gas, all details, concepts, results and conclusions of the foregoing experiments in the ideal gas are directly transposable to this universal medium and expandable to the whole of space which it pervades.

Being nothing more, or less than an ideal gas, just as much information can be found about Aether as about any other gas. It can be studied and calculated from the phenomena associated with it, just like the characteristics of air or water or any other fluids can be investigated through the quantitative analysis of the phenomena discussed by Fluid-dynamics and by the rules and assumptions of the Kinetic Theory.

With regards to the comparison in the conceivability and available knowledge about real gases and the Aether, consider the following:



There is a known upper limit for the highest frequency of sound-waves in ordinary matter. The wavelength of sound cannot be shorter than the distance between the atoms of the medium because there is nothing in there to oscillate.

In one of its forms, the basic equation of wave-motion states, that

$$\text{Wavelength} = \frac{\text{Wave-velocity}}{\text{Frequency}} .$$

which makes it clear that the higher the frequency the shorter is the wavelength and both of them depend on the velocity of the propagation of the waves. According to our best estimation, the speed of propagation of sound in steel is  $10^6$  cm/sec. The highest known frequency propagated in steel is  $10^{14}$  cycle/sec, therefore the calculated average distance between the atoms of steel is  $10^{-6}$  cm/sec /  $10^{14} = 10^{-8}$ , (0.00000001) cm.

Based on the same train of thought, – as the minimum waves of sound informs us about molecular dimensions, – the quantitative analysis of the electromagnetic waves can supply the same information about the basic characteristics of the Aether.

The highest known frequency of electromagnetic waves presents itself in the form of gamma rays, ranging from  $10^{18}$  to  $5 \times 10^{24}$  /sec, (5,000.000.000.000.000.000.000.000 cycles/second). The corresponding wavelength is approximately  $6 \times 10^{-15}$  (0.00000000 0000006) cm. If the shortest possible wavelength of sound was determined by the shortest possible average distance of the vibrating atoms of steel, than the approximate average distance between the Aethrons in the Aether should be  $6 \times 10^{-15}$  cm, (0.00000000 0000006).

It is assumed that the size of the Aethrons are negligible compared to their distances apart and therefore the above quantity also sets the density of the Aether. It turns out that the Aethrons are 6,000,000 times closer to one another than the atoms of steel, thus as a medium, Aether is six million times denser than steel.

This is certainly quite inconceivable and makes it fully understandable why classical scientist could not imagine the frictionless translatory motion of the planets through this medium. However, as it has been shown above, the planets and other heavenly bodies do not perform translatory motions relative to the Aether, but they are rather carried by the medium in their eternal journey.

Another fact also should be noted here. The limits of human comprehension of the smallness or greatness in the measurements of atoms and space and time, has been by passed long time ago. Nobody can really conceive the speed of light, being equivalent with something that flies around the globe eight times within a single second, or the tremendous distance of a light year;  $9.4 \times 10^8$  (9,460.800.000 km), or that a row of atoms placed side by side to make up one centimeter takes about one hundred million of them.

Regardless of how great or small the subject of measurement is, in our modern age they are simply expressed by the powers of ten. Although we have no idea what we are talking about, we can still count their magnitude on our fingers. For example, the density of steel is  $6 \times 10^{24}$  and that of the Aether is  $3 \times 10^{37}$ . Thus, the difference is merely 13 units of something.

Our modern knowledge about the cosmos is accumulated indirectly through theories and mathematical derivations based on abstractions beyond our senses created by analogies with the sensory experiences of the real world. Hearing sound or touching matter does not supply any more information about the molecules of the

air or the atomic structure of a piece of steel, than the sensation of starlight or the heat of the Sun or the pull of a magnet tells us about the Aether, but the abstract Kinetic Theory of Gases does for both. If electromagnetic waves are  $9 \times 10^7$  times finer than the waves of sound, it only means that our eyes are  $6 \times 10^7$  times more sensitive than our ears, and nothing else. If Aether is nine million times denser than air, it does not mean that its constituents the Aethrons are nine million times less conceivable than the atoms of the air.

In comparing the available information about Aether to those of other media, it becomes evident, that through the theories of optics, electricity and magnetism, things were not only learned about the Aether through hydrodynamic analogies, but it also worked the other way around. New discoveries about the behavior of the Aether in electromagnetism have been successfully applied later to the dynamics of real fluids, and things have been learned about them, that had previously not been known.

As it was mentioned before, the concepts of the lines and fields of force were invented for the pictorial analysis of electric and magnetic phenomena conveyed through the Aether. The concept of field was successful-

ly extended later to describe fluid flows, aero-dynamics and for the field of gravitational force.

There is indeed an all-pervading Aether, not only in space, but all through our knowledge about physical reality. The fundamental assumption of the theory of *AETHRO-KINEMATICS* is that Aether is a *real ideal gas* which pervades all space. A Universal Ocean, within which exist the Cosmos, including Galaxy, solar system, Earth, steel, air, water and us, and within the coarse interstices of all matter, there exist the all-pervading Aether.

The internal kinetic energy of the Aether, in one form or another, is the source of all energies and forces of nature, some of which produce more or less permanent motion-patterns, and the conglomerates of those, through our macroscopic perception, we call: *matter*.

Like the above description of Newton's mechanical concepts, inertia, force, acceleration, momentum, the force of gravity, and that of Kepler's Laws, eventually all known phenomena of Nature can be kinematically described, conceptually understood and mathematically expressed through the *Ideal Gas of Aether*.

The understanding of Nature depends on the development of suitable kinematical designs for the various

local disturbances, permanent localized circulatory patterns and the global motions of an ideal gas in the right order of magnitude. *Thus AETHRO-KINEMATICS as a Natural Philosophy is the single fundamental assumption required to correlate all phenomena of the whole of Nature.*

## NOTICE OF AWARENESS

There are some, more or less important general arguments against the existence of an all pervading Aether. Most of those objections came with the Special Theory of Relativity and based on the Michelson Null Result. Many of the detail arguments of relativity has been already resolved through the procedure of the kinematic description of some major phenomena of Nature, while others will be better understood in the following chapters and thereby better clarified for their ultimate kinematical analysis.

There is, however, another kind of objection, originates from classical physics, which is not against the Aether in general, but represent a century long futile argumentation about the possible models of the all-pervading medium.

In this respect the *classical wave theory of light*, to which one must revert when the special theory is dis-

carded, is directly in opposition to the *ideal-gas-model of the Aether*; by the hypothesis about *the transverse nature of the oscillation of light-waves*.

This assumption has been accepted as the only possible explanation for the phenomenon of the polarization of light and leads ultimately to the conclusion, that if the Aether is capable to support *transverse oscillation* at the immense frequencies and speed of propagation of light, it must be an elastic solid with extreme restoring forces and extreme density, much greater than those of steel.

This problem must be addressed here to avoid the impression of being oblivious to a very strong and important argument. Nevertheless, there are two compelling reasons for the postponement of the consideration of this obstruction.

a) At this stage, the Theory of Rotational Gravitation, which has been developed in the previous chapters, required the introduction of the ideal gas model of the Aether for the sake of the following discussion about the origin of the sink-vortex and its maintenance by the Evolution of Matter. The same was also necessary for the following chapter on the Lorentz Transformation, which is the completion of the kine-

tical description of Newtonian Mechanics and Electromagnetism.

b) It has been found, however, that the problem with the theory of the transverse nature of light waves cannot be resolved singularly without the complete revision of the classical wave theory, which is also necessary for the resolution of the presently accepted dual nature light. Through this discussion, besides polarization, several other major optical phenomena must be revisited and clarified and the length and complexity of the analysis would astray the train of thought of the present subject.

The hidden misconceptions of the classical wave theory, both mechanical and electromagnetic and the resulting duality of the theory of light in Modern Physics will be discussed and kinematically resolved in Chapter Fourteen.

## **CHAPTER ELEVEN**

### **THE SINK OF MATTER**

#### **DONUT VORTEX**

For the generation, which has been educated in the 20th century's anti-mechanic and anti-common-sense atmosphere, the following reminder seems to be necessary:

In the eighteenth century, during the development of the electromagnetic theory based on Faraday's concepts of lines, tubes and fields of forces, for each and everyone of the active geniuses of physics, the Aether medium was a totally accepted part of the physical reality. Just as it was known that the kinetic energy of the molecules of the air creates

physical sensations, like wind and sound, it was also known that the kinetic energy of the Aether communicates with our senses through the phenomena of light, heat, electricity and magnetism. Aether had been accepted as a frictionless gas at a supermundane order of magnitude.

During the evolution of scientific theories the mechanical analogies for some complex phenomena always served as simplified conceptual models, from which the final mathematical expressions could be derived. One of the greatest achievement of this method was the electromagnetic theory.

To make this method sufficiently clear, a typical example of the scientific procedure is quoted below :

"It was therefore natural to identify the density of the medium (Aether) at any place with the magnetic permeability, and the circumferencial velocity of the vortices with the magnetic force.

"But the objection to the proposed analogy now presents itself. Since two neighboring vortices rotate in the same direction, the particles in the circumference of one vortex must be moving in the opposite direction to the particles contiguous to them in the circumference of the other vortex; and it seems there-

fore, as if the motion would be discontinuous. Maxwell escaped from this difficulty by imitating a well-known mechanical arrangement.

"When it is desired that two wheels should revolve in the same sense, an idle wheel is inserted between them so as to be in gear with both. The model of the electromagnetic field to which Maxwell arrived by the introduction of this device greatly resembles that proposed by Bernoulli in 1736. He supposed a layer of particles, acting as idle wheels, to be interposed between each vortex and the next, and to roll without sliding on the vortices; so that each vortex tends to make the neighboring vortices revolve in the same direction as itself. The particles were supposed to be not otherwise constrained, so that the velocity of the center of any particle would be the mean of the circumferential velocities of the vortices between which it is placed.

"On comparing the mathematical expression of this system to that which represents Oersted's discovery, (the attraction between current carrying wires), it is seen that the flux of the movable particles interposed between neighboring vortices is the analog of the electric current.

"It should be noticed that in Maxwell's model the relation between electric current and magnetic force is secured by a connection which is not of a dynamical, but of purely kinematical character." (Whittaker: *Aether and Electricity*, 1951 [247])

...and so on...until the whole wonder of the mathematical reflections of the internal kinetic energy of Aether and Maxwell's *electromagnetic equations* were perfected to their final form, giving us our present electronic technology.

Since Aether has been reincarnated by its arch enemy, Einstein, the kinematics of the electromagnetic field, a characteristic behavior of the Aether medium, should also be reinstated to its original form, as it had been discovered and worked out in details by Faraday and Maxwell. If, for the General Theory of Relativity '*space without ether is unthinkable*' on both of the scales of gravitation and the propagation of light-waves, then the '*nonsense of the action at a distance*' must be abandoned in the description of electromagnetism too. It follows, that the binding nuclear forces, the attraction and repulsion of elementary particles, the cohesive forces of the molecules and the structural binders of the crys-

talline lattice in solid matter, all microcosmic lines and fields of forces should be admittedly conveyed through the all-pervading Aether medium.

Similarly, if Aether is rehabilitated, particle physics should no longer be restricted to sterile mathematical speculations in the unimaginable cosmic void. From this stand point of the existing Aether, all our modern particle accelerators and particle smashers, with today's modern experimenters resemble to the kids in the bath tub, poking the water surface and recognizing an infinite variety of patterns in the flow of the white soap layer. Some patterns are swimming surprisingly far, almost like permanent designs, some others dissipates slowly, some others disappear as soon as they formed in the wake of their fingers. According to their different life spans, these flow-patterns can be recorded, named, grouped and filed into an infinite list of entities, however, due to the internal friction of the water and soap, none of them could really be permanent. Nevertheless, – since the individual Aethrons have no internal structure and exert no forces on one another, – one of the fundamental properties of the ideal fluid of Aether is being totally frictionless.

As an introduction to the investigation for the causality, origin and maintenance of the gravitational sink-vortex, consider first the possibility, as we have learned about vortices in hydrodynamics, that a similar pattern, once it's formed in the Aether, has no reason to dissipate into randomness again, unless its dynamic structure is destroyed by another dynamic structure.

It must be emphasized here again, that none of the foregoing or following rough or detailed ideas are claimed to be final solutions. Rather, they are merely heuristic and introductory attempts to express an alternative point of view. Even if they do make sense as they are, the complexity of the phenomena is immense, and it could require decades of research by many, before *AETHRO-KINEMATICS* will be able to produce the right answers in all details.

With this in mind, consider the illustrations of Figure 11-1, showing a kinematically natural chain of events, triggered by the least possible local disturbance in the isotropy of the medium which eventually could evolve into a locally organized, permanent and autonomous circulatory system of a *three-dimensional donut-vortex*.

(a) As Figure 11-1(a) shows, any relative motion between two layers of an isotropic medium can generate local turbulence. The different speeds of the layers shown at the left are equivalent with the opposing relative velocities shown at the right side.

(b) Under suitable circumstances this relative motion can act as a *torque* and induce rotational motion. This form of disturbance is called vorticity and it is quite common in moving fluids, especially within the fluid of a large scale vortex, where, due to its *differential rotation*, each layer of the medium represents a different angular velocity.

(c) While the torque of the relative motion of the layers acts continuously, a centrifugal tendency of rotation comes into existence. This is simply the nature of motion, that each particle tends to move on a straight path and therefore tends to get out of a circular one. This centrifugal tendency opens up the center of the beginning vortex and creates a local rarefaction in the middle, which then gradually develops into a *sink*. It follows, that both from the top and bottom of the plane of the vortex, the fluid starts drifting toward the rarefied area of the sink. Let us now assume, that by chance, the flow from the top

has a slight advantage and the two drifts of opposite directions collide somewhat below the plane of the vortex. As a result, the top flow pushes the bottom sideways and a vertical flow of the medium develops through the vortex ring.

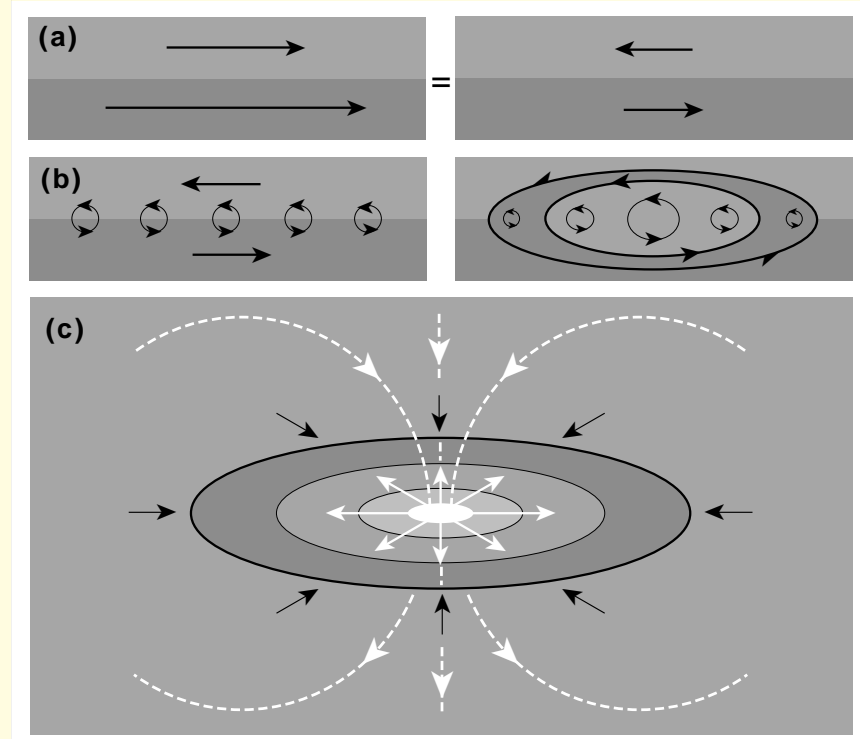


Figure 11-1 (a),(b),(c).



The result is a rarefaction at the top and a compression on the bottom, which now represents a *source*. But since in an isotropic medium all disturbances are propagated in expanding spheres, the rarefaction and compression will eventually curve toward each other. As the sink pulls in and the source pushes out the medium, the drifting Aethrons form a multitude of streams through the center of the vortex, which ultimately re-enter into themselves into an endless loop in the surrounding space.

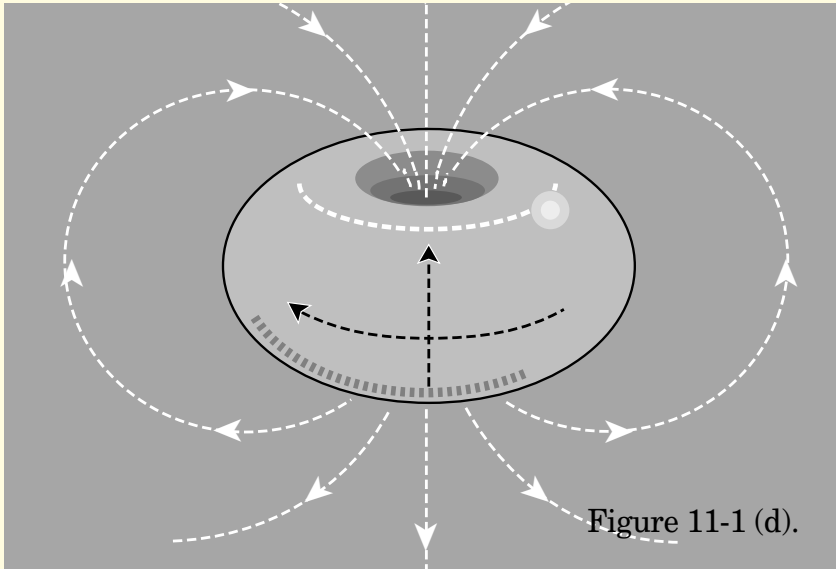


Figure 11-1 (d).

(d) Figure 11-1 (d) shows the resulting three dimensional donut-shape, rotating and spinning vortex, surrounded and penetrated by endless loops of drifting fluid. In this *donut-vortex* a certain volume of Aether, an immense number of individual Aethrons, are organized into a complex circulatory system, which, upon reaching the kinematic balance with the isotropic external pressure of the medium, gains permanency both in shape and in substance. Being self-sustaining and autonomous, it also represents a fixed quantity of *aggregated kinetic energy*.

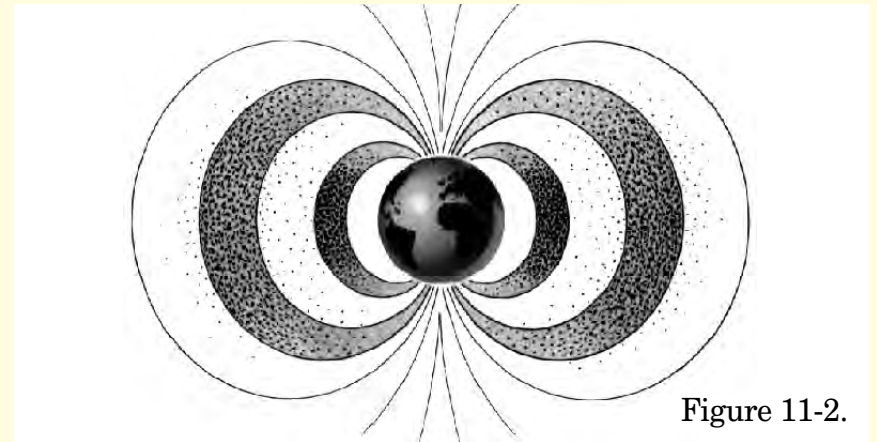


Figure 11-2.

The Earth's magnetic field shows that the flow pattern of the Donut vortex is not totally unfamiliar.

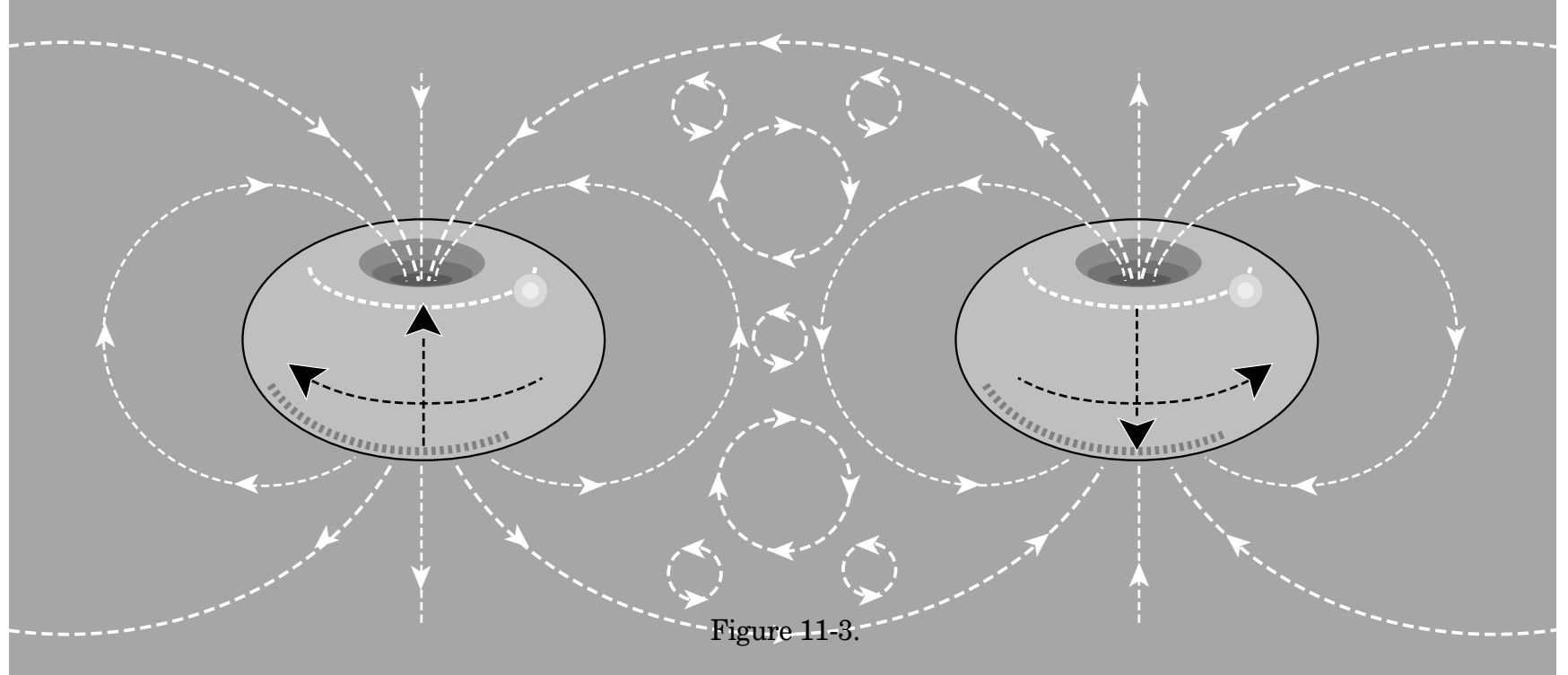


Illustration 11-3 depicts the potential dynamic coupling between two donut-vortices, oriented in such way that their flow-patterns form an interacting, permanent connection. The new flow pattern of this couple is equivalent to a linear dipole flow.

It is now easy to imagine that all kinds of further couplings are possible. For instance, a larger kinematic organism might be formed out of a whole row of such donuts and by the connection of the right side of the last member to the left side of the first in a

*permanent ring*. By a more complex inter-locking flow-pattern in three dimensions, horizontally oriented donuts can be inserted between vertical ones. In all cases, eventually a kinematic equilibrium is reached between the sinks and sources, the external static pressure and the internal elastic cushion of the medium. The size of the *loops* stabilizes and by that maintains a constant distance between the donut-vortices. Evidently, the continuous re-generation of the same flow-patterns in the frictionless environment of the Aether, the conservation of the shape and substance of the systems and their inherent ability to connect with one another implies that the donut-vortex could represent a potential kinematical description of a permanent elementary building block of matter.

Once again it is emphasized, that none of these ideas claim finality, but rather planned to be the germs of a complete description, which will probably be achieved through elaborate sculpturing. For instance, an electron can be a single donut-vortex or similar circulatory pattern, but it can also be a conglomerate of many of them, depending on the requirement of the complex characteristics of an ele-

mentary negatively charged particle. The big potential of the donut-vortices is in their connectability and that each unit has its own intake and output.

Organized communities of these vortices can be designed, connected in such ways, that the total intake of the system is received from one definite direction, while the output is dispersed in many directions isotropically. Or vice versa; the intake is isotropic and the output is directional. Or both intake and output are directional or both isotropic

There might be ways in this line of designing to achieve the characteristics of negative, positive and neutral elementary particles. Most likely, this will be achieved by computer simulation based on the kinematical algorithm of an ideal gas.

The same concept also renders an elementary kinematic pattern for electromagnetic interactions and illustrates the basic kinematic characters of both electric and magnetic force fields; unlike the one-directional drift of the gravitational field toward a *single sink* (monopole); electric and magnetic fields always result from a sink and source couple, called *dipole*, which are surrounded by a complex circulatory system contained in endless elastic loops.

It can be seen now, that with sufficient brain-power and research time, especially with the aid of today's computer generated design, this concept might be extended to simulate all the various electromagnetic forces, giving a conceivable kinematical description of the origin and maintenance of the elementary particles and those of the macrocosmic conglomerates of ponderable matter.

## BERNOULLI'S PRINCIPLE

Daniel Bernoulli, Swiss mathematician in the eighteenth century, proposed that for a horizontal channel, carrying an *ideal fluid*, the sum of the forces of the static pressure, due to the random motion of the atoms plus the dynamic pressure, due to the motion of the fluid, is a constant.

$$P + \frac{1}{2} \rho V^2 = K \quad (11.1),$$

where  $P$  represents the *static pressure* applied to the fluid, the term  $\frac{1}{2} \rho V^2$  is the *kinetic pressure* developed in the fluid,  $\rho$  (Greek; Rho) is the mass-density of the fluid and  $V$  is its velocity. This expression is essentially a statement of the *principle of the conservation of energy, applied to fluids in motion* and the conclusion is that as the velocity of a fluid increases, its static pressure

decreases and vice versa. *The total of the energy components in a moving fluid remains constant.*

As an experimental example, imagine an arrangement of a section of metal tubing, provided with small holes at regular intervals along its length. The diameter of the pipe is not constant, but it is constricted in the mid-section. Letting gas into the tube through the inlet, the jets can be ignited.

As it is illustrated in Figure 11-4 (a), with the outlet closed, the flames all reach the same height, which means that the pressure of the gas at each jet is the same, including that of the mid-section.

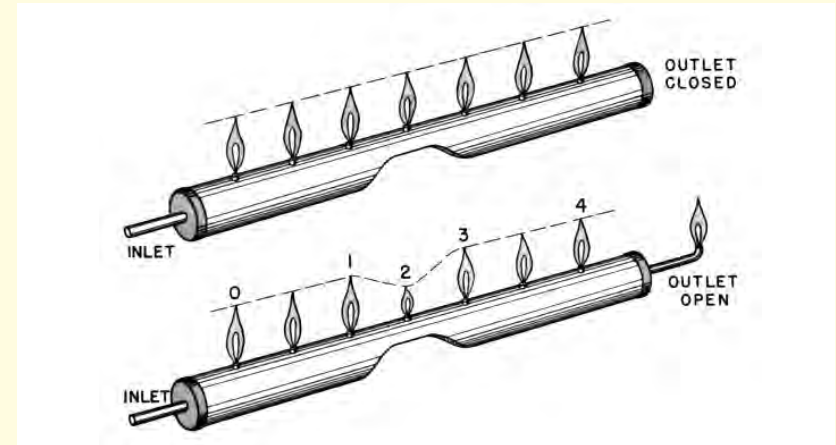


Figure 11-4

However, when the outlet is open (b), the gas in the tube is no longer motionless, but flows to the right. In this case the middle jet, over the constricted section of the pipe, shows a significant decrease in pressure. As it is expressed by the *equation of continuity*, since the volume of intake and discharge must always be the same, the gas in the constricted part ought to flow faster than in the full size pipe.

From this experiment Bernoulli concluded, that the static pressure is inversely proportional to the speed of the flow of the gas. The kinematical understanding of this empirical law follows from the concept of the *center of oscillation* of the atoms, which is at rest in a motionless isotropic fluid and drifts when the fluid performs a macroscopic flow. As it was established earlier, the drift of the atoms is merely superimposed on their initial random motion and the velocity of the individual atoms do not change in a flowing fluid. They simply move with unchanging uniform speed of their random motion, but for a longer period of time toward the outlet than in any other directions. Since the velocity of the atoms is constant, their kinetic energy also remains constant. Consequently on the average, the space within which they oscillate, should also remain a *constant volume*.

As it was shown before, whenever the collision-free path of the atom lengthens in a given direction, it must be shortened in all other directions. The collision-free sphere becomes elongated in the direction of the free path and the resulting ellipsoid has a major axis directly, and a minor axis inversely proportional to the velocity of the drift. In other words, the *volume* of the collision-free sphere or ellipsoid is a constant.

In general, this is how the oscillation of the atoms transverse to the flow and their contribution to the average static pressure decreases in proportion to their drift-velocity.

The extreme case in this respect would be, when an atom reaches *vacuum* and moves in a given direction without collision indefinitely. In this case the major axis of the ellipsoid becomes infinitely long and the minor axis equals to zero. This atom does not drift or oscillate anymore but moves continuously on a straight line with uniform speed.

Proving that Bernoulli's theory is not only true for an enclosed medium, like the gas in the pipe, but also valid for the open and contiguous isotropic medium, physicists devised an other experiment, as illustrated in [Figure 11-5](#).

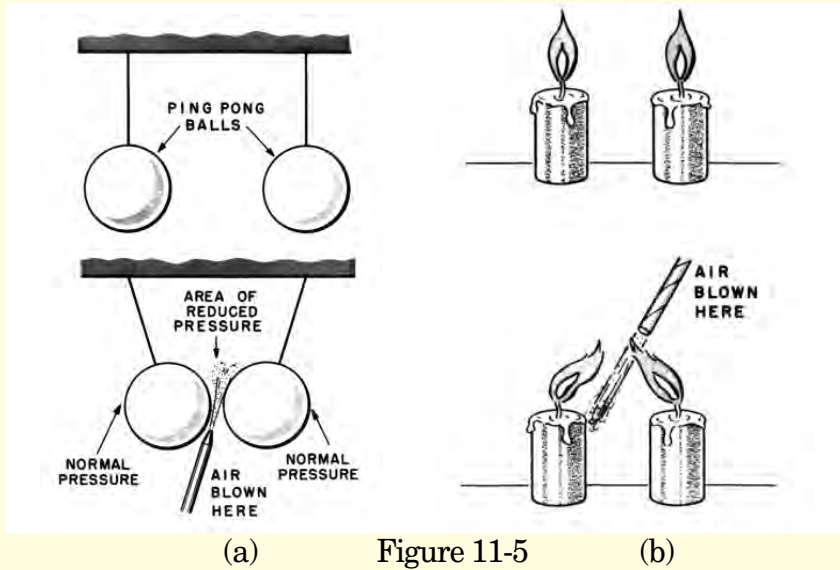


Figure 11-5

Two ping pong balls hang close together in the motionless air when a jet of air from a straw is injected between the balls (a). Contrary to expectation, the balls move closer, as if they were attracted to one another. The candle flames prove the same (b).

The reason for this is the same as in the case of the moving gas in the pipe. The increase in the velocity of the air-jet in the narrow space between the balls reduces the static pressure, transverse to the jet, and therefore, the unreduced external pressure of the air

from the outsides of the balls pushes them together.

It is evident, that whether the balls are present or not, the air-jet injected anywhere into the isotropic medium decreases the local static pressure rectangular to the direction of the jet, and therefore, the surrounding higher pressure air tends to expand into that area.

Let us now recall the kinematics of the *sink-vortex* and consider the potential role of Bernoulli's effect during the development of such motion-pattern. As it has been established, the initial macroscopic radial flow is a result of the lengthening of the collision-free paths and the drifting of the center of oscillation of the atoms toward the sink.

The collision-free spheres of the atoms are elongated in the direction of the radial drift, but as rotation develops, the ellipsoids of the oscillation turn with their major axes into the direction tangential to the spirals of the vortex.

Thus, as Bernoulli's theorem predicts, each rotating layer of the drifting atoms should represent a lesser static pressure rectangular to the spiral, than that of the isotropic external medium. Hence, as its atoms join to the rotating vortex, each layer of the medium is condensed into a smaller volume of space than it would fill

with its initial, average static pressure. Since the static pressure is inversely proportional to the velocity of the drift, and the angular velocity of the vortex depends on the radius, it follows, that the average density of the medium in the sink-vortex also varies with the distance from the sink.

When Bernoulli's theorem and other kinematical characteristics of an ideal gas are transposed into the frictionless medium of the Aether, a fundamental tendency of nature presents itself:

Consider, an imaginary sphere floating in the isotropic, motionless Aether, marking the boundary of a given volume of space. The Aether has the same density inside and outside.

The total kinetic energy enclosed in the sphere is equal to that of any other part of the Aether contained in the same volume of space and therefore the imaginary sphere experiences an equal static pressure on both its internal and external surfaces.

Let us now assume, that by some cause, rotation is induced at the center of the marked space. Recall and apply the evolution of the *donut-vortex* to this situation, as it has been described before and illustrated in three steps on Figure 11-6.

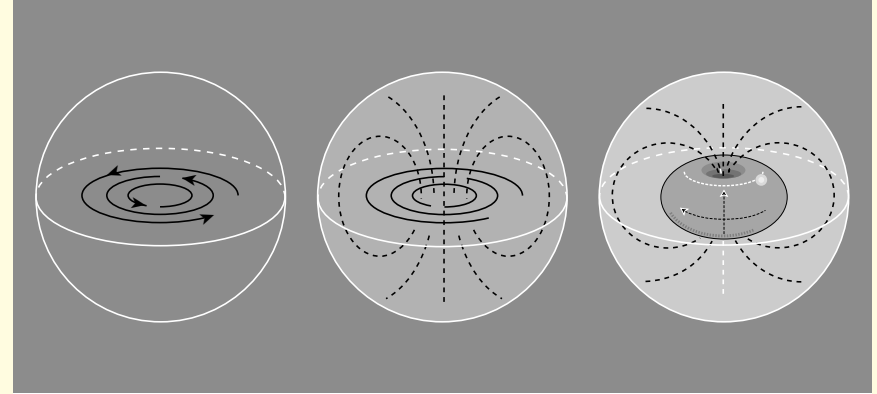


Figure 11-6

After the initial vortex has been formed, the drifting motion of the Aethrons are superimposed on their random oscillations. As it was established before, the drifting of the Aethrons toward the sink or the formation of the loops involve no acceleration, but merely means the ability of some to move in a given direction for a longer period of time.

Hence, Bernoulli's distinction of *dynamic energy* and *kinetic energy* is merely a differentiation between Aethrons of the isotropic medium oscillating in complete randomness and the Aethrons whose centers of oscillation are drifting in an organized manner in a given direction. Evidently, the total kinetic energy of the

system and therefore the sum of these two should remain the same throughout the evolution of the donut-vortex.

Nevertheless, an important difference between this and the two previous examples should be noted. In both of the former experiments, the gas pipe and the balls, the dynamic energy of the linear drift enters and leaves the space within which Bernoulli's theorem is valid. The lighting gas flows in and out of the pipe and the air-jet enters and leaves the space between the balls. Unlike these, in the present example the dynamic energies of the drifts turn into themselves in the rotation of the donut. The continuous circulation of each endless loop forms a permanent unit of dynamic energy. Thus, by the assumption that the imaginary sphere is impenetrable, the donut-vortex together with the locked-in, random medium can be accepted as an *isolated system*.

Although Bernoulli's theorem of the conservation of kinetic and dynamic energy is still applicable, here a new factor must be considered. The initially completely random medium is now separated into two parts; the part that has been organized into the flow patterns of the donut-vortex, and the part that did not take part in this organization, but stayed in its initial random state.

On the one hand, the kinematics of the donut-vortex shows that eventually a balance must be reached between the sink and source, the external pressure and the internal cushion of the random Aether, that is, the dynamic and kinetic pressure should reach equilibrium. But in the light of Bernoulli's theory this means, that as the rotating and revolving Aether gains drift-velocity or dynamic energy, at the same time, the static pressure of each drifting layer decreases. It follows, that during the formation of the donut-vortex, each layer is condensed into a decreasing volume by the dominating static pressure of the surrounding random medium.

On the other hand, as the number of Aethrons involved in the circulations are taking up less space, the rest of the Aethrons, still in random motion, must fill up more space than before the formation of the donut and therefore the random Aether within the sphere becomes rarefied in proportion.

Indeed, the total kinetic and dynamic energies were conserved within the isolated system of the sphere, but the content of the donut-vortex takes up less space than before, thus the medium in the rest of the sphere must be rarer than the average density of the external medium.



At the boundary of the isolated system, the internal wall of the imaginary sphere experiences lesser static pressure than the average isotropic pressure exerted by the external Aether on the outside surface of the sphere.

From these two important kinematical tendencies the following can be established:

1) If the wall of the sphere would suddenly disappear, the denser external medium would rush into the sphere to re-establish the isotropic density. But this also means that if the sphere were open from the beginning of the formation of the donut, then the external medium would continuously re-adjust the average isotropic pressure by an influx of Aethrons from the whole of the medium. In this case the donut-vortex is compelled to form under greater pressure into a smaller volume of space.

This influx from the surrounding medium simply means that anywhere in space the formation of a donut-vortex is equivalent to the kinematical concept of a *sink*

2) Taking another count on the contents of the volume of space initially marked by the imaginary sphere it is now found that there are a greater number of

Aethrons and an *excess amount of kinetic energy* within than in any other equivalent volume of space in the free Aether.

This is then the *AETHRO-KINEMATIC* description of a natural tendency of the all-pervading Aether: The condensation of its kinetic energy into the dynamic forms of elementary particles, binding forces, electromagnetic fields, atoms, molecules, crystalline structures, etc.; *A natural, evolutionary condensation of kinetic energy into ponderable matter...*

## THE EVOLUTION OF MATTER

Next, consider another group of general ideas:

With respect to the origin and history of matter, the two most widely accepted cosmogonical ideas; the *Big Bang* and the *Steady State Theories* present extreme opposite views in their accounting for the origin and abundance of the different elements in the universe. According to laboratory experiments and astronomical observations 99.999% of all matter in the observable universe is made up between the two simplest elements, Hydrogen and Helium.

The total abundance of all the other 101 known heavier elements make up the remaining 0.001%. On the one hand, according to the Big Bang Theory as

George Gamov renown expert puts it, all elements, as they are in existence today, were produced in the first half hour of the life of the universe in the *primordial atomic pressure-cooker*. On the other hand, Bondi, Gold and Hoyle's Steady State Theory declares, that all elements of matter are in *continuous creation* everywhere in the universe. Hydrogen is created in inter-stellar space at the rate of one atom per gallon in every 250 million years. The heavier elements are being created in the extreme internal heat of stars and spread through the whole of space mostly by supernova explosions.

Both theories were invented to synchronize with the Theory of the Expanding Universe and with the empirically found abundance of the various elements.

The Big Bang Theory leads to an ever thinning universe as the initially created amount of matter expands into greater volumes of space. In the Steady State Theory, the assumed rate of the creation of hydrogen is carefully adjusted to keep up with the expansion and thereby achieve a constant density of matter in the universe.

Needless to say, that at the present state of cosmogony and astrophysics, there is no observational, experimental, mathematical or logical verification or

disapproval for either of these extreme speculations. Their validity merely comes from their synchronization with the expanding universe hypothesis which itself suffers the same uncertainty. Therefore, the same free credit should be allowed for any newly invented hypothesis which may lie in between the two extremes, or even if it is not adjusted to the requirements of the expanding universe.

With this in mind, let us first consider the fate of solid matter, say a piece of rock, when it is heated to higher and higher temperatures. Rocks are made up of the crystalline lattices of molecules, composed by the atoms of different chemical elements. At low temperature (under 1000° Celsius) the crystalline lattice of the rock is a rigid system and the thermal vibration of the molecules are controlled by the cohesive electromagnetic forces. From the stand point of the kinetic theory of matter, the added heat transforms into kinetic energy in the form of the increasing amplitude of vibrations of the molecules. Over the melting point (1063° C), the molecules still remain strongly attracted to each other, though the thermal agitation is strong enough to dislocate them from the fixed positions in the crystalline lattice, and the rock

liquifies. At still higher temperature (2600° C) the liquefied rock reaches its boiling point, the cohesive forces are not able to hold the molecules together anymore, they fly apart in all direction and the rock reaches its gaseous state.

In general, over a few thousand degrees not even the molecules can stay together, but they separate into their constituents; the atoms of pure chemical elements. The violence of thermal collisions at such high temperatures also damages the atoms by chipping off their outer electrons. This thermal ionization becomes more and more pronounced when the temperature rises to hundreds of thousand of degrees and reaches completion at a few million degrees, which is quite common in the interiors of stars. Inside the sun it is about 20 million degrees and the atoms, as such, cease to exist. All electronic shells are completely stripped off, and matter becomes a gaseous mixture of bare nuclei and free electrons, called *Plasma*.

At temperatures above 10 billion degrees the thermal agitation of the protons and neutrons is great enough to overrule the strong force that keeps them together and the nuclei begin to vaporize. Temperatures of this magnitude may well occur for short periods of

time during supernova explosions. At this point, however, the speculation must stop since neither can we imagine higher temperature, nor do we have any plausible idea of the internal structure of the elementary particles. This procedure is called the *thermal dissociation of matter* and agrees with the assumption of thermodynamics, that the kinetic energy of the elementary particles is proportional to the absolute temperature in all states of matter.

In order to come back to the present state of the universe, the whole procedure can be projected backward, creating a reciprocal sequence, which may be called *thermal association*.

Starting from the slow cooling of the billion degrees hot proton- neutron- electron-gas, as the individual elementary particles slow down, nuclei and electrons can form. Later, at a given level of the temperature, by the capture of free electrons, atoms can come into existence. As the thermal kinetic energy further decreases, the force-fields of the atoms succeed in creating molecular ties and by the induction of cohesive forces, liquification becomes possible. Finally, in the total domination of the nuclear, atomic and molecular forces, matter solidifies in crystalline-lattices.

Observation proves that this thermal association does happen everywhere in the universe at all times at different temperatures and in various circumstances, parallel to the evolution of the Earth, planets, suns, stars and galaxies.

But the thermal effects on the kinetic energy of the particles is not the only cause for the changes in the states of matter. Besides the rapid and large scale dissociation and association due to heating and cooling, there are other subtle transformations on nuclear and atomic levels, which effect only a small percentage of an elements at a time, proceeding slowly and independently of temperature. – Radioactive decay of certain elements is a special case of dissociation which happens independently from thermal agitation. The radioactivity of different elements manifests different types of radiation in the forms of the continuous emission of a specific particle. It has been found that in the process of disintegration, the expulsion of a particle leaves behind a new system, which is lighter than before and possesses physical and chemical properties quite different from those of the parent element. The number of atoms that disintegrate during a given time interval is in a definite proportion to the atoms initially present.

This proportion is a characteristic constant of the body. For example, one half of a given number of Uranium atoms will decay into something else in four and a half million years. This period of time is called the characteristic *Half-life* of Uranium and since it decays on its own power, it has been classified as an *unstable element*. It is evident, however, that the concept of half-life is purely quantitative, expressing a given rate of radioactive dissociation of an element, it merely depends on the sensitivity of our devices and an arbitrarily chosen time-scale whether an element is classified as stable or unstable.

If four and a half million years of half-life represents un-stable, what should then be the higher limit of stability; forty million, four hundred million, or four and a half billion years?! The concept of half-life demonstrates that radioactivity is a random and accidental procedure and could only be measured on statistical basis. If one hundred uranium atoms could be separated and their radioactivity measured, the prediction would be the same; in four and a half million years 50 out of the 100 will disintegrate into something else, but there is no way to foresee which 50 will change and when. In order to even discover radioactivity in a group

of 100 atoms, the experimenter should be able to detect the triggering of his counter by an emission, on the average, once in every 90,000 years, but there is still a *non-zero probability* for two emissions within a trillionth of a second. When it comes to atomic particles, it is impossible to predict how single individuals will behave. All that can be done is to foretell the average behavior of an immense number of particles in a group according to the rules of probability.

Theoretically nothing is infinitely improbable and there is no known reason to assume, that *a similarly accidental procedure cannot occur in the opposite direction*. After all, how does matter solidify from the plasma all the way to the crystalline structure of matter if not by *accidental association* of the elementary particles.

Until most recently, the general belief was that the origin of the heavier elements requires immense heat and must happen in a biblical type creation under very extreme circumstances, like in the primeval atom or in Supernova explosions.

The main reason for this belief was the large force of repulsion that exists between protons, which must be overcome in collisions with tremendous velocities in order to get them close enough together for the short

range nuclear force of attraction to take charge. In the last few decades, however, research shows more and more results that contradict this belief. The latest discoveries of *cold nuclear fusion* established the fact, that certain electron-like particles, called muons can catalyze nuclear associations which circumvents the need of high temperatures or extreme velocities entirely. It is experimentally proven that muon-catalyzed cold fusion can take place rapidly at room temperature or even close to absolute zero.

Muons are particles with a negative charge equal to that of the electron but about 207 times more massive. When they are introduced into a chamber containing isotopes of Hydrogen, Deuterium and Tritium, some muons form unusually tight associations between the nuclei of two Hydrogen atoms. These nuclei then bond together into one Helium nucleus which ejects the muon, capture some free electrons and become a Helium atom.

The muon in turn goes on to catalyze other fusion reactions. Obviously there is Helium association in the chamber with a *reciprocal half-life*, which is proportional to the initial number of Hydrogen atoms and the number of muons in a unit volume of space. The pre-

sent theory about the procedure of muon-catalysis is based on the explanation of molecular cohesion. When atoms collide in a gas, their electrons come close enough that they are captured by the other nucleus and they continue to orbit around both nuclei. The result is an attraction between the two atoms and the formation of a molecule. In the cold fusion muons take over the role of the electrons, but they are much heavier and slower and they can pull the two nuclei close enough together that eventually fusion occurs.

The discovery of *muon-catalysis* might revitalize a theory proposed by William Prout in 1815. According to his hypothesis, the hydrogen atom, (one proton and one electron) is the basic unit of 'matter' out of which all other elements were compounded. This idea was strongly supported by the repetitious chemical properties of the elements in the periodic table and by the fact that the weights of elements were nearly all multiples of the weight of the hydrogen atom.

Later, however, atoms were discovered that did not fit Prout's hypothesis. For instance, the weight of a chlorine atom has been found thirty-five and one-half times that of the hydrogen atom. Because of this and other discrepancies and since the way out of this difficulty

was not known to Prout, his theory was abandoned and never reinstated. However, after the discovery of the third elementary particle of the atom, the *neutron*, having nearly equal mass with the proton, Prout's controversy were effectively resolved.

It has been found that the chemical properties of an element are determined purely in terms of the number of electrons and protons in the atom, but the number of neutrons in the nucleus, can take a range of different values. In the crucial case of chlorine, with seventeen protons, there can be between sixteen and twenty-two neutrons in the nucleus. Out of these isotopes, only two chlorine atoms with eighteen and twenty neutrons occur to any extent in Nature and there is about three times as many lighter ones in the common mixture of chlorine as heavier ones. This results in exactly the right proportion for Prout's theory, giving an average weight for the chlorine atom; thirty-five and a half times that of the Hydrogen atom.

There is no doubt today that the basic building block of matter is the proton-electron pair but the role of the neutron in the stability of a nucleus is still not known. It has been found however, that under certain conditions, a neutron can disintegrate in the nuclei,

changing over to a proton and ejecting an electron. The same happens to a free neutron with a half-life of twelve minutes.

In any case, based on present knowledge, it can hardly be declared that the probability of cold fusion is surely limited to the case of Helium creation or that there is no chance for the accidental *association* of hydrogen atoms, a cold procedure of building matter to different levels of complexity, similar to Prout's speculation.

In an other department of experimental physics Uranium atoms are bombarded by accelerated neutrons with the result of nuclear fission.

A certain isotope of Uranium, having 92 protons and 143 neutrons (235) by absorbing one of the neutrons, becomes a new isotope with 236 nucleons and splits up in to two equal parts, producing a radioactive isotope of Barium. Since the bombarding is completely random, why does the Uranium atom split in half instead of into different other fractions? According to present theories, the binding energy of medium heavy elements is the strongest, therefore lighter nuclei gain stability by fusion and heavier ones when they break up in fission.

Is there *zero probability* for a procedure through which two Barium nuclei could fuse into a Uranium 235 atom and eject a neutron, say, with a half-life of 16 million or 160 million years?

It might be useful to assume, that the accidental fusion of matter at any level of complexity is merely a question of the *lapse of time* and the coincidental effect of a suitable catalyzer, or maybe several of them sequentially or simultaneously.

There is a great inventory of particles with different charges and various masses to take the role of catalyzers and most certainly there is *time enough* in the life of the Universe. If there was an *evolutionary theory* of matter based on some thermal or catalytic or some other presently unknown procedure, it would be founded on the probability of an accidental, step by step *association* of the elements with gradually decreasing chances as matter grows more and more complex. The final equation and the predicted half-life for the evolution of matter through the different elements would be carefully adjusted to synchronize with the empirically found quantities of the natural abundance of the elements and with the presently believed age of the Universe.

This will be then a kind of *mutational evolution of matter* from the random state of kinetic energy of the Aether toward the organized and condensed forms of elementary particles, atoms, molecules and conglomerates of them; *a procedure in the opposition to the arrow of entropy*; an accidental evolutionary tendency exposed to a natural selection through the radioactive dissociation of the unstable elements; *a Darwinistic cosmogony?*!

Correlating the kinematic theory of Rotational Gravitation with the three groups of ideas, suggested above, consider the following hypothesis:

The elements of matter are permanent circulatory patterns in the frictionless ideal gas of the all-pervading Aether triggered by the universally existing torque of differential rotation. The concept of the donut-vortex shows the possible existence of such patterns with their potential to form interlocking complexes of different constructions and various sizes.

Predictably, similar designs can be achieved for the kinematics of the internal structure of elementary particles and thereby an explanation for their different fields in the medium and through that, the forces exerted on one another. Having a rarefying effect on the

medium within their space of origin, a tendency is created for random cloud formations and their rotational separation.

Atoms, molecules, crystals and their conglomerates are organized from elementary particles and sustained by electromagnetic activity. The lines and tubes and fields of electromagnetic forces, as it was already established in the nineteenth century, are also circulatory patterns in the Aether, produced by the sink-source action of the elements and their elementary particles.

It is assumed that the formation of ponderable matter begins with the Hydrogen atom, the nucleus of which is a single proton, holding a single electron in orbit. Through a step by step evolutionary process, more complex nuclei are formed out of protons and neutrons, which capture free electrons equal in numbers with those of the protons.

Atoms are bound into molecules in gases by their interlocking force fields. The molecular cohesive forces tie together immense numbers of atoms, producing fluids and solids on all levels of complexity. Each minute change in this evolution requires a re-arrangement in the construction of the bond between these elements of matter and calls for a more complex network of electro-



magnetic force-fields to sustain the equilibrium of the new state.

The formation of particles, nuclei, atoms etc. and the complex network of the electromagnetic structure; that is, the formation of all circulatory drifts of the Aethrons in various shapes and sizes proceeds under the constant pressure of the random, isotropic medium. Consequently, in agreement with Bernoulli's theorem, as the Aethrons are being organized into these dynamic constructions of matter and accumulating drift-velocities, their static pressure, rectangular to the drifts decreases in proportion. Thus, under the unchanged static pressure of the external medium, the Aethrons involved, are gradually condensed into a smaller and smaller volume of space compared to what the same number of Aethrons have occupied by their initially random oscillation.

As a result, there are two evident kinematical consequences of the formation and evolution of matter:

a) When some part of the Aether is condensed into a smaller volume of space, the local procedure produces a proportional rarefaction around and within the 'matter', which is constantly re-adjusted by an in-flow of the surrounding isotropic medium. As it was discussed earlier

in connection with the ideal gas, this radial drift toward the sink, the state of motion of a test-particle can be described in Newton's concepts in a way that its radial component is a result of the constant, centripetal force of gravity and its tangential component is determined by Kepler's Laws.

Thus, whenever and wherever matter is forming and evolving it can be considered as the center of an in-flow, which *consumes* Aethrons at a steady rate from the surrounding medium and therefore equivalent with a *sink of matter*.

This phenomenon appears everywhere in the observable Universe in various sizes and capacities, at all ages at concomitant levels of evolution and seemingly in an infinite chain of orders of magnitude. In modern terminology these evolutionary stages of matter are called rotating gas-clouds, proto-stars, proto-planets, planets, suns, red giants, white dwarfs, quasars, black-holes and in the higher orders of magnitude, galaxies, galactic clusters, super clusters, etc.

The two most common characteristics of these *sinks of matter* are *Rotational Gravitation and the gradual condensation of kinetic energy into the various states of matter*.

The evolution starts with the formation of elementary particles, nuclei and the atoms of Hydrogen. Eventually and by chance, these formations gather into rare gas-clouds, form a core in their densest part and, due to the differential rotation of the one stage higher order of magnitude, the cloud start rotating.

From here on Rotational Gravitation and the immensity of chaotic chances drives the evolution all the way up to the super heavy solids with mean densities exceeding that of water by a factor of 500,000.

To point out the plausibility of this hypothesis, it should be noted, that the volume of space taken up by the orbit of the most inner electron of an atom is ten thousand times greater than the volume of the nucleus. Therefore, the electromagnetic tie between nucleus and orbiting electron reaches through distances comparable in proportion to the vast space in the solar system.

From the stand-point of Aethro-kinematics, this vast, allegedly *empty space*, is filled with vorticity and the interlocking electromagnetic force-patterns of the all-pervading Aether, forming and re-forming, adjusting and re-adjusting to each minute mutation of matter through unthinkable distances in all orders of magnitude of the Cosmos.

On the one hand, there is a slow, step by step evolution of the elements on all levels of complexity, but the most minute changes in the microcosmic structure of matter involves the consumption of comparatively great quantities of Aethrons.

On the other hand, the small extent of this consumption and the magnitude of the proportional gravitational Aether-drift can be judged from the experimental fact, that the strength of the force of gravity is  $10^{36}$  (trillion×trillion) weaker than that of the electromagnetic forces. Recall, how a tiny horseshoe magnet picks up a nail from the floor when it gets in its vicinity, doing it with ease against the colossal gravitational mass of the whole Earth.

Consequently, the *rate* of the evolutionary process of matter, the capacity of the resulting sink, and that of the consumption of Aether can be comparatively slow and small.

*The consumption of the number of Aethrons per unit time is equivalent to Newton's qualitative concept of gravitational mass. The kinematical effects of the spiral vortex are equivalent to Huygens' centripetal acceleration and Kepler's formula for the angular velocities of the planets on their elliptical orbits.*

Hence, in a rough sketch, the kinematical description of Newton's earthly and celestial mechanics and the conceptual simulation of their origin and maintenance in the ideal, isotropic, all-pervading Aether is completed.

b) There is a tendency parallel with the evolution of matter from the initially random motion of the Aethrons toward the organized dynamic stream-lines of the particles and binding forces among them, which is equivalent to *the general tendency of condensation of kinetic energy into ponderable matter*.

The quantity of matter is proportional to the number of Aethrons involved in the dynamic motion-patterns or drifts organized into particles and force fields. If in some way the condensed state of these organized patterns were broken up and the Aethrons were forced out of their permanent flows, and they would regain their state of random motion, they would *expand into the surrounding space with their average velocity, equal to that of light*.

This immense kinetic energy, freed by the de-condensation of matter, can be expressed by the famous mathematical equation:  $E = mc^2$ .

## PHILOSOPHICAL NOTES

Before closing this chapter and discussing its consequences, (while it is fresh in the mind,) let us note some of the unique philosophical aspects that emerge from all of the aforementioned.

1. As it has been discussed before, one of the characteristics of the universally observed phenomenon of rotation is, that the units of rotation, in all orders of magnitude are autonomous and isolated systems. In the global result, this is true, but in the case of the kinematical units of sink-vortices, there exists an exchange of dynamic and kinetic energies between the rotating and the surrounding medium. Since the capacity of the sink is proportional to the average atomic density of the *material body*, that produces it, so is the size of the spiral vortex, that delivers the Aether to the sink.

Parallel to the evolution of the material substance from gas to solid, from light to heavy, the capacity of the sink is constantly increasing. As it was discussed before, between the vortex and the isotropic medium, at a given distance from the center, there exists a boundary of equilibrium, where the centripetal effect of the sink together with the isotropic pressure of the surrounding medium are in balance with the inertial centrifugal ten-

dencies of the Aethrons. The diameter of this boundary is also a function of the density and size of the body. Thus, the state of matter and sink and vortex are all taking their parts in the process of evolution.

Nevertheless, these evolutionary effects are extremely slow and small and, because of the vast distances between the rotating units, with regards to the autonomy and independence they are totally negligible. For all observational and theoretical purposes, within humanly measurable time interval the boundary of a sink vortex can be taken as constant and beyond that, the sink does not affect the isotropy of the external medium. Vice versa, the extremely slow thinning of the all-pervading Aether (on account of the evolution of matter) does not affect the internal structure of the rotating units.

If the external medium is involved in the rotation of a higher order of magnitude, it carries the vortex with it as an autonomous, immutable unit.

Since it is generally assumed that the fundamental laws of physics are the same throughout the observable Universe, it can also be assumed that the laws are the same in all orders of magnitude. Although there seems to be an endless chain of orders of magnitude, because

of the autonomy of each system, the theory of *AETHRO-KINEMATICS* is not involved with the problem of *infinity*. The laws of physics can be discovered and established in any one of the orders of magnitude and extended to higher orders, as they enter into the scope of human observation.

As for the lower orders of magnitudes; the basic assumption of the theory is, that all phenomena of Nature can be explained based purely on the kinematics of the Aethrons and therefore their internal structure, if there is any, is non-essential for the description of the laws of physics. Thus the concept of *Rotating Universe* is an open ended assumption, which merely describes the presently imaginable highest order of magnitude, within which the laws of *AETHRO-KINEMATICS* are valid.

2. Another fundamental character of the sink-vortices is their *differential rotation*. As it has been shown through the origination of the donut-vortex, any relative motion between adjacent layers of a medium has the potential to produce vorticity, which eventually could generate some kind of permanent kinematic patterns, like a sink-source dipole and its resulting permanent force-fields.

The dependence of angular velocity on the distance from the center, that is, the differential rotation of the Aether in the sink vortex represents a relative motion between adjacent layers and such constant torque-like effect has been shown to be the only requirement for the origination of the elements of ponderable matter. Thus, universal rotation is not only concomitant with universal gravitation, but with the universal evolution of matter, as well.

3. With the concept of the *center of oscillation* and its drift, it has been established, that truly *continuous motion* only exist in Nature in the order of magnitude of the Aethrons and therefore the only true speed, that measures continuous motion against time and space is the average speed of the Aethrons, which is equivalent to our measurement of the speed of light.

It can be seen through the analyzes of the gravitational drift, that the formation of matter, and the transition of directional drift-velocities through one-to-one collisions, create the illusion of the Newtonian inertia, and that the intuitive human concept of motion is also an optical illusion, similar to that of motion pictures.

Under the constant bombardment of the Aethrons of the isotropic static pressure, everything that exist in

Nature is oscillating with the speed of light and with an immense frequency, proportional to the number of Aethrons in the conglomerate of the body. This oscillation, however, is unrecordable on the human time scale.

What is recorded by our senses as changes in position in space is merely the *drift of the center of the oscillation* of the bodies in a given direction. Our senses are fooled, recording continuous motion, when 24 frames of still-pictures jumps into view per second, and likewise, we are deceived by the 60 mph speed of our automobile.

In kinematical reality the car is oscillating with a frequency of trillions times trillions per second with the speed of light in every possible direction. Superimposed on this random oscillation, under the constant impulses of the crankshaft, the machine is forced to oscillate forward an infinitesimal time-interval longer than backward or in any other direction. It is this drift velocity of the huge mass of the car, that we measure 60 mph smooth riding.

Keeping all this in mind, we can now attempt to rehabilitate the kinematical details of electricity and magnetism, most of which has been already done by the geniuses of the nineteenth century and were discredited and ridiculed by those of the twentieth.

## **CHAPTER TWELVE**

### **ELECTROMAGNETISM IN THE IDEAL GAS**

#### **THE PICTURES OF EMPTY SPACE**

The hypothesis of the all-pervading light transmitting medium of Aether, had been an essential part of natural philosophy from the Greeks on. According to the theories of Descartes, Huygens, Leibnitz, Euler and others, Aether was the conveyer of light-waves as well as the rotational and gravitational forces, and even Newton believed in its existence.

Further more, in the nineteenth century Faraday, Oersted, Gauss, Maxwell, Lorentz and others assumed that electricity and magnetism would also find their final analysis and explanation through the characteristic behavior of the Aether medium.

The two thousand years of research on magnetism and electricity culminated in *Maxwell's electromagnetic equations*, which were the mathematical completion of a step by step conceptual investigation of the kinematical and fluid-dynamical properties of Aether as the foundation of all electromagnetic phenomena.

The composite result, Maxwell's great mathematical memoir; *A Dynamical Theory of the Electromagnetic Field*, was read to the Royal Society in 1864.

With the modern tendency to justify the non-conceptual solutions of twentieth century physics and to depreciate the value of the old conceptual classical theory, contemporary teaching presents Maxwell's memoir as his final turn away from the simple mechanical analogies, and in general, from the use of the hypothetical Aether. While new physics accepts Maxwell's complete mathematical system, his step by step conceptual investigation had been declared

mere *temporary scaffolding* with little scientific value, which should be discarded to avoid confusion.

The historical fact, however is, that Maxwell neither had the intention of giving up the hypothetical Aether, nor to turn away from the clarification of physical concepts by mechanical and kinematical analogies. Among other important later writings, in 1871 he published his *Treatise on Electricity and Magnetism*, a thorough comprehension of every branch of electromagnetism from the point of view of Faraday, which was clearly based on Hydrodynamic analogies applied to the Aether medium.

Nevertheless, when it comes to electromagnetism, modern educators try to keep young scientific minds away from the historical importance of mechanic and hydrodynamic analogies and with almost fanatic desperation try to describe the phenomena in the aetherless, characterless void of empty space.

In the totally inter-related nature of the complex system of electric and magnetic phenomena, it is practically indifferent where one starts the description of the subject. Both the sciences of electricity and magnetism were originated by the Greeks and

developed separately until 1820, when Hans Christian Oersted observed that an electric current has a magnetic effect in the space surrounding the conductor. From there on, the concepts of electricity and magnetism became entirely interdependent. No magnetic phenomenon could be explained without the use of the concepts of electricity and vice versa. It followed, that a simple, step by step separate description of either one of the two phenomenon became impossible. A condensed version of the contemporary approach of explaining the subject is given here.

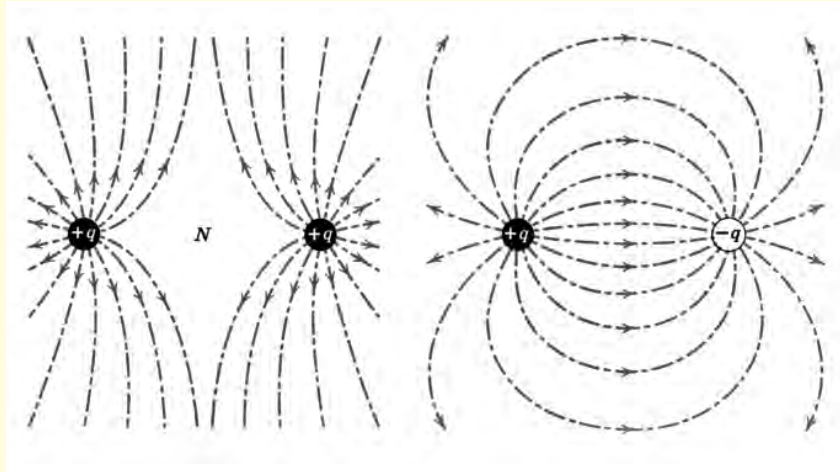
The introduction of the theory of electricity commonly starts with some simple experiments on producing static electricity and forming the concepts of negative and positive charges, carried by the elementary particles of matter, the electrons and protons. The basic character of these electric charges is, that like charges repel and unlike charges attract one another.

Thus the forces of static electricity are described, just like gravity, as *action at a distance* forces through empty space. These two entirely different forces, gravity and electricity are also equivalent mathematically. The inverse square law of the elec-

trical attraction and repulsion was established empirically by Augustin de Coulomb in 1785.

$$F_g = G \frac{M_1 M_2}{R^2} \quad F_e = \frac{q_1 q_2}{R^2},$$

where  $F_g$  is the force of gravity,  $M_1$  and  $M_2$  are the masses involved,  $F_e$  is the electric force between the charges  $q_1$  and  $q_2$ .



(a)

Figure 12-1

(b)

The essential difference is that while gravity is an exclusively attractive force, electric charges pro-

duce both attraction and repulsion. Figure 12-1 shows the schematics of the electric fields in empty space in the vicinity of two unlike charges attracting (a), and two like charges (b), repulsing one another.

Next, as it follows historically, the theories of batteries and electric currents are presented, which are based on the attractive forces between the unlike charges of protons and electrons.

By certain chemical processes between lead, lead-dioxide and sulfuric acid an electric potential difference is created between the two poles of the battery; that is, a surplus in electrons at the negative pole and deficiency of them, or rather an excess of protons at the positive pole.

In copper and other conductors, some of the electrons on the outside of the atoms are held loosely and easily escape.

"These *valence electrons* move in a random manner within the body of the wire like an 'ideal gas'. When the circuit is closed, or 'on', under the influence of the attractive force of the protons, the free electrons start drifting towards the positive terminal. To keep the current continuous, however, after arriving to the



positive terminal, the electrons must somehow return to the negative terminal. The transfer of electrons through the sulfuric acid back to the negative terminal against the repulsion of the negative charges is a consequence of certain complicated chemical processes." (Atkins, Physics [293])

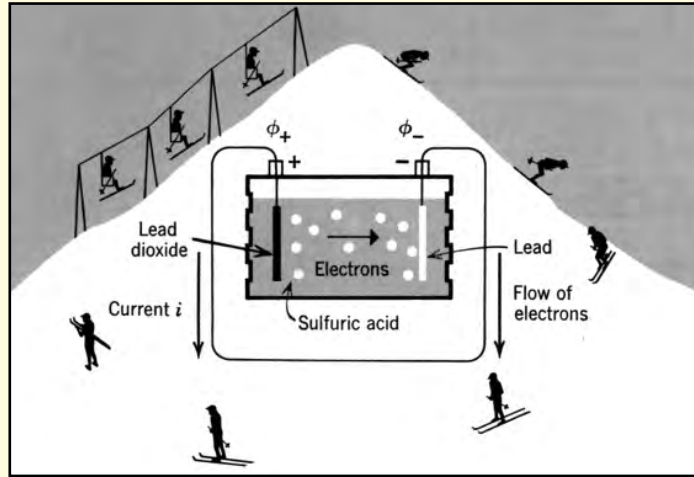
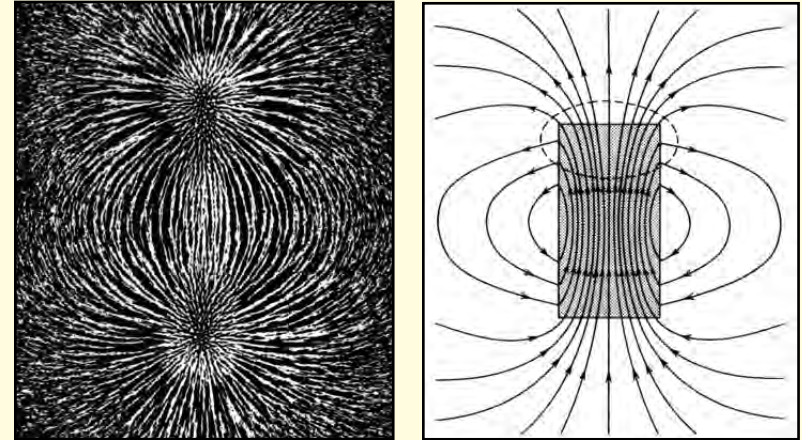


Figure 12-2

Discussing the parallel between gravity and force of electricity Figure 12-2 illustrates a storage battery by the picturesque analogy of the gravitational potential energy of a ski-lift where the skiers are representing the drifting electrons.

According to the theory of static electricity, these drifting electrons supposed to constantly *accelerate* toward the positive terminal, however, they constantly collide with the atoms of the metal, transfer their kinetic energy, and have to start accelerating again. This transfer of the kinetic energy of drifting electrons is an electromotive force, which converts into the electromagnetic radiation of heat and light.



(a) Figure 12-3 (b)

Next, magnetism is represented by the phenomenon of a bar magnet. Figure 12-3 (a) shows the magnetic field of a permanent bar magnet traced by iron filings. (b) illustrates Faraday's concept of the *lines of*

*force* around the same bar. The three dimensional effect of these lines of force in the neighboring space of the magnet is called the *Magnetic Field*. Faraday himself was firmly convinced that these lines of force, surrounding the magnet are actually flow patterns or stresses in the aether, and they exist even when no iron filings were present to trace them.

Faraday found that the lines of force act as if they were stretched fibers in space which are continually trying to contract and thus pulling on the poles at their ends. They also act as if they were pushing one another sideways as they contract. Their strength depend on the distance from the magnet and on the medium they pass through. Lord Kelvin called the ease with which lines of force may be established in a medium, the *permeability* of the medium compared with vacuum.

"There is no insulator for magnetic lines of force, just like there is none for gravity, but soft iron, with its supreme permeability attracts them and guides them, and it is frequently used as a magnetic screen." (Newton H.Black, College Physics, [321]).

The Earth also seems to be a magnet. Compass needles point toward the Earth's magnetic north pole

because they are under the influence of the Earth's Magnetic Field. The same needles brought near a bar magnet align themselves in definite directions relative to the poles of the magnet. – A detailed description and kinematic explanation of the bar magnet can be found in [Appendix II](#).

The next step is the introduction of the discovery of Christian Oersted; the magnetic effects of a current carrying conductor on compass needles. The experimental fact of this discovery is, that a current carrying wire deflects the compass needle from its normal position of pointing toward the north pole.

[Figure 12-4 \(a\)](#) shows, that if a wire is held over the needle and the current flows from south to north, the needle is deflected toward the west. When the current flows the other direction, the needle is deflected toward the east. When compass needles are placed in a plane perpendicular to the wire, they all line up tangential to the circle, centered on the wire, (b). If the current is reversed, all needles align themselves end to end in the opposite direction.

The photograph of [Figure 12-4 \(c\)](#) was obtained by sprinkling iron filings on a sheet of paper, which was held in a plane perpendicular to the current car-

rying wire. The filings of soft iron are long and thin and align themselves in the magnetic direction like miniature compass needles. They evidently trace out circles centered on the wire.

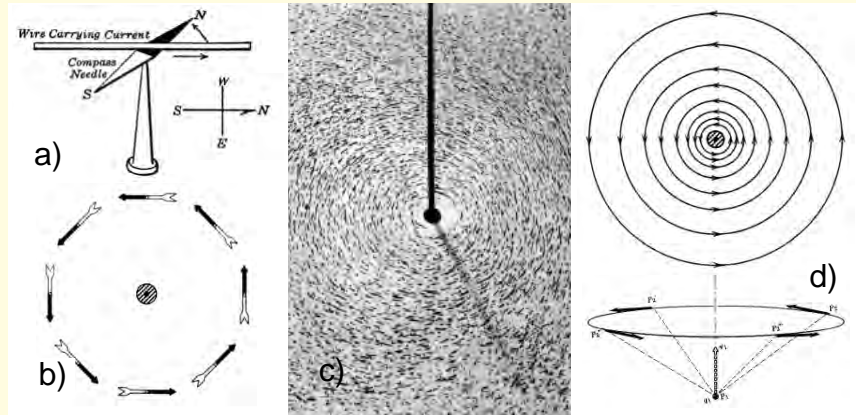


Figure 12-4

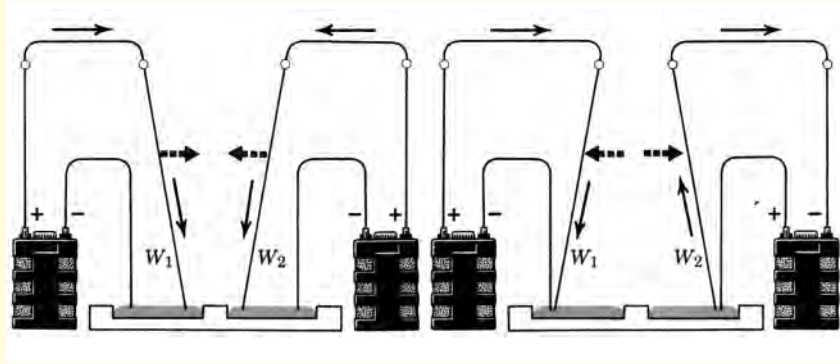
The schematic drawing (d) illustrates the vector representation of these circles. The circular vectors and the distances between them represent the direction of the force on the needles and the inverse square relation in the magnitude of the force with the different distances. These vectors represent the same circular vortex which has been discussed in connection with the great storms and Newton's refutation of Descartes' solar vortex.

It is assumed that a Magnetic Field exists wherever a compass needle takes a definite alignment in space. Obviously one of these cases is the current carrying wire with the resulting circular alignment of the compass needles or that of the iron filings around it. However, the field around the conductor seems to have no resemblance to the field around a magnet and for distinction, it is called a *Circular Magnetic Field*, where there is no south or north poles to which the needles would be attracted. The lines of force appear to form circles centered on the wire, but neither starting nor ending on it. While the lines of force of a magnet are endless loops and their directions always point from its South to its North pole, the force of the Circular Magnetic Field is always tangential to a circle about the wire, and its direction depends on the direction of the current.

The magnitude of the magneto-motive force is directly proportional to the strength of the current and inversely proportional to the square of the distance from the wire. If the current stops, the Circular Magnetic Field ceases to exist.

Coordinating these findings with the assumption that the electric currents are made up of drifting

electrons, scientists concluded that *moving electrons produce a magnetic field in the plane perpendicular to their motion*. – Some further characteristics of the Circular Magnetic Field is demonstrated by Andre M. Ampere's experiments on the magnetic forces between two conductors.



(a)

Figure 12-5

(b)

Figure 12-5 illustrates Ampere's equipment. The vertical wires are freely hinged at the top and their lower ends dip into mercury pools, which also conduct electricity. This way the wires can freely swing without breaking the circuit. When the currents generated by the two batteries flow in the same direction (a), the vertical wires attract one another and when the currents flow in opposite directions (b),

they repel each other. If either one of the current ceases, no force exist between the wires.

Since the conductors always contain as many protons as electrons, the forces between them cannot be the result of static electricity and therefore it is assumed that this phenomenon is a further consequence of the Circular Magnetic Fields around the conductors, produced by the moving electrons.

When this assumption is accepted, the following conclusions can be established:

"A charge moving with constant velocity produces a *Circular Magnetic Field* in the plane rectangular to its motion. In turn, this magnetic field effects the motion of the other charges. Aside from the electro-motive attraction and repulsion, when two charged particles are both in motion, they exert on one another a new kind of force that depends on their speeds and directions. This force is zero, if the velocity of either one of the charges is zero. A charge produces no magnetic field unless it is in motion." (Atkins, Physics, [311] ).

Note, that these statements are not purely empirical descriptions of the facts, but rather speculative postulates, tailored to fit the phenomena.

Seemingly these conclusions are somewhat contradictory to the statement of the theory of static electricity, namely, that like charges repel one another. Ampere's experiments shows, that conductors, carrying currents in the same direction, attract one another. It should follow from this, that parallel moving electrons would exert two forces on each other at the same time; an electric force of repulsion, as like charges of static electricity, and a magnetic force of attraction, because they move in the same direction. Moving in the opposite direction they would doubly repel each other.

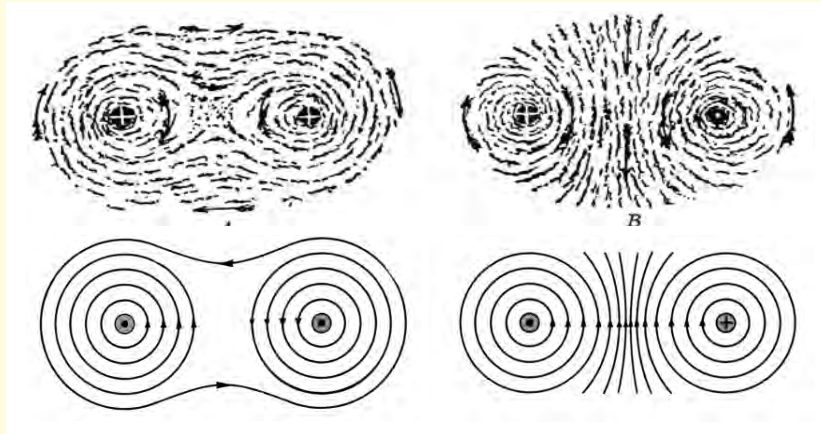


Figure 12-6

This contradiction supposed to be eliminated by the intermediate role of the circular magnetic fields and the phenomenon was explained by Faraday's lines of force, as illustrated.

"We may understand the effect of two parallel conductors by studying the magnetic fields traced by iron filings about the two wires. Figure 12-6 (a) shows the magnetic field about the two wires in which electric currents flowing in the same direction.

"Here we would expect the wires to attract each other because of the tension in the lines of magnetic force. Picture (b) shows the magnetic field about two wires carrying currents flowing in opposite directions. Here we have repulsion between the wires due to the sideways push between the magnetic lines of force." (Newton Henry Black, College physics [400]).

Faraday also proved experimentally that the circular magnetic fields are also *in rotation* about the conductors. Figure 12-7 shows Faraday's *rotator cups* filled with mercury through which the electric current can pass from the overhead support to the conductor: The north pole of a magnet rotates around the current-carrying rod, (a). The current carrying rod rotates around the north pole of the magnet, (b).

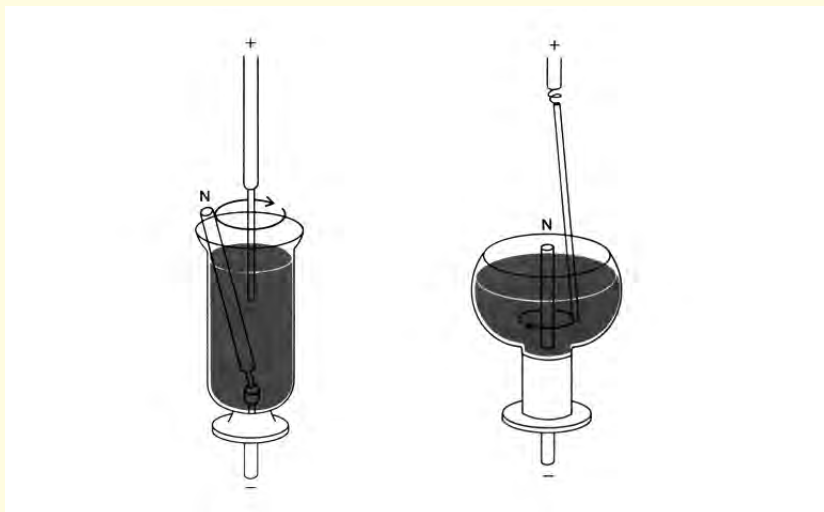


Figure 12-7

The next link in the introduction is illustrated by Figure 12-8: If a circular loop is formed out of a current carrying wire it produces a magnetic field very similar to that of a bar magnet.

A compass needle brought to the vicinity of any part of this loop, acts as if it was close to a magnet. The magnetic field of the loop has a north and a south pole, which are reversible by changing the direction of the current. With some three-dimensional imagination it can be pictured, how the rotating Circular Magnetic Field everywhere around the

curved wire is creating the overall *flow-pattern* through the ring. The endless loops of the lines of force, emerge from the north pole of the ring and re-entering at the south pole.

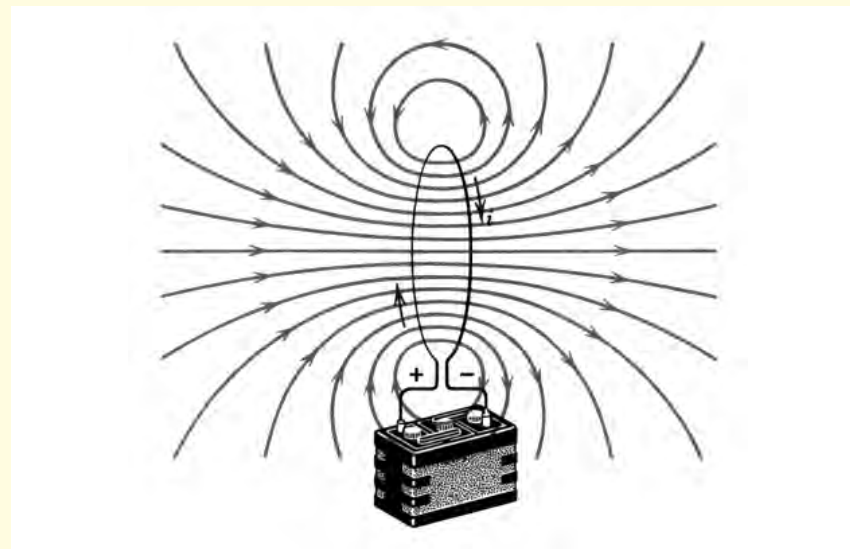


Figure 12-8

By changing the direction of the current, the poles can be reversed. It follows, that two circular loops of conductors with unlike current must attract, and with like must repel one another. When a *helical coil is formed* by winding a number of such loops, the

magnetic effect is greatly strengthened because the fields of the individual loops reinforce each other.

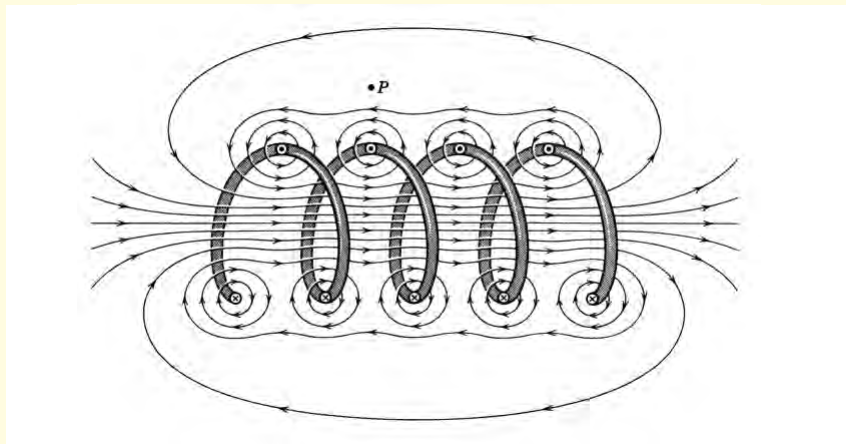


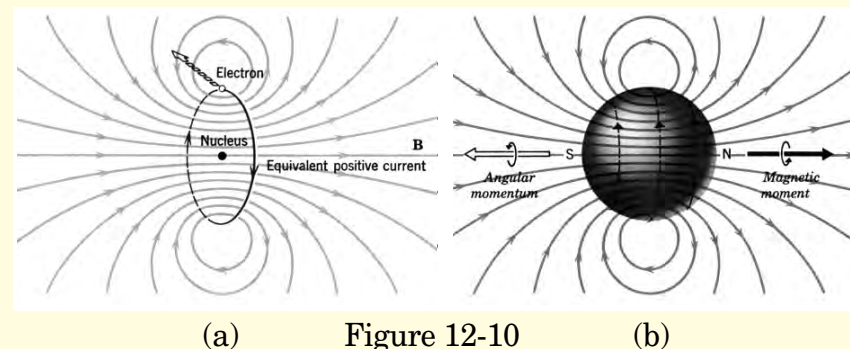
Figure 12-9

A coil of this type, called *solenoid*, is shown on Figure 12-9. When an iron rod is placed within a densely wound solenoid, it intensifies the strength of the magnetic field hundreds of times and the two together form a powerful *electro-magnet*.

Soft iron loses its magnetic properties as soon as the current ceases to flow through the solenoid. However, permanent artificial magnets can be produced from other ferromagnetic materials by placing them into the magnetic field of a solenoid. Next, the

magnetic properties of a material are explained in terms of microscopic electric currents due to the behavior of the electrons. An electron can produce a magnetic field in two ways.

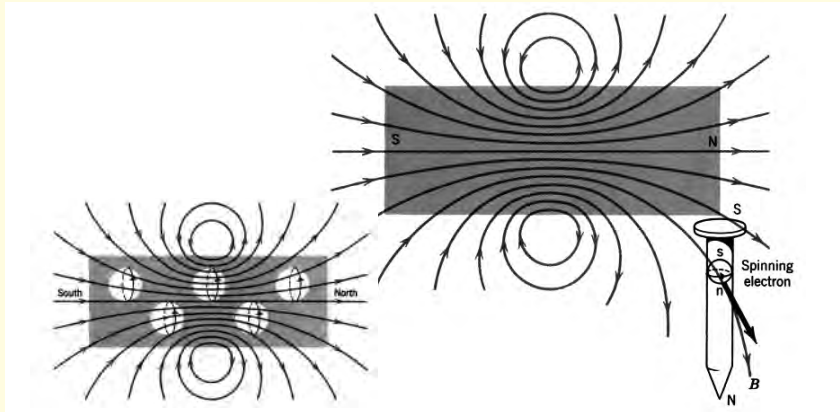
"An electron moving around the nucleus of an atom in a circular orbit is equivalent to a circular loop of current and produces a similar magnetic field, Figure 12-10 (a). In addition, an electron may be visualized as a small spherical cloud of negative charge which is spinning about its axis. Any small portion of the electron describes a circular path which is equivalent to a current in a circular loop of wire, producing a magnetic field, (b).



"Most materials show no magnetic effect because of the orientation of the orbiting and spinning of the

electrons are random and cancel out the magnetic fields of one another. The important exceptions are the *ferromagnetic* materials in which there is an excess of electrons spinning about axes pointing in the same direction and adding together they produce a large combined magnetic field." (Atkins, Physics)

In a normal size bar magnet there are about  $10^{24}$  spinning electrons. In soft iron, such as a nail, the electron spin is random, but very easily turned about in any direction by an external magnetic field. Figure 12-11 illustrates how the spin of the electrons of a bar magnet are lined up, which then aligns the electrons of the nail, and draw it to one of its poles.



(a)

Figure 12-11

(b)

With this, the conceptual circle has been completed; electricity explains magnetism and magnetism explains electricity. The description of these phenomena resembles to that of Newtonian mechanics, where one concept is defined by the other and none of them, on their own, are really understood.

Just like the concept of force cannot be explained by the concept of inertia, the mystery of magnetism can hardly be explained away by the mystery of electricity. The assumption, that a magnet has its properties because it is made of tiny magnets, says nothing about the nature of magnetism. Theorizing that an orbiting electron is equivalent to the electric current in a circular wire and it creates its own magnetic field, is merely a transference of the mystery into a lower order of magnitude.

Hence, after the final removal of the so-called *scaffolding*, Maxwell's ingenious mathematical system of electromagnetism has been left in a complete conceptual vacuum. But if the conceptual description of electromagnetism is impossible, then where should we file the pictures that scientists drew for us on the canvas of empty space. Are they mere ghosts of our imagination? Can it be a mere coincidence that these



pictures makes mathematical and conceptual sense? Or maybe Einstein hit it right in the second time around, and perhaps empty space is not really and completely empty?!

The AETHRO-KINEMATIC description of Newton's mechanics showed that the complexity of the phenomena, recorded by our senses, evolves from the chaotic simplicity of the ideal gas. Thus, the mystery of the action at a distance force and that of the unexplainable Kepler's Formula has been reduced to the comparatively simple kinematics of the sink-vortex. Let us now see if there is any possibility for a similar kinematical simulation of the action at a distance mysteries of electromagnetism.

## MAGNETISM AND KINEMATICS

Oersted's and Ampere's discoveries about the Circular Magnetic Field, an interaction between electricity and magnetism, seem to involve all fundamental ingredients of electromagnetism, and for now it is assumed that the kinematic understanding of these experiments and the Circular Magnetic Field will serve as a key to explain all other phenomena. To simulate these experiments, it is necessary to

describe the kinematics of the following phenomena: *a magnet, a battery, a conductor, an electric current, and a circular magnetic field.*

Thus, the first thought-experiment, will be a simulation of a bar magnet in the familiar *great room* filled with the isotropic and homogeneous ideal gas.

Suppose somewhere in space a small cylindrical drum is suspended, and that initially both the cylinder and the gas are motionless. Next, a *fan-propeller* is introduced inside the cylinder, at its mid-section. When the blades start to rotate the fan draws the gas from behind, pushes it forward, and creates a current flowing from left to right through the drum. Evidently, there will be a movement of the gas inside the drum, and some random turbulences in the medium because of the compression in the front and the rarefaction at the end.

Now, suppose that the wall of the cylinder is not solid, but it is perforated in such a way that the random kinetic energy, or the flow patterns between the external and internal gas can be freely exchanged. Figure 12-12 (a) illustrates a magnified portion of the perforated wall which is an essential part of the this and following simulations. As the external gas is

sucked in behind the propeller, each individual hole of the perforated walls becomes a *sink* and where the internal gas pushes out in front of the propeller, each hole becomes a *source*. With this, the evolution of a complex circulating system begins.

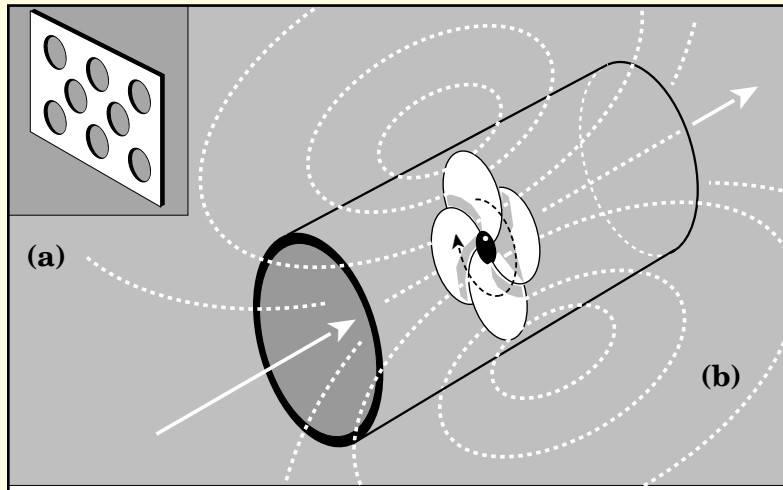


Figure 12-12

The rarefaction produced by each hole behind the fan and the condensation in front of it are both local disturbances in the isotropy of the external medium. These disturbances with opposite density differences are propagated outward from the holes in spherical shells. Pulses of compression and rarefaction.

Some of these shells, generated by neighboring sinks and sources, in the vicinity of the propeller, will meet each other outside the cylinder. Eventually two shells with opposite pressures will interconnect over the wall and form a circular stream; a loop of gas circulating in and out through the perforated wall.

As a consequence of this circular stream, the static pressure around the new loop decreases, which in turn, helps in the formation of a larger loop, bridging over sinks and sources further apart. Beyond those even larger ones, and so on and on...

Eventually, a whole three dimensional system of loops evolves in a complex pattern of circulation, entering at one end leaving at the other end of the cylinder, then turning back in space and reentering again. The schematics of this pattern is identical with the magnet illustrated above on [Figure 12-3](#).

Further more, as it has been shown in the kinematics of gravity, no steady radial flow toward a sink can exist without triggering rotation. The same is expectable in each case of a source which is pushing against the isotropic medium or that of a sink, sucking in fluid. The final flow pattern around and through the cylinder is a system of endless elliptical

circulating filaments, which greatly resemble the picture of Faraday's *lines, or tubes of force*, as they were traced by the iron filings around a magnet.

It follows from above, that the core of the system, the cylinder itself become a sink at one end, where the greatest loops enter and drags the free gas with them, which is ejected at the other end, creating a source. These are the two poles of the 'magnet'.

When two such cylinders are placed nearby in free suspension, they will eventually turn toward each other and seek out their *opposite poles*; the source finds the sink and vice versa. The kinematic reason is illustrated on Figure 13, where two fan-magnets are shown parallel but offset to each other. The white dotted lines represent the initial circulation of the medium around the bars. The emphasis is on the envelope currents (black) evolves around the two separate circulatory systems which connects the opposite poles of the two units.

Figure 14, (next page) shows how the whole system evolves, under the constant isotropic pressure of the medium, representing a tendency for condensation and symmetry that force the two units to turn to a mutual axis and connect their opposite poles.

Hence, Faraday's rubber-band-like lines of force is not needed to pull the magnets together, it is rather the isotropic pressure on the two circulatory systems, which turns and pushes them into the most condensed symmetry, which is a new combined unit, again possessing only one North and one South pole.

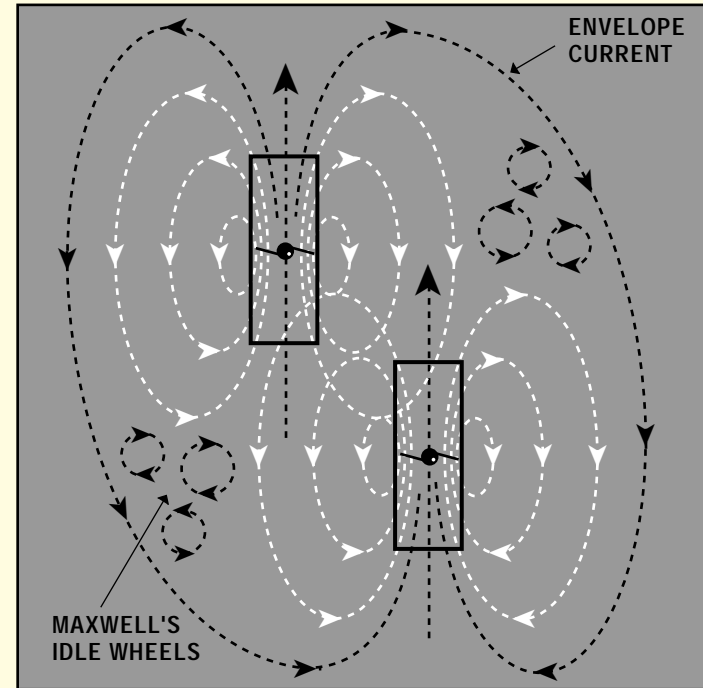


Figure 12-13

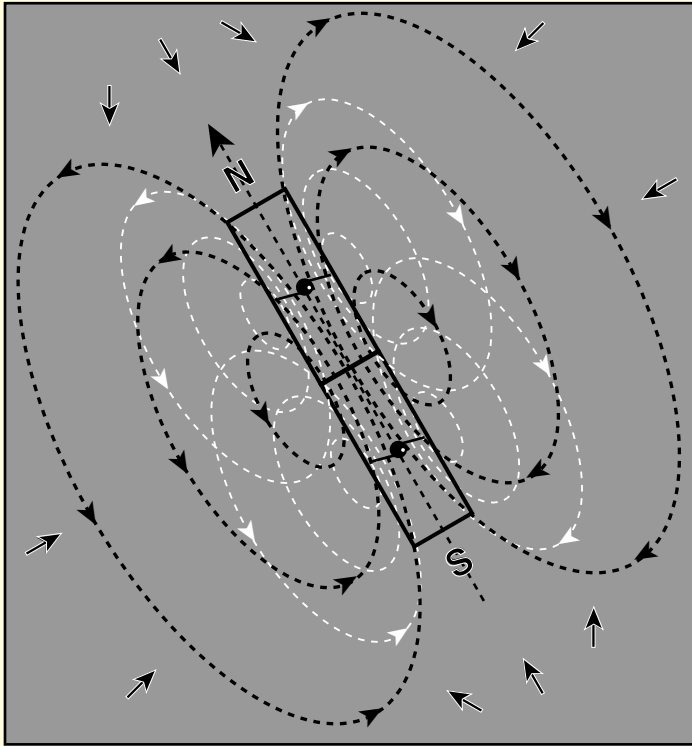


Figure 12-14

Now, it follows naturally, that there will be a repulsion between like poles because the circulations of the two systems are in opposite directions which drives the poles away from one another. (See App.II.)

The collisions between the two opposite currents brake up the loops and turbulence is created. The temporary increase in the static pressure between the two systems overpowers the external pressure. The results is a repulsion between the two like poles.

Next, recall the classical electron theory of magnetism. Figure 12-15 and 16 (next page) illustrates an analogous hypothesis.

Consider a great, perforated, cylinder, within which, instead of one big fan at the center, there exist a great number of *miniaturized* fan-magnets, just like the unit described above.

These tiny units are freely suspended in a way that each can turn in any possible direction, however, their centers are fixed in space in an organized symmetry relative to the great cylinder, and to one another. In the initial state of the system, (Figure 12-15) all the small fan units are active, but they are oriented in completely random.

This means, that the same number of fans are pointing in every direction and therefore the density disturbances they produce with their individual circulation cancel out each other. As a result, there is no net flux or flow pattern within the great cylinder,

and the internal and external densities and pressures of the gas are in equilibrium.

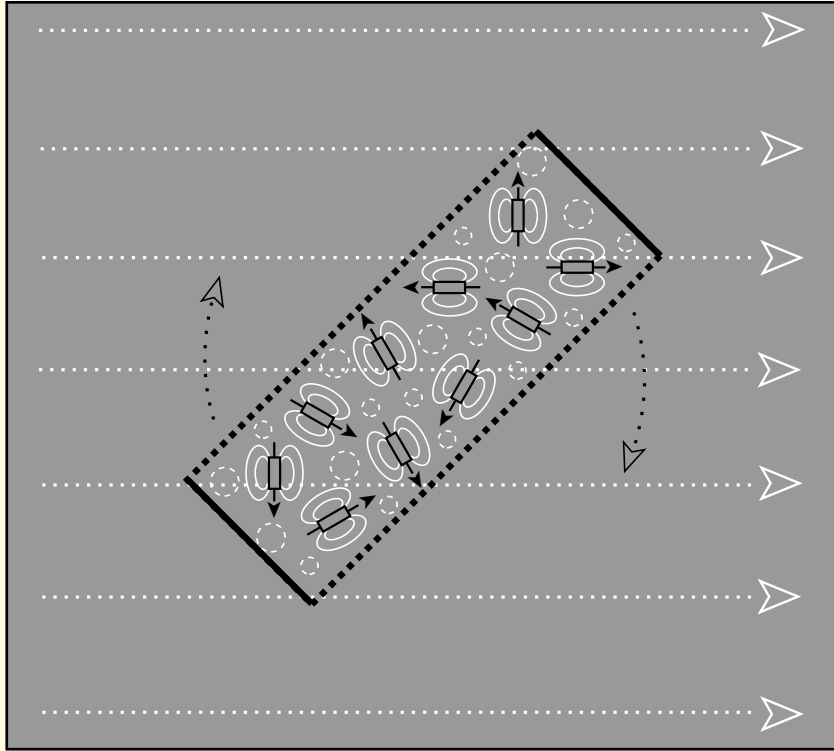


Figure 12-15

Let us now introduce a mild external vertical draft in the medium, a current, which passes through the location of the main cylinder, analogous

to a uniform magnetic field (dotted white lines). Since the main cylinder is also freely suspended at its center, the draft will eventually turn it to the direction of least resistance, lining up its axis with the draft, (Figure 12-16).

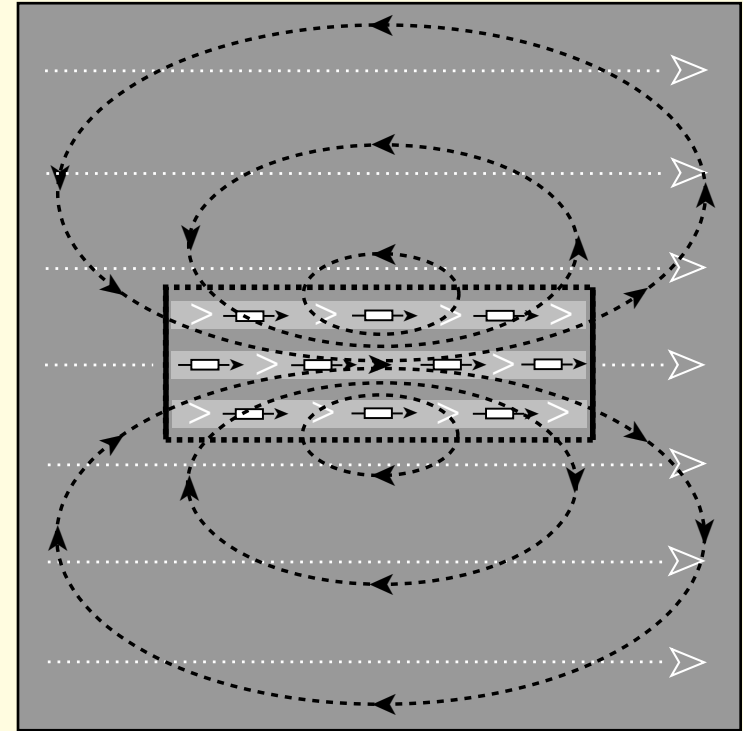


Figure 12-16

Consequently the draft will enter and leave through the open ends of the cylinder and since at this stage the draft is the same inside and outside, if nothing else happened, there would be no kinematic reason for the formation of any circulatory patterns.

However, the draft inside the cylinder, will gradually turn all freely suspended, active fan units into the same direction, parallel to the axis of the main cylinder. Without the draft, the individual currents of the fans were cancelled by their random orientation, but now they lined up, and the strength of their combined currents are adding to the draft. As more and more fan units turn into the direction of the draft, they produce an overall flow of the internal gas of the big cylinder far greater than the strength of the initial mild external draft.

The flow pattern through and around the big cylinder is now developing by the draft combined with internal drives of the aligned fan units. Due to the greater internal flow, and the resulting smaller internal static pressure, and because of the intervening perforated wall, the final product is the same sink and source circulatory system as that evolved around the original small fan units. Hence, the same

kinematic phenomenon is recreated in a higher order of magnitude.

If the general draft ceased to exist, the small units gradually loose their mutual orientation and the system returns to its initial random state. This is then the hydrodynamic analogy of the temporary magnetization of a soft iron bar.

Consider now, that the suspension of the fan units might not be completely free, but they are semi-fixed in random directions and their re-orientation would cause some resistance. In this case, a certain minimum strength of a draft is required to establish their re-alignment. A sufficient strength of draft which overpowers the resistance, can produce the uniform orientation of the units and then the circulation through the cylinder will remain permanent, even when the draft ceases to exist.

Substituting now the ideal gas with the all-pervading Aether, the miniaturized fan units can be replaced by the kinematically equivalent donut-vortices. The perforated wall is a representation of kinematic communication between the internal and external Aether through the spaces and interstices of the crystalline structure of ponderable matter.

This solution allows the development of the temporary or permanent circulatory systems through the body between the internal and external Aether.

The *non-free* suspension of these units represents the electromagnetic construction of matter, that is, the complex internal flow-patterns, connecting the donut-vortices by the force of cohesion that keeps atoms, molecules and crystalline structures rigidly or elastically together.

The *draft*, affecting the cylinder and the fan units inside, can be taken as the effect of a solenoid or that of the Earth's magnetic field or, in general, the capability of a uniform magnetic field to produce magnets out of certain metals.

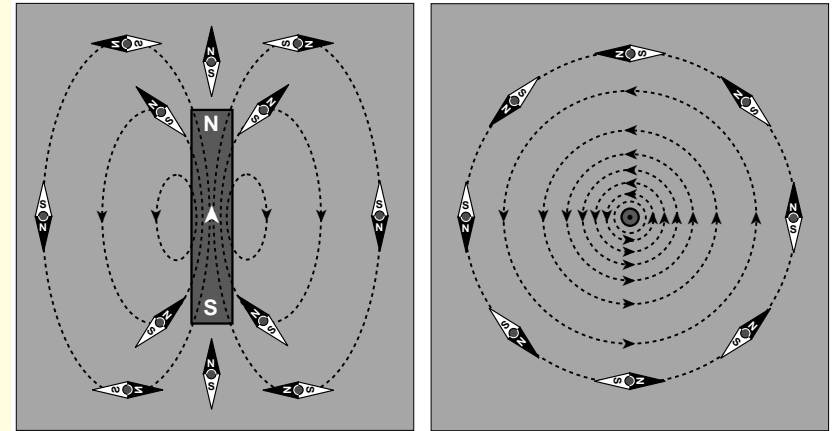
Hence, the natural magnet, Faraday's fields of force, the kinematics of the action at a distance forces of magnetic attraction and repulsion has been simulated in the environment of the all-pervading ideal gas of Aether.

## THE ELECTROMAGNETIC FLUID

There remains the task of describing the kinematical origin and maintenance of the complex phenomena of an electric current and the circular mag-

netic field around a current carrying conductor. These phenomena includes the magnetic effects on compass-needles and on another current carrying conductor.

As it was mentioned before, there is very little resemblance between the magnetic field of a magnet and that of a current carrying wire. In fact, the only similarity between the two is, that they both move a compass needle out of its initial orientation by an action at a distance force, although even the change in the direction of the needle, relative to the source of the field, is entirely different in the two cases.



(a) Figure 12-17 (b)

On the one hand, as Figure 12-17 (a) illustrates, all lines of force in the vicinity of a magnet are endless elliptical loops surrounding end penetrating the material body. The torque exerted on the compass needles turns their axes tangentially to the elliptical lines of force, which at the center of the external field is parallel to the axis of the magnet. Closer to either ends, the directions of the needles first turns perpendicular to the bar, then directly toward the poles.

On the other hand (b), the lines of force around the conductor do not have any contact with the material body of the wire. They seem to be exactly circular, centered on the wire and in the planes rectangular to the axis of the wire. As a result, the torque exerted on the needles at any point of this field is always exactly rectangular to both the wire and to the radius of the circle. Hence, from a kinematic point of view, the circular patterns of the *magnetic field* surrounding a current carrying conductor and the elliptical endless loops passing through a regular bar magnet must be entirely different in their origin and maintenance.

Nevertheless, there is one similarity between these fields, that the strength of both forces are

inversely proportional to the distance. The force of the circular magnetic field is,  $F \propto 1/R$ , the same formula that describes the *circular vortex*.

As it stands at present, this part of the theory of electricity and magnetism is quite ambiguous even in Maxwell's and Lorentz's versions. The fundamental assumption that *moving charges*, like electrons, are producing magnetic fields is itself an enigma. There isn't even an approximate theory of how this could work nor is there any parallel to this phenomenon in Nature. According to the presently accepted hypothesis, an electron moving in a conductor creates a circular force-field perpendicular to the direction of its motion. The force vector is also perpendicular to the radius in the plane of the circle.

Reversing the direction of the motion of the electron also reverses the direction of the force. If there are two conductors and electrons moving in both, there is an attraction or repulsion between the wires, dependent on whether the directions of currents are the same or the opposite.

This differentiation, is not simply the result of the relative motions of the electrons, because the force does not exist at all, when the charges are at



rest in one of the wires. This empirical fact, however brings up the question; At rest relative to what?!

Remember, that a frame of reference can always be chosen to be at rest relative to one of the electron drift. Not even relativity attempted to answer questions like this. But there are other sensitive questions as well. – Even the hypothesis of the motion of electrons in a current is unclear, since it is based on the concept borrowed from static electricity; on the action at a distance force of attraction between the opposite charges of protons and electrons.

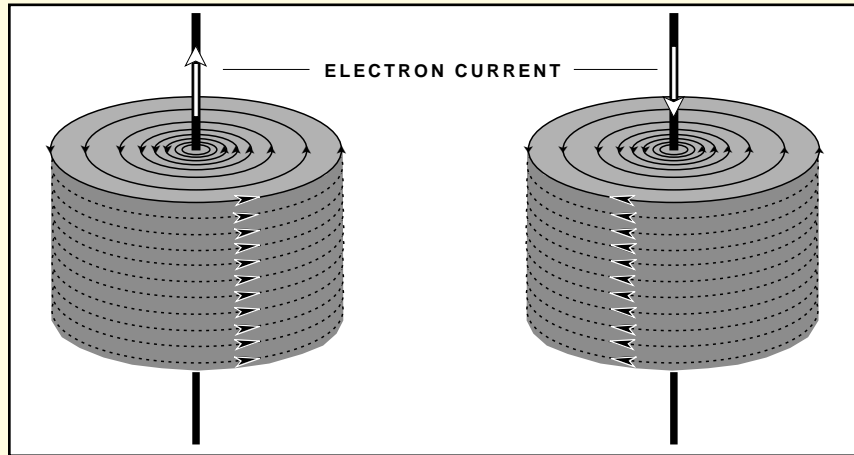


Figure 12-18

It is assumed that certain chemical processes in the battery creates an excess positive charge at one terminal and an excess negative charge at the other. Since the positive protons are firmly fixed in the atoms of the metal, under the influence of the mutual attraction the free electrons are the ones that must migrate toward the positive pole.

One problem with this idea is, that the force between charges decreases by the square of the distance and it can hardly be assumed that the positive pole would attract all electrons evenly at unspecified distances through the whole length of a conductor. To remedy this ambiguity, it is hypothesized, that free electrons in the body of the wire act like the randomly moving particles of an ideal gas which expand into the rarefied space from which the electrons were pulled into the positive terminal.

But even if this overly speculative theory is accepted, another question arises; In order to keep the current going contiguously, after arriving to the positive terminal, the electrons must escape again, drift through the fluid, back to the negative pole against the increasing repulsion of the negative terminal. How ?

The answer is another unclear assumption: "this is the consequence of certain complicated chemical processes".

There are also great complications with the creation of the circular magnetic field by the moving charges. To visualize the complexity of this circular field, consider Figure 12-18, illustrating the three dimensional schematics of the magnetic lines of force around a straight portion of a current-carrying conductor. – Recall the experiment with the iron filings on the sheet of paper, held in the plane rectangular to the conductor, Figure 12-4.

It is evident that the circular pattern will remain the same if the sheet was moved up or down parallel to itself. Meaning, that the circular magnetic field exists in each infinitesimal plane, continuously and simultaneously in the whole length of the wire. The resulting description is not only a *circular*, but rather a *cylindrical magnetic field*, which surrounds the body of the conductor and follows its direction from one terminal to the other.

Now, try to imagine the contribution of each individual electron to the creation of the cylindrical field while it is in random oscillation in the electron gas,

drifting toward the positive terminal, colliding with the atoms, loosing its drift, and re-accelerated again by the static electric attraction toward the protons. In- deed, the only possible conceptual simplification here is to assume that the cylindrical magnetic field is an effect of the drift of the free-electron gas, as a kind of electromagnetic fluid.

Still, there are more perplexities in the presently accepted theory. A single current-carrying conductor moves the magnetic compass needle, but does not move a nail or another conductor that carries *no* current. As it is hinted by the pattern of the iron filings, (Figure 12-5) the attraction or repulsion between the wires are most likely the results of the interaction between the two magnetic fields generated separately. For any interaction at a distance between two material bodies, *there must be a magnetic field around both*; either two current-carrying wires or one of those and an active magnet.

Insisting on keeping these forces as '*actions at a distance*', one must end up with Einstein's gravitational curvatures of empty space. In this case, however, the geometry of these curvatures is much more complex, and the interaction is not between field and

matter, as it is with gravity, but *between field and field*, or let's say, *between two sets of the curvatures of empty space?!*

Adding to this the comparatively primitive relativistic excuse that gravitational mass simply distorts the texture of space, but complicating the problem with the negative charge and the moving mass of the electron-fluid, it is not surprising that the last quarter century of Einstein's life did not produce a successful unified field solution to the phenomena.

## A HYDRODYNAMIC BATTERY

In the previous discussions, the magnetic field around magnets were simulated in the ideal gas and transposed to a kinematically conceivable flow-pattern of the Aether through and around the material core of the magnet. Continuing with the same technique, the following thought experiment is an attempt to describe the AETHRO-KINEMATIC origin and maintenance of the battery, the electric current and the resulting Cylindrical Magnetic Field around a current carrying conductor.

Let us start with the popular way to explain the operation of a battery by hydrodynamic analogies:

"The action of an electric cell (battery) may be compared with that of a pump for circulating water through a system of pipes. A battery cell may be thought of as a *machine for pumping electricity*. The rate at which a current of water flows through a pipe may be expressed as a certain number of gallons per second. In the same way, the rate of a current of electricity may be expressed as a certain quantity of electricity flowing per second past a certain point.

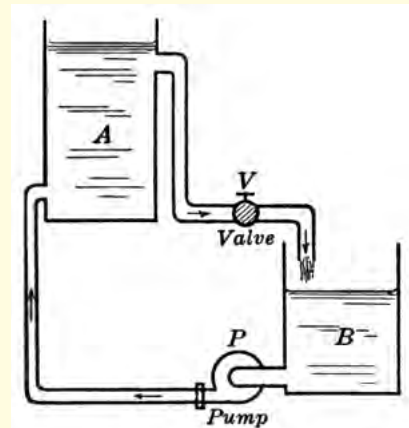


Figure 12-19

"Suppose two tanks, A and B in Figure 12-19, are placed so that A stands on a higher level than B. A pipe with a pump P leads from the bottom of B to the bottom of A. If the tanks are partly full of water and the pump is started, water will be drawn from tank B to tank A, which

raises the water level in the latter. If an overflow pipe is carried from tank A to tank B, the overflow will run back to the depleted tank and the water will

simply be circulated by the pump in a current flowing through the system of pipes and the two tanks. This is somewhat like the electric cell (battery) when the external circuit is closed.

"Now, if the overflow pipe is closed by a valve V, the pump will soon empty the tank B; after this it may continue to run, but it cannot pump the water, and no current of water will flow through the pipes. This is similar to the condition in an electric cell which does not have its terminals connected by a wire. The plates are maintained at a difference of electric potential, but no current flows." (N. Black, College Physics, [363]).

"The flow of charge through a conductor is often compared with the flow of water through a pipe, which occurs because there is a difference in pressure between the ends of the pipe, established perhaps by a pump. This pressure difference can be compared with the potential difference between the ends of a resistor established by a battery. The flow of water (liters/second, say) is compared with the current (amperes/second). The rate of flow of the water for a given pressure difference is determined by the nature of the pipe. Is it long or short?

'Is it narrow or wide? Is it empty or filled, perhaps with gravel? These characteristics of the pipe are analogous to the resistance of a conductor.'" (Halliday-Resnick, 1964 Physics, [679])

The flow of water is a close analogy to electric current for another reason. The electrons, as they drift through the conductor, suffer the same viscous resistance by the collisions with the atoms of the metal as the water molecules suffer by their friction with the wall of the pipe or by their collisions with the gravel or any other obstructing filler in the pipe. Viscosity is one of the mutual characteristics of both water and electric currents.

Going this far with hydrodynamic analogies, we continue the following thought experiment in water, adding the assumption that it is an ideal frictionless fluid and the system is described in weightlessness. In order to extend these analogies to the phenomenon of the Circular Magnetic Field, some adjustments should be introduced on the initial design of the *water-battery*.

Suppose, we use only one container to represent the battery and a rounded-square shaped pipe as a conductor which leads from one side of the tank to

the other. As Figure 12-20 illustrates, at the left end of the pipe a pump is installed, which pulls the water from the pipe and driving it into the tank, creates a *source*. The same time, the other end of the pipe pulls the water from the tank, creates suction, which represents a sink.

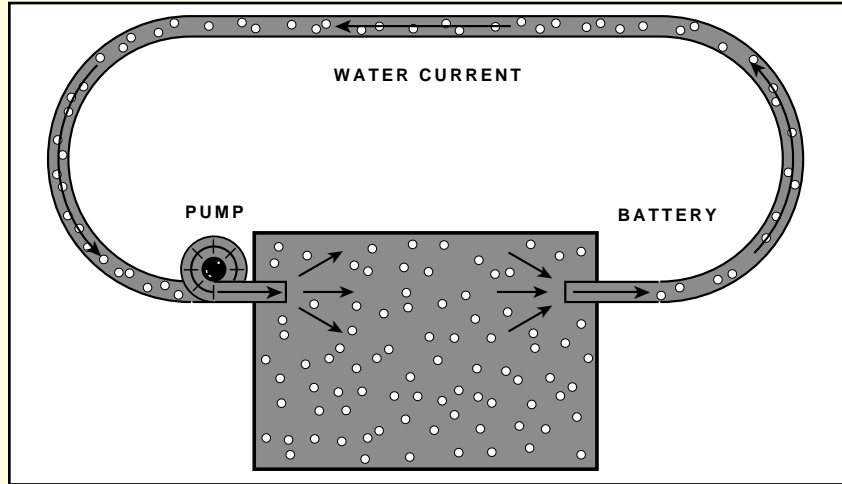


Figure 12-20

In the assumed weightlessness, this setup gives the same result as the double tank, that is, it creates a steady current of water, which continuously circulates through the whole system. Regarding to the direction of an electric current relative to the positive

and negative labels attached to the terminals, the following quote shows that this is also a somewhat confusing issue in the electromagnetic theory.

"...When a battery is connected in an electric circuit, it sets the free electrons in motion in a definite direction. This stream of electrons, moving through the conductor is an electric current, but it should be carefully noted that its direction in the external circuit (conductor or pipe) is from *the negative to the positive terminal*. This is just the opposite direction from that in which convention has so long assumed.

"The source of the confusion is an old hypothesis, according to which the electric current flows from positive to negative. By the time of the electron theory was established, so much has already been written based on this idea, that scientist decided to leave the old convention as the direction of a hypothetical positive current. This fallacy is still in use. (Black, College Physics, [360]).

Evidently, in the water-current analogy, there is no such problem. With regards to the average pressure in the container the pump-end or source-end should be the positive and the sink-end should be the negative terminal.

While the pump works, there is a complete circulation of the water, from negative to positive through the *external circuit* (pipe), and from positive to negative in the *internal circuit* (within the space of the tank). From sink to source outside and from source to sink inside. – When very small pieces of wax are suspended in the whole body of water, they are carried by the current through the pipe from the negative to the positive terminal. Then the *source* disperses them into the tank, from where they are recollected by the *sink* at the negative terminal. This is equivalent to the direction of the *current of electrons* in electricity, which is, in this case, obviously equivalent with the current of the water. Note, that the only force acting here is the pump and the drifting of the wax particles or the circulation of the water are not produced or hindered by any action at a distance forces, like attraction and repulsion.

In order to simulate the cylindrical magnetic field produced by a current carrying conductor, the next step is to submerge this *water-battery* in a great container, also filled with water, which exerts an isotropic pressure on the system, *normal* to the surface at all points. *At this stage, the external and internal*

*media are completely separated by the solid walls of the battery-device.*

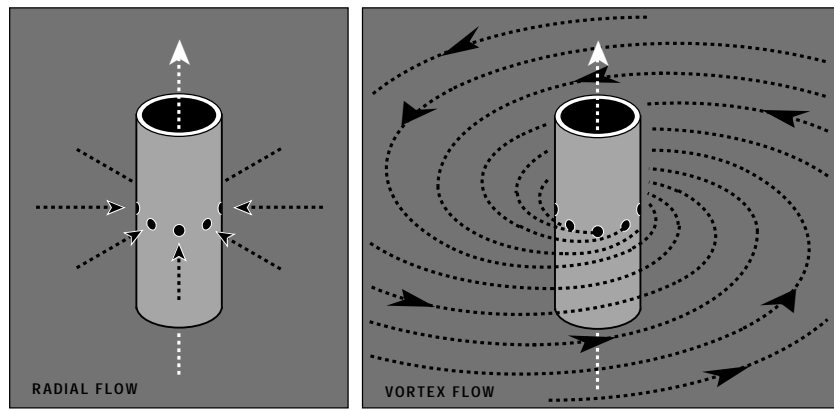
However, as we have found in the earlier simulation, in order to generate a continuous flow-field around and through the *fan magnet*, it was necessary to establish an isotropic communication between the internal and external medium. This was done by the perforation of the walls of the cylinder.

Before the introduction of the concept of the perforated pipe-conductor in the hydrodynamic battery simulation, a special character of a suction pipe should be discussed.

## THE CYLINDRICAL SINK-VORTEX

It is a common method to replace a suction-pump by a simple device inserted into a garden hose which has a hole on its wall transverse to the flow of water. As Figure 12-21 (a) shows, when the hose is submerged, and water flows through the device, it sucks in and carries away the neighboring external water.

This is again based on Bernoulli's theorem. The flowing water in the tube has a smaller static pressure than the external water, therefore, the latter pushes through the holes into the hose.



(a) Figure 12-21 (b)

Consequently, a perforated pipe submerged in water and itself carrying a flow will act as a multitude of sinks, which will initiate a radial flow toward the pipe around its whole length.

Recall now the kinematic conclusion from the gravity simulation, that a general radial flow to a sink *must trigger rotation*. As it is illustrated on (b), the same kinematic necessity will not only result in a sink-vortex around each individual hole, but an entire rotational system will develop perpendicular to the pipe; a *cylindrical sink-vortex*, surrounding the submerged pipe through its whole length.

Next, let us submerge this whole device into a great container, also filled with water, which exerts an isotropic pressure on the walls of the battery, *normal* to the surface at all points. At this stage, the pipe, representing the conductor, is isotropically perforated between the terminals.

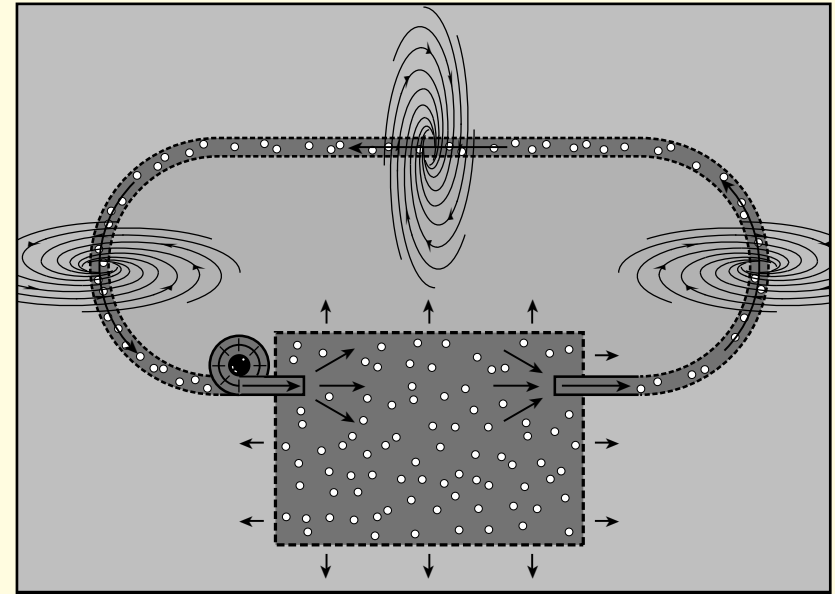


Figure 12-22

Based on the behavior of an ideal fluid, from the illustration of Figure 12-22 several plausible kinematic

matic effects can be contrived which are closely analogous to the concepts of electromagnetic phenomena.

(a) While the pump is idle, the pressure and the density is isotropic and the medium is motionless all through the outer and inner spaces of the device. However, once the pump starts working and drawing the water from the pipe into the container, the static pressure inside the pipe falls below the external isotropic pressure. Thus, the kinematic result is a *cylindrical spiral vortex* surrounding the perforated pipe-conductor between the terminals. Evidently this result is closely analogous to the phenomena called the Circular Magnetic Field.

(b) When a *fan-magnet*, described above, placed in the vicinity of the perforated pipe, it will line up tangentially to the vortex, and in a plane rectangular to the pipe. When the direction of the current is reversed, the device will rotate its *poles*, in the opposite direction, analogous to the behavior of a compass needle.

(c) The question now presents itself; What happens with the excess water, which is sucked in through the perforated pipe from the external medium and continuously pushed into the internal space

of the battery? Evidently, it cannot disappear through the sink and dispersed through the perforations of the pipe, because this would stop the circulation of the system. Nevertheless, as the illustration shows, the natural solution to this problem is to assume that the battery wall is not totally impenetrable either. Thus, through the perforation of these walls the excess water and the excess pressure can be dispersed omni-directionally and isotropically into the external medium without disturbing the general character of the circulation.

(d) Since the rotation of a sink vortex extends far into the surrounding space, it follows from the different directions of the rotation of the cylindrical vortex, that there will be a global flow of water through the whole ring, the direction of which will depend on the direction of the current in the pipe. This is again identical to the lines of force or the flux, or the induced magnetic field through and around a ring-shaped conductor, (Figure 12-7).

(e) It also follows, that when the current carrying perforated pipe is bent into a continuous coil, the external medium will be driven through the internal space of the so-called '*solenoid*' of the spiral pipe,



exactly as it is illustrated on Figure 12-19.

(f) A common analogy for the electric resistor is a local constriction of the flow of water by the installation of a narrower pipe into the circuit. According to the equation of continuity the local speed of flow of the fluid and the carried wax particles should increase in the narrow pipe and the resulting greater friction among them will actually generate heat.

(g) As for the attractive and repulsive magnetic forces between two freely suspended conductor, consider the following analogy in the ideal fluid.

A pair of operating perforated pipes are submerged and freely suspended in the water parallel to each other, and currents flow through them in the same direction. The combined effect of the two resulting vortices, spinning in the same direction, will drag the external medium all around in the same direction forming layers of circulating *envelopes* around them. As the kinematics of this drag has been described around the two magnets, these envelopes, in turn, move the pipes toward each other because of the isotropic pressure of the surrounding medium.

When the currents are flowing in opposite directions, the cylindrical vortices are spinning in opposite

directions. In this case, due to the increasing turbulence and the static pressure between them, the two pipes are pushed apart. Recall the flow-pattern marked by the iron filings in Figure 12-4 (a) and its reciprocal in (b), which represent the top view of two circular magnetic fields.

It can be seen from the above that all known electric and magnetic phenomena can be simulated in an *ideal gas or fluid*. It seems to be merely a matter of imaginative designing to simulate the effects of the whole of electromagnetism, including static electricity, electric and magnetic induction, and any other related phenomena.

## SINKS AND SOURCES

In the ideal gas of Aether the perforation of the water-pipes, as before, represents the gaps between the atoms in the crystalline structure of the metal conductor. The Aether-current, that replaces the flow of water is, of course, much more responsive and persistent, having no friction among its constituents. From the above analogies it is evident, that the stream lines in the Circular Magnetic Field are not closed circles centered on the conductor, as it is believed, but are spiral filaments of a cylindrical sink

vortex. This could probably be made visible by slow motion photography of the patterns of the iron filings while the glass plate is gently vibrated and moved perpendicularly up or down on the current carrying conductor.

The pieces of wax, carried by the water, can be taken as analogous to the free electrons, or donut-vortices, drifting with the Aether circulation between the negative and positive terminals.

In the water analogy, it is evident, that the motion of the wax particles have nothing to do with some mysterious action at a distance attraction by the positive terminal, or to the creation of the current or that of the cylindrical vortex around the pipe. Instead, the circulating water, is responsible for the acceleration of the wax particles in the pipe from the negative to the positive terminal and for the drifting through the internal space of the battery in the opposite direction. The same current through the perforations of the pipe sucks in the external medium and therefore it also originates the cylindrical vortex.

It follows, that in the AETHRO-KINEMATIC description of the electric current, *the action at a distance forces of attraction or repulsion* is not needed to

create the drift of electrons toward the positive terminal, consequently, there is no repulsion either against their internal drift back to the negative terminal. Similarly, the mysterious connection between the motion of the charges and the surrounding magnetic field is also explained away by the AETHRO-KINEMATICS of the cylindrical sink vortex.

Obviously, *the cause and effect is totally reversed*. The magnetic field is not produced by the moving charges, but the constant circulation of the Aether, which is also the carrier of the electrons through the circuit and the internal space of the battery.

There remains the fundamental question;

What is the original cause of the circulation of the Aether, or in the analogy, what is the initiating force, that circulates the Aether and replaces the pump of the water battery?

Recall that the initial cause for the gravitational sink-vortex has been found to be the evolution of matter. In other words, the decrease in the density and pressure of the Aether in the vicinity of the evolving matter is a result of the ongoing organization and reorganization of the medium into the more and more condensed electromagnetic force-fields,

particles, nucleons, atoms, molecules and crystalline structures. This evolution is assumed to be driven by the random kinetic energy of the Aether and dependent on the incidental local disturbances, which gain permanency in rotation and create fusions among the force-fields of the elementary constituents of matter. This procedure is a localized *condensation* of the Aether, producing the phenomenon, which has been called, *the sink of matter*.

In a miniature scale a similar procedure is initiated chemically in the electric battery. That is, in a given chemical procedure, matter is being organized and thereby the Aether is being rarified at the positive terminal, which therefore becomes a sink.

Seemingly, the molecular characteristics (permeability) of a metal conductor provides the fastest route toward achieving equilibrium. Very likely, in the rigid crystalline structure, the parallel positioning of the atoms of a good conductor leaves continuous open channels for the Aether flow, unlike non-conductors or dielectrics, where either the unparallel structure, or the random motion of the atoms, more or less blocks the free flow of the Aether. This difference in permeability could account for the preference

of pulling the Aether from the conductor rather than from the internal structure of the battery.

Similar to the magnetization of iron by an initial draft, once the circulation of the Aether has been established in the external and internal circuits, a small and steady re-creation of pressure difference between the terminals can perpetuate the circulation. The magnitude of the flow and with that the number of electrons carried and accelerated by the medium is proportional to the pressure, or the so-called electric potential difference between the terminals, and therefore proportional to the strength of the chemical procedure.

The same is the case of the Circular Magnetic Field, where the force, exerted on the compass needle is directly proportional to the magnitude of the current, and inversely proportional to the square of the distance from the conductor.

An intriguing thought occurs here.

It seems quite clear now, that the long lasting mechanical mystery of gravitation and electromagnetism has been originated and maintained by the same over-sights, happened three centuries apart; Newton's refutation of Descartes solar-vortex, and the

electromagnetic theory of the circular magnetic field, both has been based on the mechanics and mathematics of the 'wrong' circular vortex instead of the concepts, mechanics and mathematics of the medium consuming spherical and cylindrical sink-vortex.

## THE RULE OF THUMB

Finally, the relation between the direction of the current and the direction of the rotation of the cylindrical sink vortex should be discussed.

The discoveries of Oersted and Ampere and the experiments of their followers established the fact that the direction of rotation of the Circular Magnetic Field is dependent on the direction of the current in the conductor. In this respect a most practical rule has been found; the '*rule of thumb*' or '*right hand rule*' which gives a pictorial description of this relationship.

When a conductor is grabbed by one's right hand and the extended right thumb points in the direction of the *conventional current*, the direction of rotation of the field will follow the curling of the fingers as it is illustrated in Figure 12-23.

Nevertheless, one who looks for the relation bet-

ween the *real electron current* and the direction of rotation, should reverse both rules and end up with a left-hand rule, exactly the opposite of the illustration. The origin of this rule is strictly empirical and neither classical nor modern theoretical physics made any attempt to reason with the phenomenon.

Recall that we have met this very same problem in a higher order of magnitude, discussing the kinematic necessity of rotation around a gravitational sink. Obviously the head-on collision of the initial

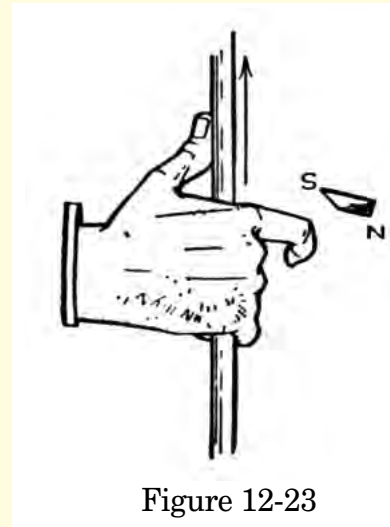


Figure 12-23

radial momentum must transform into angular momentum, and the question was, what is the determining factor for the direction of rotation of the resulting sink-vortex.

Recalling the Coriolis effect and the role of the differential rotation of the surface of the Earth in determining the direction of cyclonic vortices or the

differential rotation of the galaxy as a factor of the

rotational direction of gravitational vortices, it seems, that the all-pervading Aether itself has a differential rotation, which preconditions space at any point of the Universe for the *rule of thumb*. At least, this seems to be the case in our local order of magnitude of the observable universe.

Consider, in this respect, the common nature of the galaxy, the Cyclone, the kitchen sink and the direction of the spiral in the growth of human hair. The right or left handedness, conventional or real, seems to be a general character of the Universe.

Nevertheless, as we can notice in the kitchen sink and in the special events of galactic disasters, or in the man made confusion created in the particle accelerators, there are exceptions even to this general rule. For at some exclusive times and places, in uncommon circumstances, the universal Aetherial preconditioning of handedness can be locally overpowered and a rotation can be triggered in the '*wrong*' direction.

In particle physics this phenomenon is called matter and antimatter, particle and antiparticle, proton and antiproton, all of which, of course, due to

their oppositely rotating vortices, annihilate one another on contact.

It is maybe needless to emphasize the awareness of the greatly simplified nature of the above described analogical simulation.

Nonetheless, a distinction should be pointed out between the concepts of perplexity and complexity. It is assumed here, that AETHRO-KINEMATICS is indeed able to dissolve the old perplexities of the action at a distance forces of both classical and modern theories, but the same time it opens up the problems of the immense kinematical complexity of Nature's mechanism.

## **CHAPTER THIRTEEN**

### **KINEMATICS AND THE LORENTZ TRANSFORMATION**

#### **THE NULL RESULT**

As it was originally suggested by Clerk Maxwell, the theory of the Michelson-Morley experiment was founded on four fundamental assumptions:

1) It was assumed that all space is filled with the super-mundane, isotropic medium of Aether, which is eternally motionless.

2) From Huygens to Lorentz, through three centuries, a basic assumption has evolved that light is

propagated in the form of waves through the Aether with a velocity of 300,000 km/sec relative to the isotropy of the motionless medium.

3) The observational facts of astronomy, interpreted through the scheme of Copernicus, and Newton's Celestial mechanics lead to the assumption that the Earth revolves around the Sun with approximately a 30 km/sec orbital velocity.

4) It was assumed, that the Galilean Transformation, or the Law of the Addition of Velocities is universally valid for all relative motions.

From the Galilean Transformation and the other three fundamental assumptions, scientists concluded, that since the Earth is in motion relative to the motionless Aether, the velocity of light-waves measured in different directions on Earth should reveal its orbital velocity.

"This situation has been picturesquely described in terms of an '*Aether Wind*' (30 km/s) blowing through the earthly laboratory, giving resultant light velocities between a minimum of  $C-V$  and a maximum of  $C+V$ ,  $V$  being the velocity of the wind." (Centenary volume, Silvio Bergia [73])

If all assumptions are right, according to the theory of the Michelson experiment, the measured velocity of light should be  $300,000-30 = 299,970$  km/sec in the first case, and  $300,000+30 = 300,030$  km/sec in the second case.

Starting with Michelson's first experiment, performed in 1881, several similar experiments were designed by him and others to prove the Earth's motion relative to the motionless Aether by measuring the speed of light in different directions and different times during the Earth's yearly revolution.

Various other electromagnetic phenomena were similarly measured with devices much more sensitive than needed to find the small difference. But for four decades of experimentation without exception, each produced an undeniable '*null result*'. These experimental facts clearly manifest that at least one of the fundamental assumptions of the theory of the Michelson experiments must be wrong.

But which one?

The abandonment of the Aether alone would not solve the problem of the null results, because, even if light was propagated in empty space, its finite speed

should still show a difference in the measurements of moving observers.

The Earth's motion cannot be given up without the collapse of the whole Celestial Mechanics and modern astronomy.

Interestingly, discarding the wave theory for a corpuscular theory of light would have solved this problem of the null result, but scientist rejected the idea because it would cancel the scientific understanding of most of Optics and that of various electromagnetic phenomena.

To escape the dilemma without discarding any fundamental principles, George Francis Fitzgerald proposed in 1882, that the fourth basic assumption, Galileo's addition of velocities is the one that does not work in the special case of the speed of light.

According to this hypothesis, the expected difference cannot be found because all material bodies, including the measuring devices, *are contracting in the direction of motion relative to the Aether*. In order to agree with the null result, this effect should be proportional to the ratio between the velocity of light and the velocity of the moving observer.

Thus, based on the mathematics of the Michelson experiment, Fitzgerald concluded that, if the velocity of the Earth is  $V$ , and the velocity of light is  $c$ , and the factor of the *undetectable difference* is represented by the Greek letter *Beta*,  $\beta$  then :

$$\beta = 1 / \sqrt{1 - V^2 / c^2} \quad (13.1).$$

For explaining the Michelson null result by his contraction theory, FitzGerald recommends that the length of the moving measuring devices must contract according to the above ratio.

Hendrik A. Lorentz, one of the great followers of Maxwell and the author of the first consistent electron theory of electricity, proposed a scientific explanation for Fitzgerald's *ad hoc* hypothesis. Based on the electromagnetic construction of matter, this theory lead to the same mathematical conclusion:

$$L = \frac{1}{\sqrt{1 - V^2 / c^2}} \quad \text{or} \quad L = \frac{L_0}{\sqrt{1 - V^2 / c^2}} \quad (13.2),$$

where  $L$  is the length of a body in motion and  $L_0$  is Lorentz's distinction for the *proper length* of the body at rest relative to the Aether.

This is the reason why in the case of the velocity of light the Galilean Transformation does not work.

Our measuring devices are foreshortened in the direction of motion in the ratio that guarantees the *null result* in all cases. It has to be realized, that this suggested foreshortening is very minute. For instance, in the case of the earth's orbital velocity of 30 km/sec, its diameter of 28,000 miles would only contract 2.5 inches in the direction of motion.

"Lorentz went on to show that when the FitzGerald contraction is applied to subatomic particles, one could deduce that the mass of the body must increase with motion in just the same proportion as its length decreases. In short, if its *rest mass* is  $m_0$  and its mass while moving is  $m$  then :

$$m = \frac{m_0}{\sqrt{1 - V^2 / c^2}} \quad (13.3).$$

"The mass of such particles can be obtained by measuring their inertia, that is, the force required to impose a given acceleration upon them." (Asimov: Understanding Physics [99])



The issue was all the more important, because in the last decade of the nineteenth century, experiments with fast moving electrons already showed some unexpected increase in their resistance against acceleration. This could be interpreted as an increase in mass, which depends on Fitzgerald's contraction ratio between the velocity of light and the velocity of the particle relative to the Aether. The experimental results showed that the mass-increase, or the excess force needed to accelerate the particles agreed with the predictions of the Lorentz Transformation.

These phenomena opened up new possibilities :

"If the gain in mass of a speeding particle is the result of its motion relative to the Aether, then a new method of measuring '*Absolute Motion*' might offer itself. Suppose some particles measured as they sped along in one direction, others as they sped in another direction, and so on. If all directions are taken into account, some particles are bound to be moving with the *Aether Wind* while others are moving against it. Those moving against the Aether will have a more rapid motion relative to the Aether than will those moving with it. By the changes in gain of mass in different directions, the Absolute Motion of the Earth

can be determined." (Isaac Asimov, *Understanding Physics* [101])

This seemed to be a winning proposition, since, contrary to the undetectable foreshortening and time-dilation, the mass increase is certainly measurable by the magnitude of the excess force required for the same acceleration on a higher speed. Nevertheless, this idea also failed, like all the preceding ones. The gain in mass proved to be the same in all directions and the experiment ended with another null result.

About the same time, a new experiment was conducted by Kennedy and Thorndyke, which was specifically designed to exclude the effects of contraction in the measurements. Like all others, this experiment also produced a null result, thus totally refuting the Lorentz-Fitzgerald contraction hypothesis.

With all these failures to prove the Earth's motion relative to the Aether, in spite of its successful mathematics, the Lorentz-Fitzgerald theory, based on the Aether and the electromagnetic construction of matter, collapsed. The scientific society was stunned, frustrated and well prepared to admit that there is no imaginable solution to this riddle.

Indeed, in the famous article, published in 1905, Einstein declared the whole problem physically insoluble by *postulating* the pure and unarguable conclusions and consequences of the Michelson null results:

*The velocity of light is always measured the same regardless of the motion of the observer or that of the source.*

Using the *Constant Speed of Light* as the ultimate transmission signal, both the concepts of length and time become relative and with that, simultaneity also turned out to be dependent on the subjective measurements of the moving observers. It also follows from the postulates of relativity, that the hypothesis of an all-pervading Aether is useless and needless, and that it is physically impossible to detect *Absolute Motion*.

The relativistic conclusion was that the Lorentz Transformation is mathematically correct, but it is conceptually false. The same mathematics can be derived from the basic philosophical postulates of relativity, which have nothing to do with any *physical* contraction, time-dilation and mass-increase, or the electromagnetic construction of matter. Nevertheless,

out of the respectable loyalty of the scientific community, the mathematics of relativity retained the name of its original author and still called: *The Lorentz Transformation*.

In the theory of AETHRO-KINEMATICS an important distinction must be made between the null results of all Michelson-type experiments and the latest ones concerned with the mass-increase of the speeding sub-atomic particles.

On the one hand, the goal of all Michelson-type experiments were to prove the existence of a relative motion between the Earth and the Aether. However, as it follows from the theory of the solar sink-vortex of matter and Universal Rotational Gravitation, according to AETHRO-KINEMATICS *the planets are carried by the solar vortex and therefore no relative motion exists between the rotating Aether and the revolving Earth*.

Consequently, the Michelson-type experiments can show nothing but null results and since there is no relative motion, there is neither any *physical* reason for the Lorentz-FitzGerald theory of real contraction nor Einstein's illusorical contraction and time dilation. It follows, from the acceptance of Rotational

Gravitation that both the significance of the Michelson-Morley null results and the philosophical and epistemological conclusions based on those experiments and postulated by Einstein in the theory of special relativity are needless and useless from the standpoint of theoretical physics.

On the other hand, in the mass-increase experiments the particles are indeed speeding relative to the laboratory, therefore also moving relative to the locally motionless Aether. It is also important to point out, that these particles perform translational motion like bullets and are not propagated in the Aether like the waves of light or other electromagnetic disturbances. These experiments do produce positive results individual, by the measurements of definite quantities of '*mass-increase*'. This, in turn, proves that there is a real and measurable physical interaction between Aether and moving particles, and exactly in the proportion as the Lorentz Transformation formulae had predicted.

The fact that these mass-increases measure the same quantity in all directions, which has been considered to be another negative result, only proves again, that *there is no Aether-wind, but that indeed*

*the Earth and the earthly laboratories all carried along by the Aetherial vortex stream.*

Nevertheless, if the mass-increase is not *the illusion of the observers*, as it has been lumped together with the contraction and time-dilation in relativity, then it is a *real physical* phenomenon, which must have an explanation within this theory.

### MASS-INCREASE AND MACH-NUMBER

The following is a three centuries old foreword to this subject; Descartes words from his *Principia Philosophiae* (1644):

"...We think that the sky, as well as the sun and the fixed stars, is made from liquid matter. This view is now commonly accepted by all astronomers...But it seems to me that several are mistaken, for, instead of attributing to the sky the properties of liquid, they think of it as a completely empty void, not only offering no resistance to the movement of other bodies, but also having no power to move them and carry them with it. For apart of the fact, that such void in Nature is impossible, all liquids have this in common: *that the reason why they offer no resistance to the movements of other bodies is not that they consist*

*of less material substance, but they are equally or more disturbed, and that their small parts can easily be made to move in all directions; and in cases when they are caused to move all together in one direction, this means, they are forced to carry with them any bodies which they contain and surround all sides."*

Indeed, the elasticity and resistance not only depend on the density of the fluids, but also on the average speed of their constituents. The speed of sound in air is a direct consequence of the average speed of the randomly moving air molecules, which also determines *the speed of the dissipation* of the local pressure differences caused by a moving body.

This time, the AETHRO-KINEMATIC simulation of the phenomenon of mass-increase requires neither the great room of ideal gas, nor the innovation of thought-experiments. The kinematics of the 'mass-increase' has been already established theoretically, experimentally and mathematically in the field of Aerodynamics by the theory of the *Mach-number*.

"The *incompressible fluid theory* of classical hydrodynamics has proved useful for the estimation of aerodynamic parameters, and when applied to problems of low-speed flight has yielded sufficiently accu-

rate results. Newton's law of hydrodynamic resistance states, that the force opposing the steady motion of a solid body through a fluid medium is proportional to the square of the velocity of the body, its cross-sectional area, and the density of the fluid.

"It has been found, however, that the flow pattern about a body moving through air at high speeds is affected to a large degree by changes in density resulting from compression or expansion of the fluid. An understanding of compressible flows is, therefore, of the utmost importance to the designer of high speed aircraft. (The simplification of incompressibility is not allowable,)

"A consideration of the theory of elasticity as applied to fluids, indicates, that the effects of small pressure changes in a real fluid are transmitted throughout the fluid in the form of waves which travel at the speed of sound. It may be seen then, that the effects of a pressure change which occurs behind the critical point at which the speed of sound has been reached, cannot influence the flow field ahead of the point.

"Since at the critical point the forward motion of the pressure waves are completely arrested by an air

stream velocity equal to the velocity of wave propagation, a wave front is formed, that constitutes a sharp discontinuity in the flow, associated with large increases in pressure, density and temperature and a decrease in the velocity of the moving body.

*"The speed of sound is taken as a reference velocity, because it is a function of fluid elasticity. As applied to compressible flows, this means that the amount of pressure necessary to cause a given change in density in any given fluid is proportional to the speed of sound in the fluid."*

*"Since the pressure is proportional to the square of the velocity, the velocity which a body may attain before appreciable density changes occur, is also proportional to the velocity of sound in the fluid."*

"It is apparent, therefore, that the flow pattern about a body will be altered by density changes to a degree dependent upon the ratio of the velocity of the body to the velocity of the sound in the fluid. This ratio is known as the *Mach-number* and is taken as an index of the effects of compressibility on the flow pattern." (V. Nostrand, Scientific Encyclopedia [48])

If the velocity of sound is  $S$ , and the velocity of the body is  $V$ , then the Mach number,  $M = V/S$ . When

$V$  is very much smaller than  $S$  then the Mach-number is much smaller than one. Up to about  $M=0.3$  the fluid can be taken as incompressible and *Newton's law of hydrodynamic resistance is valid*. However, as the velocity of the body increases and gradually approaches the velocity of sound, the Mach-number approaches one and the medium suffers an *increasing incapability to dissipate the disturbances*.

As a result, the fluid becomes compressed in front of the body, which creates an increasing density and resistance against its motion. Consequently, to accelerate an airplane to a speed approaching the speed of sound requires a greater amount of force than it is predicted by Newton's hydrodynamic law of resistance based on incompressibility. Since the Newtonian resistance of the fluid is proportional to the square of the velocity of the body, the factor of the extra resistance,  $\beta$  can be expressed as

$$\beta = \frac{1}{\sqrt{1 - M^2}} \quad \text{i.e.,} \quad \frac{1}{\sqrt{1 - V^2 / S^2}} \quad (13.4).$$

Thus, depending on the ratio between the speed of a body and the speed of sound, Aerodynamics uses

two different theories to explain and calculate the resistance of the air against the motion of a body:

a) At low speeds, based on incompressibility, Newton's law is valid and the resistance of the fluid is proportional to the square of the velocity.

b) As the velocity increases and gradually approaches the speed of sound, the resistance increases beyond Newtonian proportion and the theory of the compressible flow, and the Mach-number must be applied. If the Newtonian resistance is  $R_o$  and the combined total resistance is  $R$ , then its magnitude can be expressed in the following equation:

$$R = \frac{R_o}{\sqrt{1 - V^2 / S^2}} \quad (13.5).$$

where  $R_o$  is the Newtonian resistance,  $V$  is the speed of the body and  $S$  is the speed of sound.

At the other side of the analogy, the situation is the same:

Depending on the ratio between the speed of a particle and the speed of light, there are two different theories to explain and calculate the magnitude of *inertial resistance* of a body against acceleration:

a) According to Newton's Second Law of motion,  $m_i = F / A$  the classical inertial mass is *constant* and it requires the same magnitude of force for each unit of acceleration regardless to the initial uniform velocity of the particle.

b) However, at higher velocities, approaching that of light, it has been found, that beyond Newton's law, there exist *an increase in the requirement of force needed to achieve the same unit of acceleration*. This should mean an increase in the inertial resistance of the body, which in turn, has been interpreted as a relativistic increase in its inertial mass.

If the total inertial resistance, is expressed by combining the Newtonian initial inertial mass,  $m_o$  and the relativistic mass-increase, due to high speed, represented by  $m$ , then the total magnitude of the *inertial mass* can be calculated by the equation of the Lorentz Transformation:

$$m = \frac{m_o}{\sqrt{1 - V^2 / c^2}} \quad (13.6),$$

where  $m_o$  is the classical inertial mass,  $V$  is the velocity of the body and  $c$  is the velocity of light.

This obvious equivalence of Equ.13,5 and 6, representing the two sides of the analogy, can hardly be a pure mathematical coincidence without some conceptual resemblance.

Since the fundamental assumption of AETHRO-KINEMATICS is, that all space is filled with the ideal gas of Aether, the Relativistic Transformation is accepted by this theory for what it was originally designed by Lorentz; a mathematical system to describe the effects of *real* motion of electromagnetic matter relative to the isotropic Aether, and vice versa. As such, *Lorentz's mass-increase is a physical phenomenon*, which requires and suggests a kinematically understandable explanation.

AETHRO-KINEMATICS describes inertia, force and acceleration as the different forms of the one-to-one, accumulative transmission of the drift velocities between the Aethrons of the isotopically random medium and those, which have been organized into electromagnetic matter.

It follows, that inertia is simply a time-consuming transmission of the directional kinetic energy from one part or form of the Aether to its other part

or form. Once the drifting of a body, or rather, the drifting of its *center of oscillation* has been created by a constant force, the motion of a body in the all-surrounding isotropic medium gives rise to the same kinematic action; a one-to-one transference of the directional kinetic energy of its drifting to the randomly moving individual particles of the medium.

In other words, the motion of electromagnetic matter produces a directional disturbance in the isotropic Aether, which is dissipated in all directions in the form of waves with the average speed of the Aethrons, e,i., the speed of light. It is exactly the same procedure as it is in air and indexed by the Mach number of the speed of sound.

Once this part of the analogy is established, it is quite evident that instead of the inconceivable concept of mass-increase, the Lorentz Transformation must be interpreted the same as the Mach-number in Aerodynamics:

An mathematical description of the compression of the fluid, – in this case the Aether, – and its extreme density changes due to the motion of the particle when approaching the speed of dissipation of locally caused disturbances.

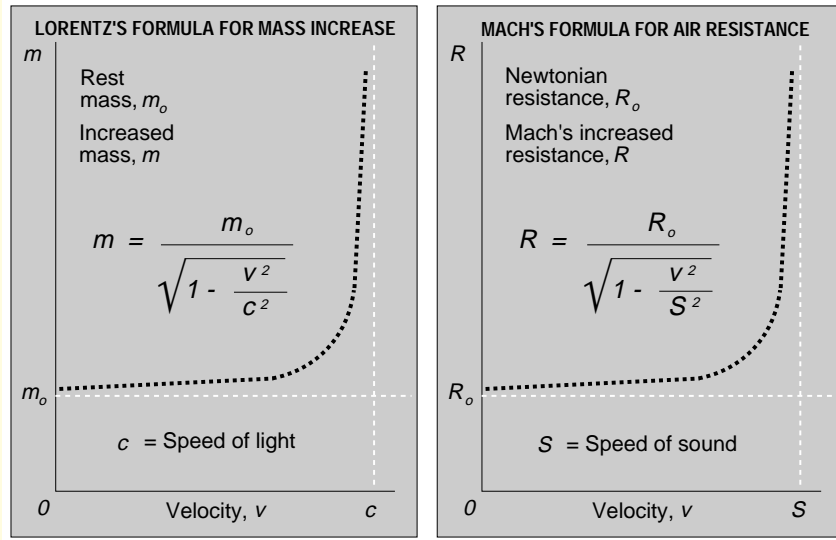


Figure 13-1

Evidently, the mathematical formula of both the Mach number and the Lorentz Transformation simply describe the ratio of the fluid-resistance, set by the reference velocity of sound in air and the reference velocity of light in the Aether.

This is then the point where the fundamental duality of theoretical physics and the incurable contradiction between the total void of Galilean and Newtonian space and the all-pervading motionless

Aether of the Maxwellian electromagnetic theory can be clarified and resolved.

The original goal of the theory of the Michelson experiment was to unify Newton's celestial mechanics with the electromagnetic wave theory of light, that is, to correlate the Galilean total void with the existence of the hypothetical medium of Descartes and Huygens; the luminiferous, all-pervading Aether.

Nevertheless, it finally becomes evident, that the fundamental duality between the two major departments of theoretical physics was originated by the two faulty assumptions.

It follows from all above, that neither *Galileo's eternal uniform motion in empty space* nor *Maxwell's eternally motionless Aether* have ever really existed.

On the contrary.

It is quite clear now, that, measurable or not, the resistance of fluids does not come into existence only when the speed of motion approaches the limiting speed of the dissipation of disturbances in the media. It is already there in the form of an isotropic pressure exerted on a body even at rest, and turns into a



directional density and pressure difference; *a retarding force, acting against all motions with any velocity greater than zero.*

Consequently, instead of Galileo's resistanceless eternal uniform motions in empty space, all displacements of material bodies relative to the ideal gas of Aether is opposed by a definite force of resistance, the magnitude of which is expressed by the *Electromagnetic Mach-number; the Lorentz Transformation.*

It is also quite evident, that Maxwell's electromagnetic Aether is not at all motionless, but exists in an all-pervading turbulence through the infinite chain of orders of magnitude, from micro-cosmos to super-cosmos.

Nevertheless, it can also be seen, that there is a sole exemption to this turbulence in our subjective human observation, finding Aether at rest when measuring the phenomena of electricity and magnetism and the speed of light in the frame of reference of our earthly laboratories which, of course, are rotating and orbiting together with the Earth around its axis and being carried about its yearly revolution about and within the turbulent vortex of the Sun.

This is the physical cause of the illusionary '*Null Result*', measuring the propagation speed of electromagnetic phenomena on Earth, which was discovered by Michelson, and misinterpreted by Einstein.

## DESCARTES ONCE MORE

Thus, both perplexing enigmas of the Newtonian inertial resistance of matter against acceleration and that of the mysterious relativistic mass-increase due to high velocities, can be described by the simple common-sensible, kinematical concepts of the Aether. How come then, that the natural fluid-resistance of the Aether remained hidden from science for so long?

The velocity of sound in air is 330 meter/sec, the velocity of light in the Aether is 300,000.000 m/sec. If light would follow the surface of the Earth, it would circle the globe more than seven times in a single second. Although Aether is some ten million times denser than air, the dissipation of disturbances in this medium is one million times faster than the same in air. It follows, that the effects of normal resistance and the extra retardation, due to the increasing density in front of the speeding body, are one million times smaller in Aether than in the air.

There are good reasons to assume that Newton's approximate law of hydrodynamic resistance is also valid for the motion of matter in Aether: The retarding force is proportional to the density of the medium, to the amount of matter (inertial mass), and to the square of its velocity. In addition, there is the infinitesimal addition, due to changing density in front of the body, at high speeds, expressed by the Lorentz Transformation.

One very important aspect of Descartes hypothesis is, that the Aether not only offers a resistance against the relative motion of material bodies, but by the same factor it is also capable of moving them.

The Lorentz Transformation serves as an index not only for the deceleration of the bodies moving faster than the local motion of Aether, but also for the acceleration of those, moving relatively slower. In both cases, the tendency of the effect in the medium is, just like that of the frictional forces of fluid dynamics; to reduce and eventually eliminate the existing relative motion.

In the earlier discussion about gravitation, this effect has been made responsible for the acceleration due to gravity. Thus, an inquiry is justifiable, if all

the kinematical ingredients would be available for calculating the local velocity of the inflow of the Earth's Rotational Gravitation.

Within the scope of this discussion it can be mentioned here, that an attempt to achieve this should start from the empirical quantitative knowledge of the acceleration due to gravity at a given point over the surface of the Earth. This will represent the radial (Newtonian) component of the fall of the body, while the velocity of the rotation of the surface of the Earth will represent the tangential (Keplerian) component of the fall.

Newton's hydrodynamic law of resistance and the Lorentz ratio for higher speeds can render the quantitative interaction between the flowing Aether medium and the accelerating matter, giving the required flow-velocity at that point. Once this has been achieved, a mathematical possibility can be seen for calculating the speed of the tangential and radial components of the spiraling Aether-flow at any point in a gravitational sink-vortex.

In connection with the same subject, it should also be mentioned, that Michelson's results were not exactly and always explicitly zero.

There were some experiments made for the period of a whole year, at opposite points of the orbit which showed some very minute but systematic deviations from the null result. As it was shown in the description of the gravitational vortex, at the crossings of the threads of the spiral current, on the elliptical orbit of a planet, there were occasional relative motions, inertial accelerations and decelerations of the planets, manipulated by the Aether.

It might just be the case, that through these two seemingly unrelated phenomena; the minute deviations from Michelson's Null Results may finally agree with Kepler's second law of planetary motion.

This is then the kinematic essence of Descartes' message from the past about the swiftly moving Aether particles and the existing but extremely small resistance of the liquid matter of the sky, which also creates the power to move and carry the heavenly bodies in the solar and planetary vortices.

As a memento, note here, that these ingenious ideas of Descartes were on the shelves of the library of discarded human thoughts for three centuries, untouched and unreviewed, because of their quite rudimentary refutation by Newton's authority.

## SPECIAL RELATIVITY REVISITED

Going somewhat further, however, there is a need for the clarification of some philosophical remnants, which belong to the same subject.

An AETHRO-KINEMATIC statement has been made that, since no relative motion exists between the Earth and the Aether in the sun's gravitational vortex, the Null Result of the Michelson experiments had nothing to do with the Lorentz-Fitzgerald Contraction. The same conclusion should be natural with respect to the relativistic slowing down of clocks.

The question now arises, however, whether or not, there exists a *real contraction* and time-dilation in the case of a *true relative motion* between matter and Aether?

Evidently, according to Lorentz original theory based on the Aetherial construction of electromagnetic matter, the answer should be positive in both cases. According to this theory, any elastic unit in nature, whether it is a solid piece of macroscopic matter like a billiard ball, or a soap-bubble, a living cell, a crystal, or an elementary particle, when an external directional force exerted upon it, it must

undergo some distortion of its original undisturbed shape even before any translational displacement of the body occurs. Taking a simple analogy in air: the shape of a soap-bubble is perfectly spherical while the internal and external pressure of the air is equal and isotropic. The inside volume of the air is constant as long as the soap-film is intact and the bubble is in existence.

Consider now, that a directional force exerted on the bubble by a mild jet of air. Since there is a resistance of the medium in the opposite direction, the sphere must become distorted between the two opposite forces and take the shape of an ellipsoid of some eccentricity. As long as the soap-film is intact the internal volume of the bubble remains constant. This means, that the contraction of the sphere in the direction of motion must be accompanied by a proportional *expansion in the direction transverse to the direction of the motion*.

If the force is constant, this procedure should be continuous while the bubble gradually accelerates. In extreme cases, when the external force is too great or too sudden and overpowers the cohesive strength of the soap-film, the bubble bursts and dissipates.

This example can be extended into a rod made up of a row of soap-bubbles, or a conglomerate of bubbles forming a three dimensional foam object, and the basic kinematics remains the same. The accelerating body retains the original volume of air within, but it is constantly forced into a state of contraction in one direction and that of expansion in the other.

Although this phenomenon proceeds in the air and the air resistance is expressed by the Mach-index, it is evident that the permanency of the bubble or rod or foam only depends on the cohesive strength of the soap-film and its burst and dissipation will happen independently from the velocity of sound and most likely long before reaching that velocity.

From all the above, it is justified to assume, that the constituents of electromagnetic matter would behave similarly, when being at rest or in motion relative to the isotropy of the Aether. The kinetic and dynamic pressure is in equilibrium in all the circular or spherical flow-patterns of the rotatory units when they are at rest relative to the Aether. But when a constant force compels them to accelerate against the resistance of the isotropic Aether, they must also

become distorted into some kind of ellipsoids with minor axis pointing in the direction of motion and the major axis pointing transversally to that, evidently proportional to the magnitude of the force.

The same is valid to the macroscopic conglomerates of such units. It can be seen from the analogy, that the volume of Aether organized into a material body does not change as long as the inert balance of the flow-patterns of electromagnetic forces are able to keep the body intact. Consequently, the contraction in one direction must be accompanied by a proportional expansion in the other.

Consider now these effects of contraction and expansion on the Michelson equipment, while it is in motion and measuring the speed of light in rectangular directions.

Einstein takes care of this ambiguity by convincing himself in his empty space with the thought-experiment of moving yardsticks and paint brushes. From the stand point of common sense, however, the very least it should be agreed here, that the phenomenon is somewhat more complicated than it appears in its relativistic description.

The same applies to the conclusion that matter should shrink to nothing, when it reaches the velocity of light. It follows from above, that the kinematic stability of matter depends only on the strength of the permanency of the delicate flow-patterns of the elementary units, and those of the electromagnetic cohesive forces, which keep the units together.

A particle or a chunk of matter will burst very likely long before it reaches the limiting velocity of light. Thus again, simply note, that the final dissipation of matter is in a much more complex relation to the speed of light than it is suggested in the fundamental postulates of relativity.

It should be also emphasized here, that the measured velocities of the particles driven by electromagnetic accelerators are not authentic to evaluate the effects of distortion of the particles in relative motion, since in the particle accelerators the Aether itself is being accelerated by the magnetic fields and the particle, just like a soap-bubble in the wind, is carried imbedded, with the streaming medium.

Consequently, the difficulty here is not to accelerate a particle to the speed of light, but to accelerate

*the bulk drift of the Aether* to that velocity. The particle carried within the stream is not contracted, mass-increased or time-dilated by its speed, but only distorted by its inertial adjustment to the gradual acceleration of the Aether flow.

With regards to the philosophical postulate that no material body can move faster than *the limiting speed of light*, there is an agreeing kinematical reason for it. As it has been shown, the global acceleration or flow of the Aether is nothing else, but the drifting of the center of oscillation of the individual Aethrons. It follows, that to produce a global flow in the medium higher than the speed of light is simply impossible. Even if all transverse oscillation is dampened, the drift velocities of the individual Aethrons in a given direction cannot exceed their overall average random speed, which is also the very source, of the propagation velocity of electromagnetic waves.

For science-fiction interest the analogy can be extended by comparing the *Mach number and sound barrier* with the *Lorentz-Fitzgerald ratio and the light barrier*. As the first was thought wrongly to be unbreakable for a time, one may speculate about the potential of breaking the latter. Part of the answer

has been given by the average speed of the Aethrons as the limiting drift velocity of the center of oscillation of any material body in Nature.

The other part of the answer is, that the possibility of breaking the sound barrier was based on the inertia and momentum of jet propulsion. Neglecting the existence of Aether, in Newtonian mechanics this force, the momentum of mass, was supposed to create a thrust purely depending on *inertial properties of matter in the totally empty space*.

Nevertheless, as it was shown above, the complex kinematics of inertia is created through the interactions between Aether and matter and therefore the phenomenon cannot be isolated from the surrounding isotropic medium. Hence, breaking the sound barrier by the fictitious force of inertia is essentially leaning on the random but isotropic kinetic energy of the Aether and not on the complete void. It follows, that to break the light barrier, one would need some other form of energy to lean on, even more fundamental and powerful than that of the Aether.

With regards to the Special Theory of Relativity, the fundamental point here is, that if real motion relative to the Aether does cause real contraction and

mass increase, their proportionality to the speed of light cannot justify the relativistic postulates or the epistemological limitations.

On the contrary, all these phenomena are kinematically explainable and calculable as the results of interactions between Aether and electromagnetic matter. Once these phenomena are accepted to be real, they prove the explicitly opposite concepts. Any real effect of the motion of matter relative to the Aether is a proof of the existence of an *absolute frame of reference; the 'Aether-frame'*.

Although on the astronomical scale the turbulent motion of Aether itself is immensely complex, the local motion relative to this all-pervading fluid can still be taken as a superimposed '*Absolute motion*'. It directly follows from these, that in case of *true relative motion*, the constancy of the '*measured*' speed of light can be challenged by the detectable resistance of the medium, presently called, 'relativistic mass-increase'. The same is valid for the illusionary measurements of light-speed on the famous train of the Einsteinian thought-experiment, which therefore cannot support the refutation of the general concept of *simultaneity*.

With these, all major aspects of the Lorentz Transformation have been AETHRO-KINEMATIZED and the relativistic epistemology could be replaced by purely kinematical concepts, calculated by Lorentz's original mathematical transformation.

It follows, that the philosophical postulates of the *modern principles of relativity* and that of *the absolute constancy of the velocity of light*, and all conclusion drawn from the misinterpreted Michelson Null Results are rendered needless and superfluous.

## EXPERIMENTAL JUSTIFICATION

Based on all the above, and on a lengthy analytical discussion with my best physics friend, Dr. Bert McInnis, (theoretical physicist of Ottawa, Canada), we have arrived to the conclusion that a simple incontrovertible experiment can be designed with existing scientific equipment to discriminate between the contradictory predictions of Relativity and AETHRO-KINEMATICS and in case of a very plausible positive result the problem will be reopened and solved, Thus, the all-pervading ideal gas of the Aether medium will be irrevocably and permanently reinstated.

First some general clarifications:

From the foregoing it becomes obvious that the two relativistic postulates declaring *the constancy of the speed of light*, based on the Michelson null-result, and being *the limiting velocity of Nature*, based on the relativistic mass-increase experiments, - have no theoretical relation with one another.

On the one hand, Michelson's null-results have been rendered natural and expectable by the Aethro-kinematic gravitational theory of the aethereal sink-vortex which, by carrying the planets in its stream, assures no relative motion between the Earth and the light-conveying medium, which predicts exactly a null result of all Michelson-type experiments. (With some sophisticated mathematics, the same mechanism can render the argument of the *aberration of light* superfluous.)

Since there is no 'ether wind' in the laboratory, because, together with the whole Earth, it is carried quietly within the medium, the Michelson-Morley, and similar type experiments do not represent measurements relative to the motionless Aether.

On the other hand, the postulate of the absolute and limiting light-velocity based on the experimen-

tally established '*relativistic mass-increase*' refers to a *real* relative motion between the particle and the Aether. This phenomenon is explained by AETHRO-KINEMATICS as a result of the hydrodynamic resistance of the medium which is expressed calculably by the *electromagnetic Mach-formula*, called Lorentz Transformation.

Thus let us, for the time being, forget about Michelson's zero and also suspend, till the following chapters, the major arguments against the ideal gas model of the Aether, rendered by the allegedly necessary transverse nature of light, invented for the sole purpose of explaining the still perplexing phenomenon of polarization.

According to AETHRO-KINEMATICS all space, cosmic, macrocosmic, and microcosmic are pervaded by an ideal mechanical gas, of a supermundane order of magnitude. Its constituents, the Aethrons are the fundamental units of mass, motion, velocity and momentum, therefore not only can kinematically explain Newton's mysterious mathematical concepts of inertia, force and gravitation, but as an ideal mechanical medium, it also obeys the laws of Newtonian mechanics and hydrodynamics.



Thus, as it has been justified in details above, this theory suggests that in all particle-acceleration experiments the counter-intuitive and counter-Newtonian concept of mass increase should be replaced with the simple hydrodynamic concept of Aether-resistance, which by the mathematical formula of the Lorentz Transformation becomes totally analogous to air-resistance described by the identical mathematical Mach-formula of Aerodynamics.

So, following this line of thought in the discussion with Dr. McInnis, we've realized that there is a possible fundamental classical distinction between the predictions of Special Relativity and Aethro-kinematics and it concerns Galileo's Invariance Principle.

Relativity is still based on Galileo's empty, resistanceless space, just like Newton's mechanics, but Aethro-kinematics states, that Galileo's Principle is only approximately true, and only for macroscopic objects moving with macroscopic velocities. This hypothesis is clearly expressed in the Lorentz Transformation by the Lorentz-Fitzgerald ratio related to the speed of the object with the speed of light.

$$\beta = 1 / \sqrt{1 - V^2 / C^2} \quad (13.1).$$

Where  $\beta$  represents the ratio of the increase of the hydrodynamic resistance of Aether as the velocity of the object,  $V$  relative to the medium varies and  $c$  is the velocity of the speed of light, which also represents the dissipation velocity of local density disturbances due to the motion relative to the medium.

This same formula is also the template for the relativistic mass-increase,

$$m = \frac{m_0}{\sqrt{1 - V^2 / C^2}} \quad (13.3).$$

Experimentally speaking, the above formula simply states, that greater the speed of the particle, greater the force that is needed to produce a unit of further acceleration.

Einstein states that space is empty and the only possible explanation for the requirement of an excess force is that *the inertial mass of the particle must increase* as its speed approaches the speed of light.

Why in that particular ratio? - No one knows. Thus, it must be postulated as an axiom.

Aethro-kinematics suggests that space is filled with Aether which, like any other mechanical gas,

exerts a *resistant force* against the motion of any objects submerged in it. – Why in the above ratio? Everybody knows Mach's Theory about the limiting compressibility of the air, which produces an increasing magnitude of air-resistance related to the ratio between speed of the airplane to the speed of sound. Lorentz gave us the identical formula for an object moving in the Aether and the limiting compressibility of this medium, related to the speed of light.

$$R = \frac{R_o}{\sqrt{1 - V^2 / C^2}} \quad (13.3).$$

Where  $R_o$  the initial hydrodynamic resistance of the Aether at its regular isotropic density and  $R$  is the total, increased resistance, due to the increasing density of the Aether in front of the particle which is accumulating in the ratio between the speed of the particle and that of the dissipation of the excess density with the velocity of light.

The analogy with the Aerodynamic Mach-number is so perfect that if relativity would have been applied to the near to supersonic flights, we would be compelled to conclude that the extra trust for accel-

erating the plane is needed because the mass of the plane increases and even the passengers are getting heavier with the increasing speed. Or, which is even worse, we could find the reason for the requirement of higher trust by postulating that some observers are watching the plane and find it getting contracted and all clocks on the plane are slowing down.

In any case, this situation renders a crucial distinction between the predictions of Special Relativity and the predictions of AETHRO-KINEMATICS:

Thus, here we are raising the never-asked-question; what ever happens with the relativistically increased mass when a particle does not collide with anything, but continues to move uniformly forever in empty space with its latest accelerated velocity?

Is there now that much more mass existing permanently in the universe?

– But of course, this is no problem for relativity, since the mysterious mass-increase is merely an observational illusion.

Well, it is not an illusion of some relatively moving observers for AETHRO-KINEMATICS. It is a simple hydrodynamics calculation, based on New-

ton's third law of the action and reaction between the kinetic energies of the particle and the opposing resistance of the Aether, which is explicitly expressed by the above Lorentz formula.

In this picture Newton's mass never loses its constancy and conservation, it remains as constant as in classical physics. However, there is the physically real increase in the hydrodynamic resistance of the Aether which is in a strict mathematical proportion with the speed of the particle and the speed of dissipation of the disturbance in the medium.

Now, we ask the same question from AETHRO-KINEMATICS; what happens with the particle if it does not collide with anything but continues to move in the Aether with its last accelerated velocity?

Evidently, the relativistic particle would move till eternity with its last uniform speed carrying its increased mass forever. The Aethro-kinematic particle, however, due to the real resistance of the Aether would gradually decelerate in proportion to its ever decreasing speed, which can also be explicitly predicted by the Lorentz Transformation.

Therefore, a crucial and decisive experiment can be executed by existing equipment as follows:

Accelerate a compact group of electrons in a synchrotron type accelerator where the particles are kept revolving on a circular orbit of a fixed radius between the poles of a great magnet. Cyclic *RF* sources are located on the orbit providing increments of energy on each revolution. When the designed velocity is attained, the magnetic field is turned off at the right instant and the particles are extracted from the orbit into a straight, evacuated flight chamber which lead them to a target sight. Normally, at that location the collisions and the results can be observed and measured.

The aethro-kinematic suggestion only differs in the last phase of the experiment. Instead of having a target practice on the end of the straight channel, we recommend a time of linear flight measurement between the beginning and the end of the straight path. This simple experiment will unequivocally discriminate between the contradictory predictions of relativity and those of AETHRO-KINEMATICS and the same time irrevocably establish the existence of the all-pervading Aether.

Evidently, on the one hand, with the empty space of relativity and based on the Galilean Principle of

Inertia the accelerated particles simply preserve their lastly attained velocity and continue to move with this uniform velocity (and with their increased mass) regardless of the length of the linear flight.

On the other hand, also evidently, in the all-pervading Aether which produces a kinematical resistance force, in proportion to the ratio between the speed of the particle and the velocity of light, the particles must gradually decelerate in proportion to the length of the chamber.

Therefore, in the Equ.13.3 of the Lorentz Transformation, interpreted for the resistance of the ideal gas of Aether, gives an explicit prediction of a crucially different time of arrival for the decelerating particles depending on the length of the flight.

Since both the relativistic mass-increase and the Galilean uniform motion is supposedly eternal, the only Aethro-kinematical requirement is to make the linear chamber long enough to take care of the natural fuzziness in the time and length measurements, and for the quantitative revelation of the decelerating force of the kinematical resistance of the Aether.

As Dr. McInnis has remarked at the end of the discussion: – I believe, this experiment could give us

a perfectly decisive empirical result. It is a simple time of flight experiment. – How much more basic can you get to be able to discriminate between two contradictory theories?! – In my experience, time of flight experiments were always the simplest to comprehend. If such an experiment agreed with the predictions of Aethro-kinematics, it would represent the most incontrovertible proof of the existence of the Aether and the validity of its ideal gas model.

## **CHAPTER FOURTEEN**

### **THE AETHRO-KINEMATIC THEORY OF WAVE-MOTION**

The fundamental duality of physics initiated in the sixteenth century between Newton's absolute and empty space and Huygens' all-pervading luminiferous aether, finally culminated without possible synthesis at the turn of the twentieth century.

The weight of the tremendous success of the two major departments of physics, mechanics and electromagnetism ultimately and hopelessly clashed in the Null Result of the Michelson experiment. The

laws of both sectors were as valid as can be in experimental science, but the contradiction among them seemed to be just as unavoidably valid as the laws themselves.

Modeling an ether for the requirements of electromagnetic phenomena has been rendered impossible by the opposing laws of mechanics. Absolute and empty space, required by earthly and celestial mechanics was unthinkable for the nature of electric and magnetic phenomena.

Science took the only route that seemed conceptually possible at that stage: By Einstein's recommendation the stalemate and the lack of solution within the existing laws has been postulated and the contradiction, which had been incubating for over three centuries, finally gave birth to an epistemological compromise; the official acceptance of the *Dual Nature of Light*.

To undo the resulting conceptual labyrinth and return to a single language theory of light, some misconceptions in the classical mechanical and electromagnetic wave theories will be pointed out, and the same time an alternate choice of description, the Kinematic Theory of Wave-motion will be introduced.

The presently accepted explanation of some well known phenomena should be re-examined and the inadequacies of the classical theory and the description of an alternate kinematical solution should be presented together in the sequence of the development of the classical theories.

## THE EVOLUTION OF THE WAVE THEORY OF LIGHT

On contemporary college level, *the waves in elastic media*, is generally discussed in the following manner (freely quoted from D. Halliday, R. Resnick, Physics, [404]):

"Wave motion appears in almost every branch of physics. First of all we distinguish between mechanical and electromagnetic waves. The wave-motions of various ponderable matter, for which familiar examples are water-waves, waves on elastic strings and springs and sound-waves in gases, liquids and solids. Since Newton's laws are applicable to the waves in elastic, deformable matter, they are called mechanical waves. Light-waves, radio-waves, micro-waves and radiating heat, which are propagated in vacuum, or rather in empty space and therefore no ponder-

able matter is needed for their transmission, are electromagnetic waves.

"Mechanical waves originate in the displacement of some portion of an elastic, deformable medium from its normal position, causing it to oscillate about an equilibrium position. Because of the elastic properties of the medium, any local disturbance is transmitted from one layer to the next, and therefore propagates through the medium.

"Mechanical waves are characterized by the transport of energy through matter by the motion of a disturbance *without any corresponding bulk motion of the matter itself*. The properties of the medium, that determine the speed of a wave are its inertia and its elasticity. It is the elasticity that gives rise to the restoring force on any part of the medium displaced from its equilibrium position; it is the inertia that tells us how this displaced portion of the medium will respond to the action of the restoring force. We can distinguish different kinds of mechanical waves by considering how the motions of the particles of matter are related to the direction of propagation of the waves themselves. If the oscillation of the matter-particles, conveying the wave, is perpendicular to the

direction of propagation of the wave itself, we then have a *transverse wave*. For example, when a vertical spring stretched by a weight is set oscillating sideways at one end, transverse waves travel down the string; the disturbance moves along the string but each particle oscillates transversely to the direction of propagation of the waves." (See Figure 14-1-2)

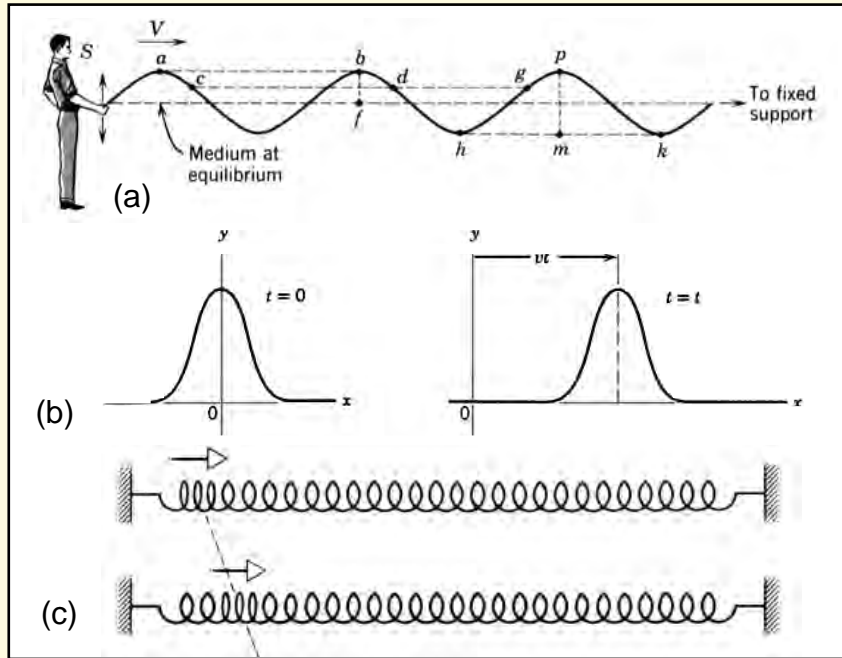


Figure 14-1.

"In a longitudinal wave, when a horizontally stretched coil-spring moves back and forth, on the axis of the spiral, the particles of the medium oscillate in the same direction in which the wave itself propagates (b). Sound waves in air are longitudinal compression waves. The disturbance in this case is a pressure change that propagates outward from the

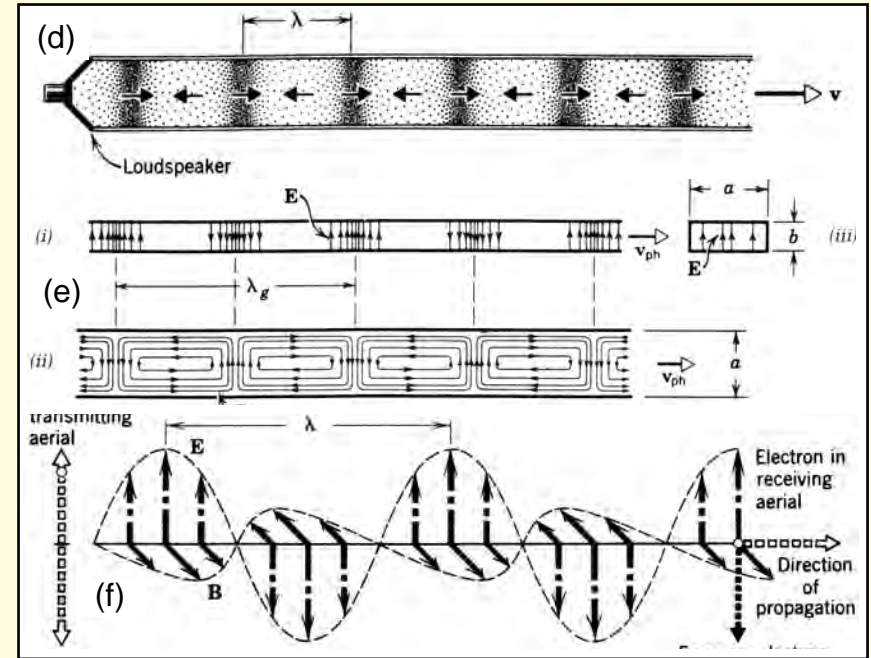


Figure 14-2.

source in spherical shells. The molecules of the medium move back and forth in the direction in which the waves themselves move (c).

"Some waves are neither purely longitudinal nor purely transverse. For example in waves on the surface of the ocean the particles of water move both up and down and back and forth, tracing out elliptical paths as the water waves pass by (d). Waves can also be classified as one, two, and three-dimensional waves. Waves moving along a string or a spring are one-dimensional. Surface waves or ripples on water, caused by dropping a pebble into a quiet pond, are two-dimensional. Sound waves and light waves which emanate radially from a small source are three-dimensional."

With this conceptual description comes a mathematical analysis of wave-motion using the *two-dimensional transverse waves on a string*, as the simplified general representation of all fundamental properties of wave-motion in an elastic medium.

Consider a long string stretched in the *x-direction* along which a transverse wave is traveling, Figure 14-1 (a). At some instant, say  $t=0$ , the shape of the string can be represented by

$$y = f(x) \quad t = 0 \quad (14.1),$$

where  $y$  is the transverse displacement of the string at the position  $x$ , and  $f$  is a function which describes the particular shape of the wave.

Illustration Figure 14-1 (b) shows a single waveform, or a pulse on the string at  $t=0$ . As time goes on, such a pulse travels along the string without changing its shape. At some time,  $t$  later the wave has travelled a distance  $vt$ , where  $v$  is the magnitude of the wave velocity. The equation of the curve at the time  $t$  is therefore

$$y = f(x - vt) \quad (14.2),$$

where  $y$  is the transverse displacement of the string at position  $x$ . This is the general equation for a wave of any shape traveling on a string. To describe a particular shape only the function,  $f$  has to be specified. The equation defines the actual shape of the string and how the transverse position of each point of the string changes with time.

By Hooke's law, a string provides a restoring force, which is proportional to the displacement of the string from its equilibrium position. The greater the displacement, the greater the force that tends to



restore the equilibrium. Thus, the resulting motion of each particle is equivalent to a *simple harmonic oscillation*.

The restoring force is also directly proportional to the tension on the string. When the end of a string is moved up and down repeatedly and the motion is periodic, it produces a *periodic train of waves*, (a) which are called *simple harmonic waves*. The particles of the string are in transverse simple harmonic oscillation and the form of the wave is sinusoidal, (c).

The maximum vertical displacement  $y$  is the amplitude of the sine curve, which itself is produced by the periodic repetition of the value of the transverse displacement. Each point on the curve represents a phase of the wave. The distance between two identical phases of the wave is the *wavelength*,  $\lambda$  of one wave.

The time required for a wave to travel a distance of one wavelength is called the *period*,  $T$ . The number of waves that travel through one point in space per second, is the *frequency*,  $\nu$  of the wave. The speed of propagation of the wave is its wavelength times its frequency;  $c = \lambda\nu$ . The same concepts and mathematical expressions hold for longitudinal compression

waves, in different media, like waves on a coil-spring (c), or sound-waves Figure 14-2 (d). The analogous longitudinal example for the transverse wave on a string is a long tube filled with gas. In this case the *pulse* is a single *pressure change or change of density* in a certain volume of the air, which travels in the tube along the  $x$  axis. The sound is produced by the oscillation of a loud-speaker which is attached to a long tube. The repetitious back and forth motion of the membrane produces a wave-train in which alternate compression and rarefaction layers are moving through the medium along the tube.

For compression waves, like sound, in a similar equation as Equ. (14.2),  $y$  gives either the back and forth (longitudinal) displacement of the particles or, by a different concept, the magnitude of the pressure variations in the medium as the wave progresses through the medium at a given point in the pipe.

Analogous to the waves of sound in a pipe it is possible to send electromagnetic waves through a hollow metal pipe with a rectangular cross section, called a *waveguide* (e). The quantity,  $y$  which meant particle displacement in the transverse waving of the string and pressure fluctuation in the longitudinal

waves of sound, in this case, it measures the amplitude of the electromagnetic vectors. Figure 14-2 (f) illustrates the transversally oscillating electric and magnetic vectors of radio waves.

## POLARIZATION AND WAVE THEORY

In the year 1669, a Dutch physicist, Erasmus Bartholinus, discovered that if a crystal of Iceland spar was placed on a picture, it produced a double image. For instance, when placed on a black dot, two dots were seen. Apparently, light passing through the crystal, split up into two rays that were refracted by different amounts. This phenomenon was named *double refraction*.

Both Huygens in his wave theory and Newton in his corpuscular theory considered the phenomenon, but neither of them could come to a clear conclusion.

Newton made some vague speculations to the effect that light corpuscles might have two different polarities like the 'poles' of a magnet, but did not get any further into the problem. More than a century later, in 1808, Etienne Louis Malus experimenting with Iceland spars, discovered that if light was reflected from a window at a certain angle, there was

no longer a double image through the iceland spar crystal. Based on Newton's concept of possible polarity, he decided that the window reflected only *one of the poles of the light*.

Thus, Malus called the reflected beam *polarized* and the effect, *polarization*. By experimentation it has been also found, that a thin tourmaline crystal, cut parallel to its optic axis, only transmits light which is polarized in a certain direction. If this light goes through a second crystal, the final intensity of light depends on the relative orientation of the two crystals. When their axes are parallel, considerable amount of light is transmitted, but when one of them is rotated, the intensity gradually decreases and when the optic axes reach right angles, the transmitted light is practically zero.

At that time and until the end of the nineteenth century, scientists believed that, analogous to sound waves in air, light is a longitudinal compression wave in the all-pervading luminiferous aether.

The discovery of double refraction and polarization brought up some serious questions for which there were no easy answers based on the compression wave theory of light.

Around 1820 Thomas Young, in his letter to Francois Arago, proposed an addition to the wave theory of light as follows:

"I have been reflecting on the possibility of giving an imperfect explanation of the affection of light which constitutes polarization, without departing from the genuine doctrine of undulations. It is a principle in this theory that all undulations are simply propagated through homogeneous mediums in concentric spherical surfaces like undulations of sound, consisting simply in the direct and retrograde motions of the particles in the direction of the radius with their concomitant condensations and rarefactions (that is, longitudinal waves). And yet, it is possible to explain in this theory a transverse vibration, propagated also in the direction of the radius, and with equal velocity, the motions of the particles being in a certain direction with respect to that radius, and this is a polarization."

Unfortunately, Young has never explained his idea in more details and his successors have chosen the simplest possible interpretation of this assumption, that light waves are analogous to the transverse waves on a string. In order to visualize the possible

mechanism of polarization, scientist created an analogy, based on the motion of transverse waves on a taut string. This simple *mechanical parallel* is illustrated on Figure 14-3.

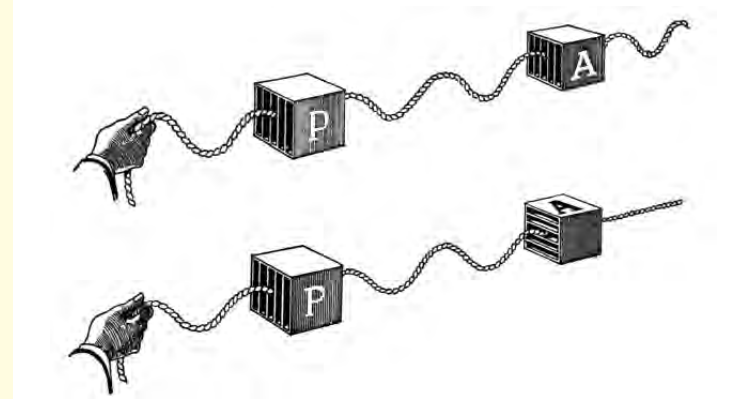


Figure 14-3

When a string is oscillating up and down, we may erect two grids with vertical slots without interfering with the transverse displacements of the string, (a). However, turning the second grid at right angles to the first, as illustrated in (b), the transverse waves cannot pass through it. The grids represent the two tourmaline crystals. *P* on the first grid stands for *polarizer*, and *A* on the second grid stands for *analyzer*, as they are called in the experimental polariscope.

From here on, in order to explain the phenomenon of polarization, theorist assumed that light and electromagnetic waves are *uniquely transverse oscillations*. But what could the mechanics of the waves on a string possibly mean in the case of the transverse oscillation of electric and magnetic fields?

According to modern theories, electric and magnetic fields induce one-another and alternately oscillate in transverse directions to the direction of the propagation of the waves themselves. In this case, in the analogous mathematical expression, taken from the waves on a string,  $y$  represents the amplitude of the transversally oscillating electric and magnetic vectors related to a given point on the  $x$ -axis.

"Common sources of visible light differ from radio and microwave sources in that the elementary radiators, that is, the atoms and molecules acts independently. The light propagated in a given direction consists of independent wave-trains whose transverse planes of vibration are randomly oriented about the direction of propagation. Such light is *unpolarized*.

Figure 14-4 "shows unpolarized light falling on a sheet of commercial polarizing material. There exist in the sheet a certain characteristic polarizing direc-

tion shown by the parallel lines. This direction is established during the manufacturing process by embedding certain long-chain molecules in a flexible plastic sheet and then stretching the sheet so, that the molecules aligned parallel to each other. The sheet will only transmit those wave train components whose electric vectors vibrate parallel to this direction and will absorb those that vibrate at right angles. The emerging light will be *plane-polarized*.

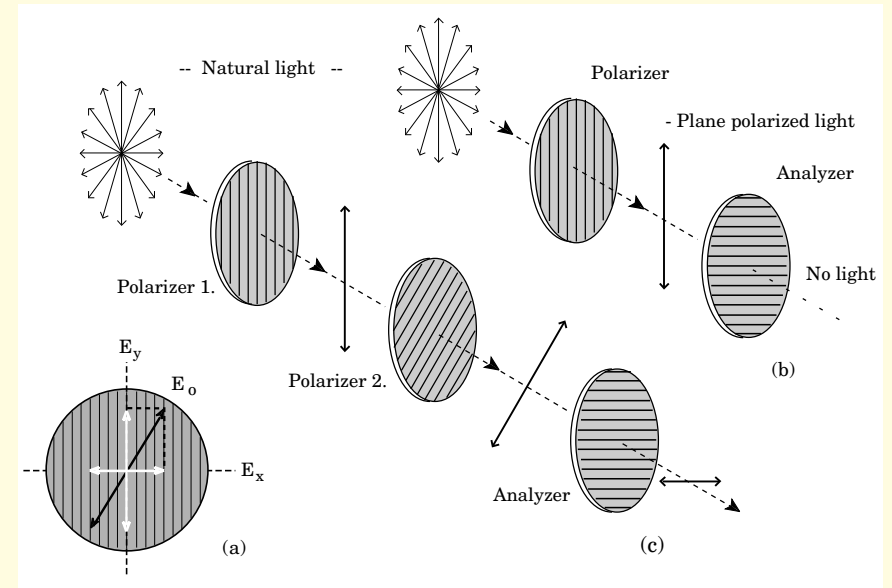


Figure 14-4

"Let us place a second polarizer sheet, called analyzer in place as shown. If it is rotated about the direction of propagation, there are two positions 180 degree apart, at which the transmitted light intensity is almost zero. These are the positions when the polarizing directions of the two sheets are at right angles. Longitudinal waves could not possibly show such effects." (D. Halliday, Resnick, Physics. [1072])

The illustration above shows the basic idea of the present theory: (a) illustrates that an electric vector,  $E_o$ , in any oblique direction can be resolved into two components related to the rectangular coordinates as  $E_x$  and  $E_y$ .

Part (b) shows, that when the Polarizer and the Analyzer set in a rectangular angle with their transmitting axes, no light can be detected beyond the analyzer. Part (c), however, shows, that when Polarizer 2. is inserted in between, and in an oblique angle, some light reappears again.

To clarify and explain this last experimental fact, a more popular style description has been presented in the 1990 video-tape edition of the college course: The Annenberg / CPB project: 'The Mechanical Universe and Beyond'.

Dr. Robert L. Goodstein professor first explains polarization similarly as above, in the language of the classical electromagnetic wave theory. He then demonstrates that when the analyzer is at  $45^\circ$  angle with the polarizer, the light intensity decreases by approximately 50%. According to Dr. Goodstein, this result is not entirely obvious if it was assumed that the first plate let exclusively the vertically oscillating light through, or if the light emerges is *uniquely plain polarized*. But then explains, that each vertically oscillating vector has some oblique components, which could still pass when the analyzer is in the oblique angle.

"This is very easy to understand" - he says, - "so long as we believe that light is a wave, but remember that light is also a particle and there must be a particle explanation of how this occurs as well. So let me tell you how that works. The problem here is, that I can't say that part of the light gets through the second filter when it is oblique, because a particle either gets through or it doesn't get through. So, here is the way it works.

"The light particles, or photons, come along to the first filter, which says: Listen guys, every one of you

is either polarized up and down or sideways. *Nothing else is permitted.* But you are polarized up and down or sideways with *some probability*; half of you are up and down and half of you are sideways. Then the light gets through the first filter, the one that is up and down, and all the sideways photons got stopped."

"Now, between the two filter, there are only photons that are polarized up and down. The second filter, as long as it is in the sideways direction, says: You guys are all up and down, and I only permit sideways photons through, so nothing gets through. If the second filter is up and down, it says; You guys are all up and down and I let up and down photons through. So they all get through and you can see the light on the screen.

"The tricky part happens when the second filter is turned left in the oblique ( $45^\circ$ ) direction, because then it says: listen guys, you thought that you are all up and down, but it is not true. Everybody has got to be oblique either to the left or oblique to the right ( $315^\circ$ ) with some probability and you thought that you are up and down only because half of you are oblique to the left and half of you are oblique to the right and now the filter lets through the ones that

are polarized oblique left direction. *And that is the particle explanation of polarization.*"

"Now, I would like to do one more experiment for you. I will turn the analyzer in the sideways direction, so nothing gets through. Then I set a third polaroid in the oblique left direction and insert it between the other two. What will happen now is the following: only up and down photons get through the first filter, they get to the oblique one in the middle and he says, no, you are not up and down, but you have a fifty percent probability of being oblique to the left and getting through, and fifty percent probability of being oblique to the right and not getting through.

"So, the ones oblique to the left get through and then they get to the last filter, which is set sideways. It says: you guys all thought that your are polarized oblique to the left, but you are not. Each one of you has a fifty percent probability to be horizontal and getting through and each one has a fifty percent probability of being vertical and not getting through. So, the horizontal ones gets through, and that means that the beam of light will reappear on the screen. And there it is.

"And this is the essence of how the new physics works!"

There could be some objection about quoting this simplistically popular lecture. However, although the mathematics get more complex, the conceptual content even at the highest theoretical level offers nothing better in explanatory value.

On the contrary.

For example, George Gamov, inventor of the famous *Big Bang Theory* has a more sophisticated view of the wave-particle duality of electromagnetic radiation. (Matter, Earth, Sky. [173])

"Instead of considering electric and magnetic fields as stresses in a certain universal substratum, we now ascribe to them a definite physical reality, in fact, about as much reality as we ascribe to ordinary material bodies. Probably the most important innovation brought by Einstein to our views concerning electromagnetic and optical phenomena is that we must ascribe a certain mass to electromagnetic energy as well as to any other form of energy (176). (...) Thus, the field around an electrically charged conductor or a magnet should be considered as a jelly-like material surrounding them in the form of a local

cloud rather than as local deformations in a jelly like medium which fills up all space (120). Similarly, while classical physics considered light waves as propagation of elastic deformations through the 'world ether' filling the entire space, we consider them now as vibrations taking place within the lumps of a certain physical entity, (i.e., electromagnetic field), flying freely through the empty space." (176)

Figure 14-5 is Gamov's original illustration and his explanation of this most modern concept of light waves.

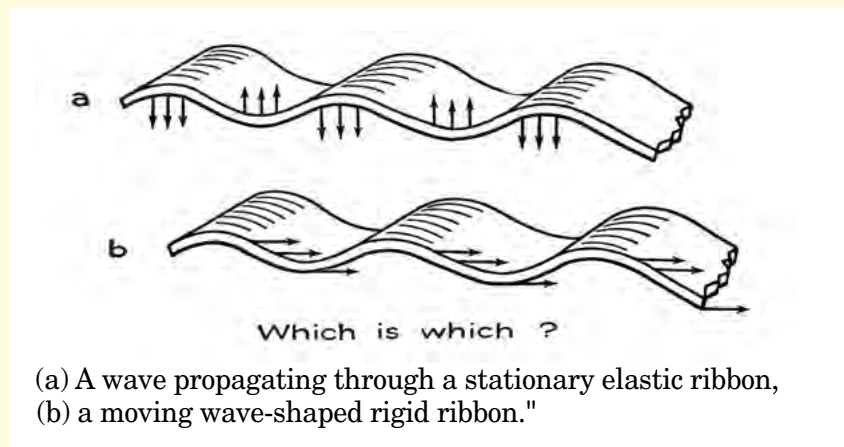


Figure 14-5

"In other words, the propagation of an electromagnetic wave is more similar to the wave-like motion of a snake crawling through the grass and carrying along its body as well as its form than it is to the waves on the surface of water, where only the form of motion but not the material itself is moving forward."

This is then the latest phase of the conceptual and mathematical evolution of the transverse nature of light-waves. Evidently, a painstaking effort, to explain the phenomenon of polarization by a visually comparable crude analogy of the waves on a string.

Nevertheless, this simple method turned out to be very costly in the evolution of science. The pioneers of the field concept, Faraday, Maxwell, Lorentz and others, until the turn of the century, thought of electrical and magnetic fields as real physical quantities, and manifestations of the stresses and strains in the all pervading electromagnetic aether. Unfortunately, the construction of a mechanically feasible model of this medium was never achieved because of the unavoidable stumbling block of the theory of polarization. The explanation, based on the waves- on a string, required the *uniquely transverse*

*nature* of the waves of light, which, in turn, called for an extremely dense solid medium with immense restoring forces capable of transmitting the great frequencies and extreme speed of light-waves.

As a result, the turn of the century brought an amazing revolution with a complete metamorphosis of the theories of light, electricity and magnetism. The transversally oscillating waves of light excluded all possibilities of designing a transmitting medium based on the principles of physics, and became a transversally waving emptiness, or in another dialect; a jelly-like cloud of alternating electric and magnetic fields, or still another language; a frozen snake, or a rigid, ribbon-like arrow, whizzing through the void with an absolute speed relative to all moving observers.

It should be a real challenge to visualize what would really happen to this creature when it meets the polarizer and analyzer and the one in between ?! Attempting this task, one may justifiably arrive to the modest conclusion, that the description of polarization, in spite of the acceptance of various languages of modern physics, is still not sufficiently complete for that task.



This is the exact point that AETHRO-KINEMATICS intends to emphasize. The explanation of polarization, based on the transverse nature of light is not unambiguous enough to justify the impossible conditions it forces on the model of a light transmitting medium, and by that on all departments of physics.

In other words, because of the above explanation of polarization, and only because of that, Aether was required to be an extremely dense solid with restoring forces beyond that of steel. Consequently it has been discarded as an absurd abstraction.

## ABOUT MECHANICAL TRANSVERSE WAVES

Let us now attempt a new view of things, take a couple of steps back into classical physics, and reconsider Young's '*imperfect*' proposition of the transverse nature of light-waves, as seriously, as he probably meant it:

*'...without departing from the genuine doctrine of undulation, it is possible to explain this theory of transverse vibration, propagated also in the direction of the radius and with equal velocity'.*

Obviously, Young merely proposed an *addition* to the longitudinal oscillation, and not a *uniquely transverse* one. It should be a component of the sound-like

compression waves in the same isotropic, gaseous aether, on which he had originally founded his undulatory theory. Nevertheless, it seems quite plausible that there were no serious attempts to correlate the theory of longitudinal waves with their potential transverse components.

Let us now attempt a closer analysis on the mechanics of the examples of *uniquely transverse* wave-motions on which the transverse nature of electromagnetic waves were founded.

"Water waves are very unsuitable for a detailed discussion because they are more complicated than other waves. We shall discuss instead the case of a transverse wave on a long spring, which is more closely analogous to the electromagnetic waves that will eventually be our main interest.

"Imagine a long horizontal spring with one end attached to the wall, the other end held in the hand and pulled taut. By moving the hand up and down rapidly two or three times, a wave can be made to travel in horizontal direction along the spring.

Meanwhile each point of the spring oscillates up and down in a vertical direction. Their motion is simple harmonic. (Figure 14-6)

"A wave is called *transverse wave* if the oscillatory motion of any part of the system is at right angles to the direction in which the wave is traveling. The shape of the spring at a fixed instant of time is a *sine wave function*." (Atkins, Physics, [397])

There are some obvious oversimplifications in the above description: A coil-spring is tempered to hold its form, which is usually a straight spiral of equidistant coils. This form of the spring represents its equilibrium state, and the external forces that tend to deform this shape meet an equal and opposite restoring force in order to re-establish the initial state of equilibrium. As it is shown on Figure 14-1 (c) the spring can be compressed or stretched longitudinally along its  $x$  axis by fixing one end and pushing or pulling the other in a plane parallel to the coils. In this case the spring can be taken as an homogeneous medium and the top and the bottom points of the coils can symbolically represent the displacement of the particles of the medium. The propagation of the analogous disturbances must evidently be restricted to *one dimension only*, along the  $x$  axis.

If the pushing and pulling is done periodically, longitudinal compression waves can be produced,

which travel along the original axis of the spring and transfer the energy of the initial force. In this case the compression and rarefaction pulses are represented by the changing distances between the coils. As the simplified view of modern text books defines, it is a *back and forth, longitudinal oscillation of the particles in the spring*. – From this definition it follows that the undisturbed initial state of the medium is explicitly the straight, unbent, unstretched and unsqueezed, one dimensional form of the coil-spring, into which the wire was *originally tempered*.

Consequently the propagation of any disturbance in this *homogeneous, isotropic medium* must always be *longitudinal in one dimension and parallel to the  $x$  axis of equilibrium of the spring*.

The classical definition states, that '*mechanical waves are characterized by the transport of energy through the propagation of a disturbance without any corresponding bulk motion of the medium itself*'.

Evidently, no forceful bending of the spring out of its initial one dimensional equilibrium can be taken as a normal disturbance, but it should be defined as the *bulk motion* of medium as a whole, including the *deformation of its axis of equilibrium*.

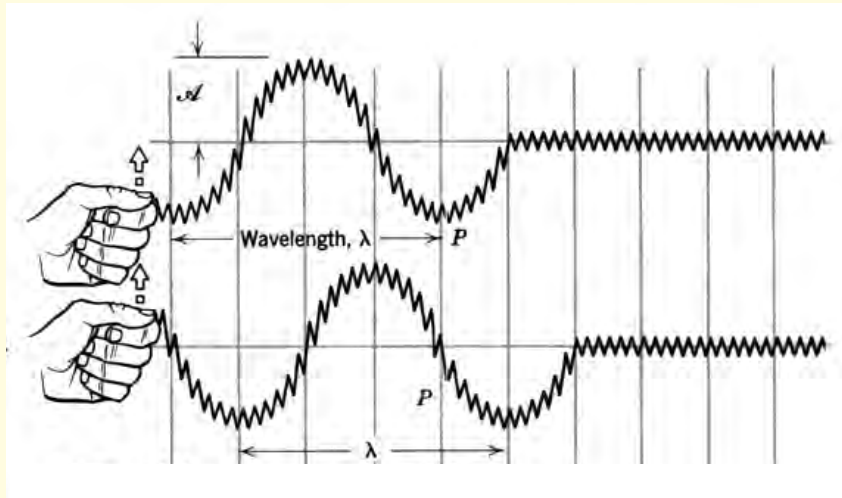


Figure 14-6

The above illustrated jerking of the spring is equivalent to produce transverse waves on a pond by shaking the entire water, like a blanket, instead of dropping a stone unto its surface.

Nevertheless, it is possible to produce wave-motions on a long spring by jerking it rectangular to its axis alternately and periodically. In such waves the symbolized particles of the spring oscillate transversely to the direction of propagation and with some stretching of the symbolism, the phenomenon can be called *transverse wave-motion*.

However, this classification is a total misinterpretation of the mechanical nature of the spring.

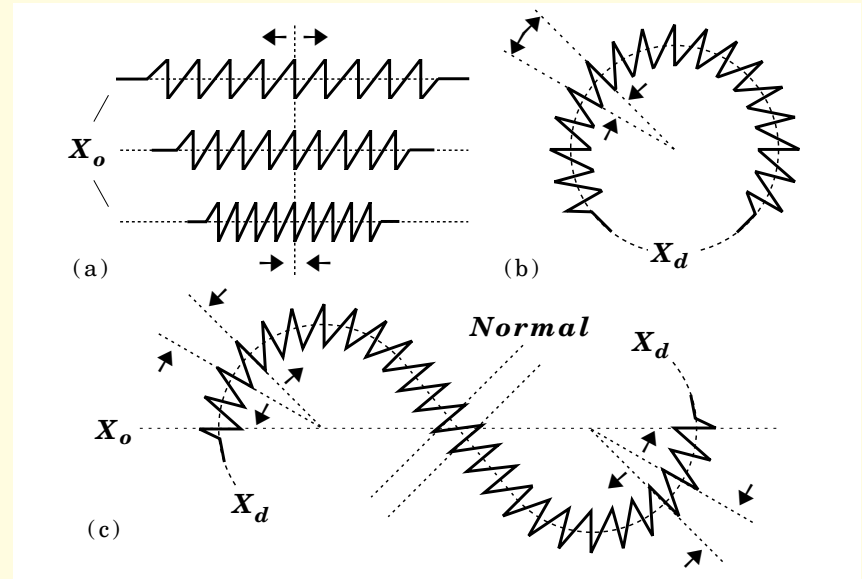


Figure 14-7

The best way to understand the true mechanics of this kind of deformation is to consider the relative positions of the coils in different situations. Figure 14-7 (a) illustrates the stretched, relaxed and condensed state of the spring. (b) shows the relative orientation of the coils when the spring is forced into a circle. It is evident that by bending the spring, we

have bent the whole one dimensional medium and its axis into two dimensions. The coils of the spring in the circle are forced into both compression and expansion at the same time; the internal parts of the coils are compressed, the external parts of the same coils are spaced apart.

Clearly, the restoring force acting toward the initial equilibrium is the tendency to re-establish the initial density of the whole medium; that is, restore the spring into its straight shape.

Evidently this force must act *longitudinally* along its distorted axis,  $X_d$  against both the internal condensation and external expansion of the coils in the circle.

With regards to the *transversal sine waves*, Figure 14-7 (c) illustrates a section of the wave on the spring. The sine curve can be taken as two opposite halves of a circle connected with a gradual transition between them. The mechanics of the deformation here is the same as in the case of the circle; It is an artificial distortion of the one dimensional medium, in which there are simultaneous longitudinal compressions and expansions of the coils at the opposite sides of the spring.

By the original symbolism, plotting the density of the *particles* at the top and bottom of the spring, it is found, that there are two sets of longitudinal compression and expansion waves existing at exactly in the opposite phases. The straight dotted lines, erected from the center of the circles, show the different densities of the internal and external part of the coils. In this case, the arrows show the directions of the restoring forces.

The top part of the sine wave starts with expansion, goes through a straight, normal density portion and ends up condensed. The bottom part starts with condensation and follows the same all the way with exactly opposite density changes.

The visual appearance of the phenomenon, the shape of the spring, on which the whole concept of the *transverse displacement wave* is based, is merely the effect of *the bulk distortion of the medium itself*, due to the artificially directed initial forces which jerk the spring and its axis out of its straight, one dimensional equilibrium. It is obvious, that both the density differences and the restoring forces act strictly longitudinally to reestablish the equilibrium of the distorted axis of the spring.

It is now easy to see, that the waves on a *taut string* demonstrates the same mechanics in its molecular construction. The same out-of-phase longitudinal compression wave-pair produce the macroscopic changes in the shape of the string. Hence, the restoring forces in the so called *transverse waves on a string*, merely act toward the initial longitudinal isotropic density of the molecules both inside and outside of the curves, which is inherent in the original straight shape of the string.

Therefore, the statement that the *particles of the medium* oscillate transversally to the direction of propagation, is a total misconception, based merely on a macroscopic optical illusion. The same conclusion is valid for all other types of transverse waves and vibrations in elastic media, including the waves on the surface of water.

As it is shown by Guy Murphie's ingenious illustration, (Music of the Spheres, [368]), the transverse waves on the water surface is merely a manifestation of the three dimensional longitudinal compression waves, as the compressed layers bulge into the isotropic atmospheric pressure of the air.

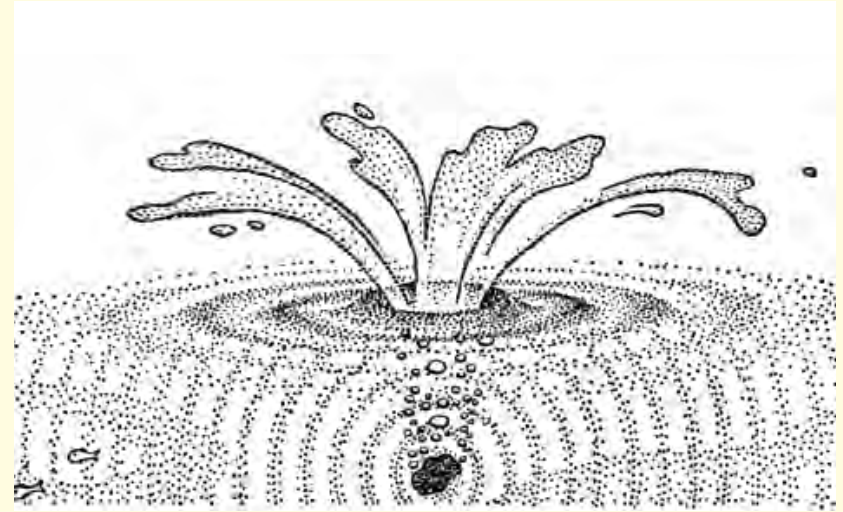


Figure 14-8

From the above, it can be concluded, that there is no mechanical wave motion, which can be described by the oscillation of the particles transverse to the propagation of the waves in an isotropic elastic fluid medium. Therefore the theory of transverse waves of any kind is also based on misconception.

## ABOUT LONGITUDINAL WAVES

Consider now the following description of the *uniquely longitudinal waves* of sound:

"Sound waves are longitudinal mechanical waves. The material particles transmitting such a wave oscillate in the direction of the wave itself. Sound, if unimpeded, spreads out in all directions from a source. It is simpler to deal with one-dimensional propagation, than three-dimensional propagation, so that we consider first the transmission of longitudinal waves in a tube.

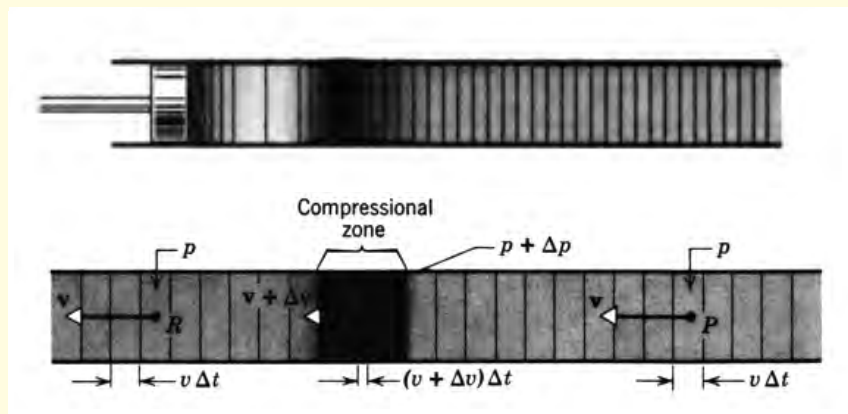


Figure 14-9

"Figure 14-9 (a) shows an oscillating piston at one end of a long tube filled with a compressible medium. The vertical lines divide the fluid medium into thin slices, each of which contains the same mass of fluid. Where the vertical lines are relatively close together

the fluid pressure and density is greater than they are in the normal undisturbed fluid, and conversely.

"We shall treat the fluid as a continuous medium and ignore for the time being that it is made up of molecules that are in continual random motion. If we push the piston forward, the fluid in front of it is compressed, which moves forward, compressing the fluid layers next to it, and a compression pulse travels down the tube. If we then withdraw the piston, the fluid in front of it expands, its pressure and density falls below the normal undisturbed values; a pulse of rarefaction travels down the tube.

"These pulses are similar to the transverse pulses travelling along a string, except that the oscillating fluid elements are displaced along the direction of propagation (longitudinal) instead of at right angles to this direction (transverse). If the piston oscillates back and forth, a continuous train of compression and rarefaction will travel along the tube.

"As the wave advances along the tube, each small volume of the element of the fluid oscillates about its equilibrium position. For convenience, let us represent the displacement of any such fluid element from its equilibrium position at  $x$  by the letter  $y$ .

"It is to be understood, that the displacement of the particles is *along the direction of propagation* for a longitudinal wave, whereas for a transverse wave the displacement,  $y$  is *at right angles to the direction of propagation*.

"It is usually more convenient to deal with pressure variations in a sound wave than with the actual displacement of the particles conveying the wave, Fig. 14-9 (b). Let us therefore write the equations of the wave in terms of pressure variation, rather than in terms of displacement. Just as we let  $y$  represent the displacement from the equilibrium position, so we now let  $p$  represent the change from the undisturbed pressure. *If the particle displacement is simple harmonic, then the pressure variation at each position  $x$  is also simple harmonic.* The maximum change in pressure is called the *pressure amplitude*." (Halliday-Resnick, Physics, 1978, [434]).

With this, the conceptual and mathematical equivalence between the transverse waves on the string and the longitudinal compression waves of sound in a tube has been established.

So, some of the allegedly negligible aspects of the phenomenon, which was temporarily suspended for

the sake of simplification, now may be reinstated. Thus, let us first re-establish the deliberately bypassed facts, that sound is not one, but three dimensional, and that air is not a continuous medium, but made up of molecules, which are in constant rapid random motion.

According to the kinetic theory of gases, this random motion of the molecules is responsible for the isotropic three dimensional pressure exerted by the gas on the walls of a container.

In the hypothetical example of the sound waves in a long tube, we were discussing only the longitudinal component of the pressure variations of the gas, and for the sake of simplicity, nothing was mentioned about the effects of the other components of the pressure directed toward the wall of the tube. A compression pulse contains an excess density and therefore an excess pressure, which travels from layer to layer and effects the average density of the medium.

Each of the '*thin slices*' of the medium should be taken as a given volume of gas of higher density enclosed by the surrounding medium and the randomly moving molecules exert an equal force on the walls of its imaginary container in *all directions*.

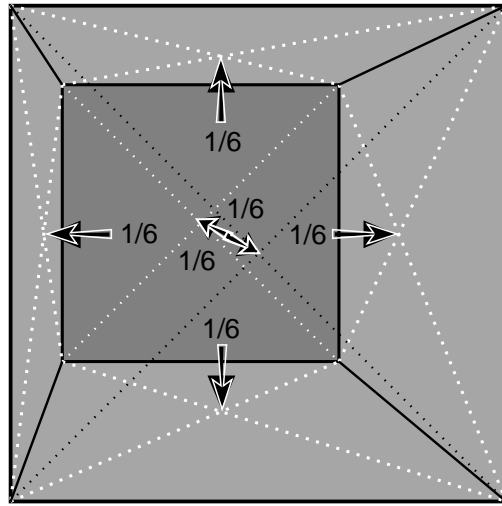


Figure 14-10

Figure 14-10 illustrates that according to the kinetic theory, in a cubical container only  $1/6$  of the total pressure effects each wall. If the thought experiment with sound was performed in a *rectangular tube*, it would be found evident that only  $2/6$  of the

total pressure difference of the compressed layer has been accounted for in the longitudinal directions, but  $4/6$  of the force which should effect the four side walls of the tube, was omitted from the analysis for the sake of simplification.

Since the force of pressure always acts at a *normal angle* to all walls, in this case only two of the normal angles represent longitudinal directions, the normal angles to the remaining four walls are *transverse* to the direction of propagation of the wave.

Evidently, it is a clear case of oversimplification that the particles in a longitudinal wave only oscillate back and forth and only in the direction of propagation. If they do oscillate longitudinally, they must also oscillate transversally. Thus, the excess pressure of the compression pulse of sound must exert a force in all directions, regardless whether there is a wall or not. In fact, nothing else but these transversal components are responsible for the spherical expansion of the longitudinal compression waves in the free isotropic elastic medium.

It follows, that the distinctive classification of *longitudinal waves* is just as superficial and fallacious as its transversal counterpart.

It must be assumed then, that the compression waves created in an isotropic medium possess both longitudinal and transversal components of the excess pressure and the individual particles do not perform specific oscillations in any preferred direction. Figure 14-11 is a schematic representation of the radial and transversal vectors acting mutually in the propagation of longitudinal compression waves.

This illustration is the clearest argument against the artificial restriction in dimensions or the bodily



distortion of a medium for the sake of the conceptual simplification. It clearly shows the role of the longitudinal and transversal components in the mechanics of compression waves, which always exist together, whether there is a restriction or distortion of the media, or not.

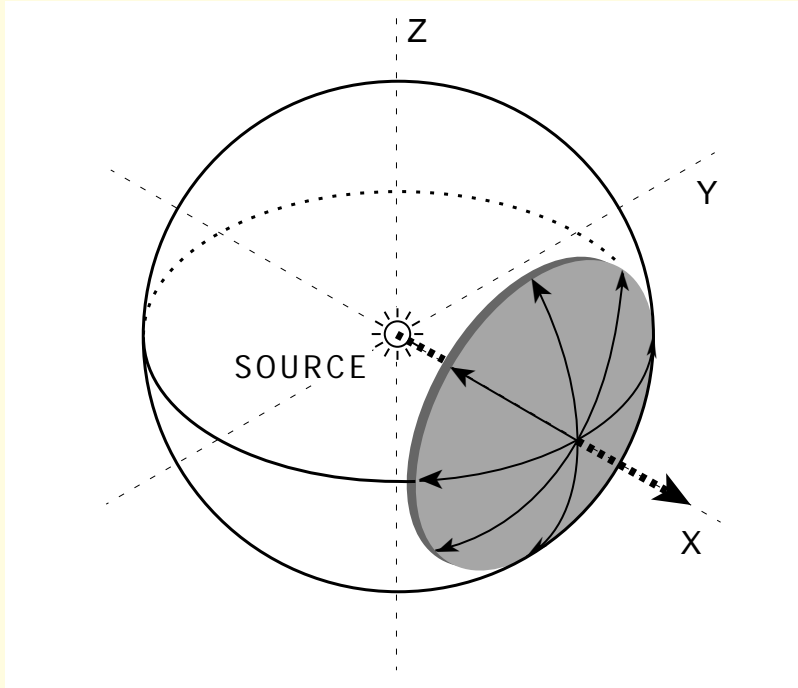


Figure 14-11

Thus, there is no reason for classifying waves separately as longitudinal and transverse, and theorize about the different oscillations of the particles, proven by different artificially simplified examples. AETHRO-KINEMATICS not only refuses the transverse wave theory of light but, based on the above, denies the existence of *uniquely transverse waves* altogether.

A kinematical extension of the classical mechanical wave-theory contemplates the transverse and longitudinal components of the compression waves as mutually active ingredients of a three dimensional transference of momentum through an isotropically free fluid. With this conclusion the forced conditions of an *exclusively transverse wave theory of light* are lifted.

With the admittance of the ideal gas model of Aether a new approach has opened for the explanation of polarization. In agreement with Young's original suggestion, a kinematic explanation must be based on the co-existence of *transverse and longitudinal components of compression waves* propagated with equal velocity through an isotropic and homogeneous medium.

Almost all of the phenomena of wave optics has been simulated by the mechanical experiments with waves of water or those of sound. If light waves were *mechanical*, then double refraction and polarization should be also reproducible experimentally in real gases and liquids. Indeed, in Classical Physics double refraction has been explained by the different speeds of light in different directions of the transparent matter, due to the asymmetry of the crystalline lattice. Thomas Young proposed a dynamical hypothesis to explain the different speeds of light by assuming that the transparent matter is *more easily compressible in one direction than in another*.

This theory has been confirmed by Brewster in 1815, showing that by simple *mechanical compression an isotropic transparent solid becomes doubly refracting*. These facts should be kept in mind for the further discussion.

In the same decade M. Chladny found that the mere obliquity of the fibers of a Scotch fir rod changes the velocity of sound in different directions in the proportion of four to five. This proves, that with sufficient precision, sound could be found doubly refracted in asymmetric materials. Nevertheless, so far no

experiment was recorded trying to achieve the polarization of sound. (Maybe it is merely a matter of the proportionality between the size of the grids and the wavelength of sound.)

## SIMPLE HARMONIC OSCILLATORS

Along with the artificial classification of mechanical waves as longitudinal and transversal in nature, comes another simple generalization, that the oscillations of the particles in all basic sinusoidal wave motions are simple harmonic in nature, mathematically analogous to the oscillations of a weight on a spring, or those of the swings of a pendulum. Again, based on the example of the transverse waves on a string, the concept of *simple harmonic waves* was formulated, and its mathematical formalism was applied to all other waves, including the compression waves of sound and the electromagnetic waves of light. Mimicking the hypothetical transverse displacements of the particles in a string, the propagation of the waves of sound is explained by *the simple harmonic back and forth oscillations of the particles of the air*.

Accordingly, the simple harmonic oscillator of the source produces simple harmonic oscillations of the

air-particles, which propagate in the isotropic medium and directly produces the simple harmonic oscillation of the receiver.

Although the Mechanical Theory of Waves and its mathematics seems to work in most cases, there is an obvious *kinematical ambiguity* in this simple transition of the concepts and mathematics from the two dimensional transverse waves on a string to the three dimensional longitudinal pressure waves of sound, and from the behavior of solid string to the behavior of gases.

On the one hand, as it is described by the above method, in a gaseous medium the kinetic energy of an oscillator is supposed to be transmitted in three dimensional longitudinal waves by *the simple harmonic back and forth oscillation* of the particles of the medium. According to the classical wave theory, the only difference between longitudinal and transverse waves is in the direction of the oscillation of the particles of the medium relative to the direction of propagation of the waves themselves. These forward or sideways oscillations of the particles, initiated by the oscillator at the source propagate throughout the medium in simple harmonic oscillation and

directly produce the resonance of the oscillator at the receiver.

On the other hand, in a different department of physics, most of the characteristics of gaseous substances, like flow patterns, resistance, pressure, etc. are successfully explained by the Kinetic Theory of Gases, through the fundamental concept of the *ideal gas*. According to this model the kinetic energy in this medium is transmitted solely through the collisions between the randomly moving particles. *All other forces between the particles of the gas, like electromagnetic and gravitational forces are taken to be negligible and therefore non-existent.*

It directly follows, that the kinematics of wave motion in gases cannot be based on any kind of *restoring forces*, acting among the atoms, and therefore *no simple harmonic oscillation* can be produced or assumed to exist in such medium.

Hence, the motion of the particles in longitudinal waves in a gaseous media could not directly mimic the waves on a solid string or mimic the motion of the oscillator of a source, or simply transmit kinetic energy to the receiver by their own simple harmonic oscillations.

*The method of the transmission of sound energy must be determined and described by the kinematics of the dissipation of local disturbances through an isotropic gaseous medium.*

Interestingly enough, this ambiguity has been strongly emphasized and made quite clear in the vehement scientific arguments against the gaseous models of Aether by the denial of its capability to transmit the transverse oscillation of light, because of the absence of restoring forces among the gas particles. – This argument, however, has never been applied against the hypothesis of the longitudinal simple harmonic oscillation of the particles of air in the mechanical description of sound.

## HARMONIC WAVES OR PERIODICAL PULSES

For a visual clarification of this alternate *Kinematic Theory of Compression Waves*, consider the following thought experiment in the ideal gas:

Let us go back into the great room, considering that a small spherical balloon is set in mid air, the volume of which can be changed by pumping more or less air into it through a thin pipe.

While the balloon is at rest in its initial size, the gas atoms simply rebound from its surface and rebound again from the atoms of the next surrounding layer. Thus, it can be assumed, that the density of the gas is the same around the balloon as anywhere else in the medium.

Calculations show that in the air at 0° C and at standard atmospheric pressure there are about  $3 \times 10^{19}$  (3 followed by 19 zeros) atoms per cubic centimeter, within which some 5 billion collisions take place per second. The length of the average collision free path is of the order of a few millionths of a centimeter and the average speed of the atoms is about 5-7 km/sec. Let us suppose that the volume of the balloon is only one cubic centimeter.

Even if the expansion is only one percent of the initial volume of the balloon, it would produce a disturbance in the random motion of billions of atoms. This seems to be an extremely complex kinematic procedure, but as it was shown earlier, it is permissible to simplify the situation.

As long as the balloon is at rest and the randomness is completely isotropic, on the average, the *Center of Oscillation* of the atoms can be assumed as

fixed in space and that each atom is at rest at that point. In this simplified picture, all stands still until a sudden expansion of the balloon puts the neighboring atoms into motion. These atoms move with the velocity of the expansion and collide with the other atoms at rest in the next spherical layer. Taking the simplest head-on collisions between *equal masses*, each moving atom stops and transfers its momentum to one at rest sending it into the next layer. There, in turn, those atoms will stop and send others into the layer next to that.

As the *pulse* proceeds in the medium in an expanding spherical shell, each group of atoms migrates into the space of the next layer and transmits its excess forward momentum to that group of atoms.

Superimposing now the initially existing isotropic random motion of the atoms, the fundamental kinematics of the compression pulse does not change. Evidently, the excess momentum, originating from the movement of the balloon, spreads through the medium in the form of an excess radial and transversal pressure represented by the migration of the atoms from each spherical layer into the next. The

intensity of the pulse is directly proportional to the initial magnitude and velocity of the expansion of the balloon. Because of the initial forward momentum disperses into an expanding spherical shell, the intensity of the pulse, or the *density of momentum per unit area* is also proportional to the inverse square of the distance from the origin.

Now, consider the opposite of the compression pulse; a single rarefaction pulse.

Starting with the motionless mid-position of the balloon, as before, the density of the medium is isotropic and all atoms can be taken as being at rest in the position of their average *Center of Oscillation*.

When the balloon suddenly contracts, it leaves a certain volume of empty space around it. Obviously, in this simplified picture nothing else happens. Since the contraction of the balloon exerts no force on any of the atoms, they all remain at rest.

Thus, by superimposing the initial isotropic random motion, there can be no transference of excess momentum to the atoms in the backward direction, but the empty space, created by the contraction, is merely filled up by the atoms which happen to be travelling in that direction in their random motion.

This procedure is equivalent to a *free expansion*, which was discussed earlier in connection with the kinematics of the *gravitational sink*.

From this obvious difference between compression and rarefaction pulses, it follows, that without any restoring forces or some kind of backward momentum, the randomly moving particles of a gaseous medium *do not, and cannot perform simple harmonic, or any other kind of oscillation*.

According to the Kinetic Theory of Gases everywhere in the ideal gas, all six inside walls of an imaginary cube receive the same isotropic pressure by the average random collisions of the atoms. It can be seen, however, that the superimposed *excess pressure* of a passing compression pulse only effects the one forward and four side walls of the cube. No excess pressure is exerted on the back wall, opposite to the direction of propagation. In fact, this absence of the backward momentum and the resulting net forward and transverse forces are responsible for the ability of the waves to propagate at all. Evidently, a wave theory based on the Kinetic Theory of Gases leads to different results than a theory derived from the mechanics of the transverse waves on a string.

For a strict distinction, it should be stated, that the kinematics of the transmission of sound-energy through a gaseous medium must be described by a train of periodical individual compression pulses, possessing both the longitudinal forward and all the transverse components of the initial momentum.

Consequently, the mechanical theory, stating that sound propagates through the longitudinal back and forth, harmonic oscillation of the atoms of the air is based on total misconception.

This distinction could be all the more important, because the uncovered ambiguity of the Mechanical Theory might be the very sprout of the later misinterpretation of the facts, which led science into the labyrinth of the duality of light.

Indeed, this argument can be strengthened by uncovering another hidden contradiction within the mechanical theory. Both classical and modern physics imply that the mechanical theory of waves in a gaseous medium can readily explain the resonant oscillation of the receiver, simply because the particles of the medium are directly conveying the oscillating energy of the source, by themselves moving back and forth in harmonic oscillation.

This assumption, however, leads to ambiguities with respect to the pressure of waves, or their ability to produce translational acceleration of freely floating particles in the direction of propagation. For if the atoms of the gas performed harmonic back and forth oscillations, they would have equal momentum in opposite directions and therefore the total net force exerted by the passing waves at any point of space would be zero.

Hence, on the one hand, the *mechanical theory*, takes it as self explanatory, that harmonic waves directly transmit the kinetic energy of an oscillating source to the receiver, but it fails to explain the other possible interactions between matter and waves.

On the other hand, the *net forward momentum* of the kinematic theory can readily explain the pressure of waves and the translatory acceleration of free particles by the momentum of the periodical pulses, but it must come up with an alternative explanation, how this momentum can produce the exact resonant simple harmonic oscillation at the receiver.

The kinematic explanation for the conveyance of the oscillatory energy between source and receiver must be achieved without assuming the harmonic

oscillation of the particles, and based solely on the forward momentum of the periodical individual compression pulses. Taking sound, produced by the simple harmonic oscillation of a tuning fork, the question is, how can the net forward force of a train of compression pulses *reproduce* the same exact simple harmonic oscillation of the eardrum without the similar oscillation of the particles of the conveying medium?

Consider then the following:

The elastic eardrum is completely submerged in the gaseous medium of air and in silence the membrane stands still in its equilibrium position, receiving isotropic atmospheric pressure.

When the first compression pulse arrives, the momenta of the *migrating atoms* push the membrane inward, in the direction of propagation. As it is displaced from the equilibrium position, the distorted elastic membrane tends to restore its initial state.

As the compression pulse is partially reflected from the drum, it receives again normal pressure. Meanwhile, the restoring force of the elastic membrane not only moves it back to the equilibrium position, but because of its inertial mass and elasticity, it

*over-shoots* in the opposite direction beyond its initial position into the oncoming rarefied layer with an equal displacement.

The next layer is again normal density and the membrane swings back toward the center. Since the restoring force is proportional to the extent of the displacement, and the period of oscillation is independent of the amplitude, the motion of the membrane should be synchronous with the on-coming periodic pulses. Consequently, the next compression pulse arrives exactly at the time when the membrane reaches its original mid-position. The pulse exerts the same inward force as before, but at this time the membrane already has a momentum in the same direction, consequently the same net force produces a greater displacement than before in the direction of propagation.

From here on, this whole procedure repeats itself periodically. The result is a gradual increase in the displacement of the membrane in both directions until the net forward force of the compression pulse is equalized by the restoring force of the membrane. At this point both the initial amplitude and frequency of the oscillation of the source are reproduced in

the simple harmonic oscillation of the receiver. Hence, the simple harmonic motion of the oscillator of the source is reproduced in the resonance of the receiver by a periodical net forward force, without the necessity of assuming that the particles of the medium perform simple harmonic oscillation.

Thus, the *kinematic theory of periodical pulses*, based exclusively on *the net forward momentum* of the compression layers render a simple explanation for both the reproduction of the harmonic oscillation in the receiver and the capability to exert pressure on matter or produce translational acceleration of material particles floating freely in the transmitting medium.

The difference between these two phenomena simply originates from the different specific state of the bulks of matter, affected by the compression pulses. Both the small free particle and the massive oscillator *accumulate* their velocities from the *periodical* forward momentum of the pulses, but while the *free* particle is able to continue to accelerate in the same direction of the propagation, the massive receiver is compelled to oscillate *under the influence of its own elastic restoring force*.



## HUYGENS' PRINCIPLE – KINEMATIC INTERFERENCE

The methods of the Kinetic Theory can clarify some other unresolved problems of the classical wave theory of light, which originates from the ambiguously assumed simple harmonic oscillation of the particles of the conveying medium.

Opposing Newton's corpuscular theory, in 1678 Christian Huygens, Dutch physicist, proposed the wave theory of light, which simply suggested that light is a periodic disturbance in the all-pervading supermundane, gaseous medium of the aether, just as sound is such disturbance in the air or other fluid media.

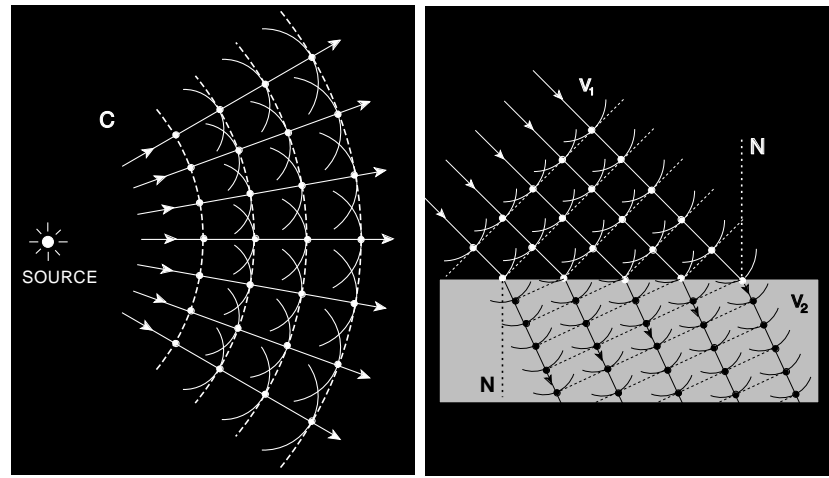
The central idea of this theory was the so-called *Huygens Principle*, which hypothesized, that each infinitesimal part of a spherical compression wave front acts as *a new point-source*, producing *secondary wavelets*, which propagate outward with equal speed in all directions.

As a result of this assumption, by the simple geometrical construction of an *envelope*, projected at the *surface tangency* of these secondary wavelets it

became possible to predict where a given wave-front will be at any time in the future if its present position was known.

One of the decisive factor in choosing between Newton's corpuscular theory and Huygens' wave theory was answering the question whether the speed of propagation of light should be lower or higher as it enters into a denser media. According to Newton the light corpuscles should speed up in the denser medium, while Descartes assumed that the waves should slow down. The choice was forced by Jean Bernard Foucault's experiment in 1850 when he proved conclusively that light is propagated more slowly in water than in air.

As an example, [Figure 14-12](#) shows the Huygens Construction, representing the spherical propagation (a) and the phenomenon of refraction of light (b) based on the assumption that the speed of propagation of light is smaller in glass than in air. When a beam of light enters into the denser medium, each secondary wavelet slows down, their consecutive tangential envelopes shows a deviation toward the normal from its original direction, and a decrease of the initial wavelength.



(a) Figure 14-12 (b)

The arrows erected as the radii of Huygens' spherical waves and those representing plane waves in great distances from the source became the fundamental concept of geometrical optics, called the *ray of light*. Young's famous double-slit experiment of interference and his mathematical derivation of the position of the interference fringes and that of the actual wavelengths of light, was also based on Huygens' geometrical construction.

After Young's success in explaining interference of two light beams by Huygens' wave theory of light,

his contemporary, Augustine Fresnel applied the same theoretical and mathematical approach to the phenomenon of diffraction.

According to Fresnel, diffraction, which is the bending of the light beam into the geometric shadow of a opaque object, is a form of interference among Huygens' secondary wavelets. These elementary radiators are at different distances from a given point on the screen and therefore the secondary wavelets arrive to the same point in different phases. This results in constructive or destructive interference among the wavelets and produce light and dark diffraction bands within the geometrical shadow on the screen. It follows, that Young's mathematical analysis of interference is also applicable to the phenomenon of diffraction.

Hence, Huygens' simple principle was capable to explain not only the propagation of light, but its various interactions with transparent matter and therefore became the fundamental tool of theoretical, geometrical and mathematical optics.

Nevertheless, there was no clear understanding of the physical reasons why this hypothesis should work. In fact, there is still an unresolved contradic-

tion, generated by the assumption of the mechanical wave theory, that longitudinal waves are propagated through *the back and forth oscillation* of the particles of the medium. Based on this assumption, and contrary to observation, it may be expected that the secondary wavelets of Huygens should radiate backward as well as forward from each point of the secondary sources.

This problem has never been resolved but merely suspended by the acceptance of Huygens' second intuitive assumption, that the *intensity* of the secondary wavelets are not uniform in all directions but vary gradually from a maximum in the forward direction to zero in the backward direction.

## THE MOMENTUM AMPLITUDE

Based on the above kinematic theory of periodic compression pulses, a simple thought-experiment and its mathematical analysis can prove that Huygens' ad-hoc hypothesis is in agreement with the fundamentals of the Kinetic Theory of Gases.

As it has been found before, in the totally random motion of the particles in an undisturbed, isotropic ideal gas, the position of each individual

particle can be taken as the center of its oscillation within its own collision-free sphere. Thus, on the average, each particle can be assumed to be at rest relative to the isotropy of the medium. Superimposed on this symmetrical arrangement of rest any locally introduced disturbance must result in an excess momentum of some particles in a specific direction. It follows that the transfer of this excess momentum can be described as the simplest kind of collision; namely, between pairs of particles of equal masses, one moving, and one at rest.

When a collision occurs in one dimension, the line of motion of the moving particle leads through the center of the target particle. In case of a perfectly elastic collision the particles simply exchange velocities. The projectile particle stops and the target particle takes off with the total initial momentum of the first. As it is illustrated on [Figure 14-13 \(a-b-c\)](#) in two dimensional collisions, the direction of motion of the projectile,  $O_2$ , can always be related as a parallel line to the direction of the line going through the center of the target particle,  $O_1$ . The distance between the two parallel lines is called the *impact parameter*,  $b$ . In one dimensional, head-on collisions  $b = 0$ .

When  $b > 2R$ , twice the radius of the particles, there is a complete miss. When  $b > 0$  and  $b < 2R$  then, through the collision, certain components of the initial momentum are inherited by each particle

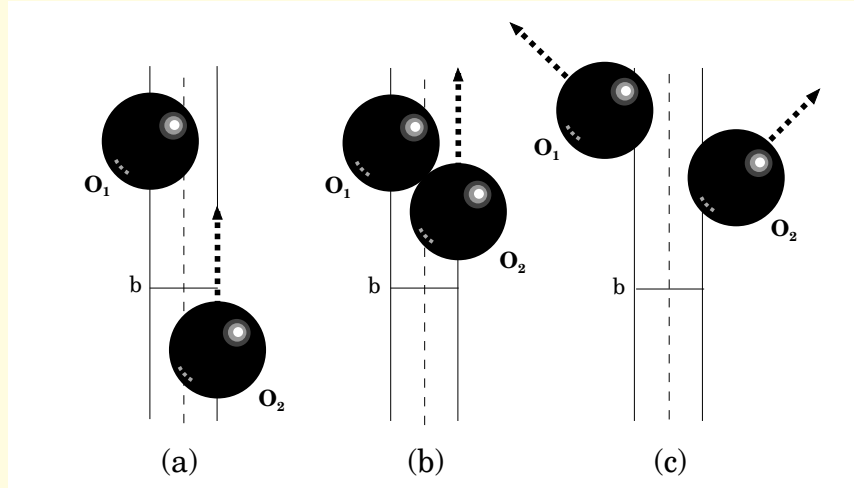


Figure 14-13

Since all particles have equal masses, based on Newton's third law and on the law of conservation of momentum, the speeds and directions, that is, the final momenta of the two particles after collision can be calculated from the initial momentum and the magnitude of the collision parameter,  $b$ . As for the mathematical analysis of the probabilities of the

momenta of the particles after collision, consider the following initial assumptions:

a) All particles of an ideal gas are taken as equal masses, therefore  $m$  represents the unit mass.

b) The spatial dimensions of the particles are the same; perfect spheres with equal radii,  $R$ .

c) The collisions are perfectly elastic and frictionless.

d) In the simplest type of collision particle  $O_1$  is initially at rest, thus its momentum,  $m\mathbf{V}_1 = 0$ . Particle,  $O_2$  is in motion with a given velocity, its momentum is  $m\mathbf{V}_2$ . The total momentum of the system, before collision is:  $m\mathbf{V}_1 + m\mathbf{V}_2 = m\mathbf{V}_2$

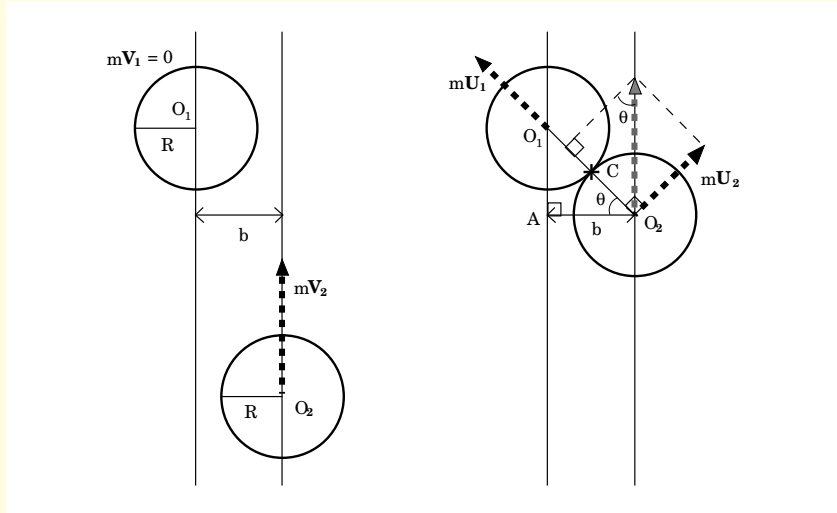
e) The collision parameter,  $b$  is the distance between the two parallel lines going through the centers of the particles in the direction of the initial momentum,  $m\mathbf{V}_2$ .

f) When  $b = 0$ , then the two parallel lines coincide. It is then a head-on collision and the particles,  $O_1$  and  $O_2$  simply exchange velocities. Thus, after collision  $m\mathbf{U}_1 = m\mathbf{V}_2$  and  $m\mathbf{U}_2 = m\mathbf{V}_1$ .

g) In the example of [Figure 14-14](#),  $b > 0$ . In illustration (b)  $O_1O_2$  is the line connecting the centers of the two particles at the instant of collision.

The length of this line is  $2R$ , and it also contains the point of contact,  $C$ .

h) Through the impact point  $O_2$  exerts a force on  $O_1$  which acts along the line  $O_1O_2$ . According to Newton's Third Law  $O_1$  also exerts a force on  $O_2$ , and the two forces are equal in magnitude and opposite in directions.



(a) Figure 14-14 (b)

It follows from all above, that through the collision  $O_2$  transfers the component of its momentum to  $O_1$  in the direction  $O_1O_2$  and moves away with the

remaining component of the initial momentum which is rectangular to that, transferred to  $O_1$ .

From the Law of the Conservation of Momentum, it follows, that the total resulting momentum of the system after collision is:  $m\mathbf{U}_1 + m\mathbf{U}_2 = m\mathbf{V}_2$ .

From trigonometrical considerations, it can be seen, that

$$\frac{m\mathbf{U}_1}{m\mathbf{V}_2} = \sin \theta \quad \text{and} \quad \frac{m\mathbf{U}_2}{m\mathbf{V}_2} = \cos \theta \quad (14.4)$$

thus,

$$m\mathbf{U}_1 = (m\mathbf{V}_2) \sin \theta \quad (14.5),$$

and

$$m\mathbf{U}_2 = (m\mathbf{V}_2) \cos \theta \quad (14.6)$$

As it has been stated before, the various resultant momenta of the particles after similar collisions depend on the magnitude of the collision parameter,  $b$ , which determines the angle between the direction of  $O_1O_2$ , and that of the initial momentum,  $m\mathbf{V}_2$ .

As it can be seen, the triangle  $A, O_1, O_2$  is exactly similar with the one before, and therefore the angle,  $\theta$  is the same.

Therefore, in terms of  $b$  it can be found, that

$$\cos \theta = \frac{b}{O_1 O_2} = \frac{b}{2R}, \quad (14.7)$$

and

$$\theta = \arccos (b/2R), \quad (14.8),$$

where  $\theta$  is the angle of the velocity,  $m\mathbf{U}_1$  of  $O_1$  after collision.

Further more,

$$\sin \theta = \sqrt{1 - \cos^2 \theta} = \sqrt{1 - b^2/4R^2} \quad (14.9).$$

Substituting (14,9) into (14,6) gives

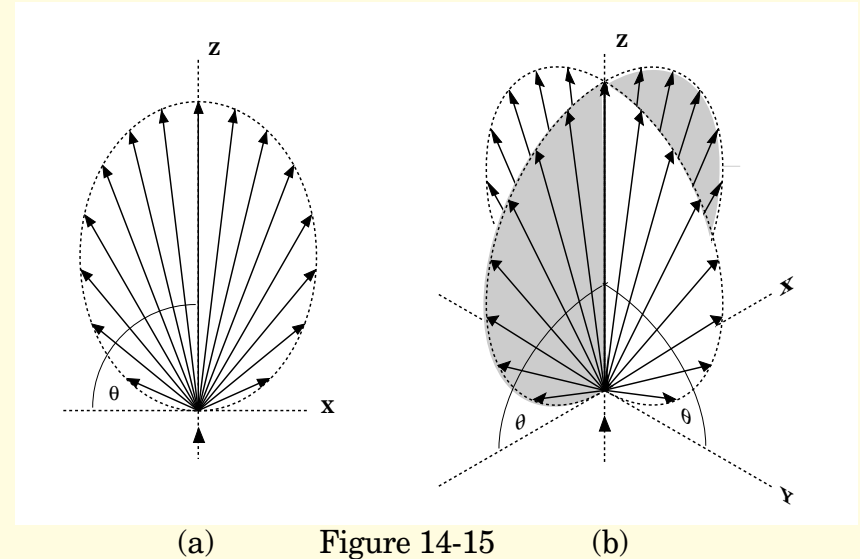
$$m\mathbf{U}_1 = m\mathbf{V}_2 \sin \theta = m\mathbf{V}_2 \sqrt{1 - b^2/4R^2} \quad (14.10),$$

where  $m\mathbf{U}_1$  is the momentum of  $O_1$  after collision. The momentum of  $O_2$  after collision is the remaining component of the initial momentum,  $m\mathbf{V}_2$ , and in case of equal masses its direction is always perpendicular to that of  $m\mathbf{U}_1$ . Consequently,

$$m\mathbf{U}_2 = (m\mathbf{V}_2) \cos \theta = m\mathbf{V}_2 (b/2R) \quad (14.11).$$

Figure 14-15 (a) illustrates the mathematically plotted probabilities of the velocity vectors of the target particle  $O_1$ , after collision, resulting from the dif-

ferent values of the collision parameter,  $b$ . This pattern is also valid for the resulting momentum of the projectile,  $O_2$ , which is the remainder of the initial total momentum, always directed perpendicular to the direction of the target particle,  $O_1$ .



Consider now an immense number of collisions *in three dimensions* with all probable impact parameters between pairs of particles, due to a directional local disturbance, that is, the forward motion of an oscillator in an isotropic, gaseous medium.

On the average, the result of the transfer of speeds and directions should be a three-dimensional formation of the probability plot of velocity vectors; a *semi-hemisphere* with its axis coinciding with the direction of the initial forward disturbance.

Figure 14-15 (b) is a three dimensional rendering of such probability pattern,  $(X,Y,Z)$  which can be taken as a general representation of the *momentum amplitude* produced by a great number of randomly moving particles colliding with one another, due to a local directional disturbance in an isotropic medium.

It should be noted here that in the sense of the conservation law, once the directional disturbance is imprinted in the medium, this pattern of the momentum amplitude is transferred from one point of space to the other and in the course of the isotropic dissipation it merely changes in magnitude but not in its initial directions.

Accordingly, the relative magnitude of the transferred momenta remains the maximum in the longitudinal direction, or in the forward axis of the hemisphere, gradually decreases in the transverse components, and reaches zero in the backward direction.

This description, which is based on the fundamentals of the Kinetic Theory of Gases, is conceptually equivalent with the Huygens Principle and not only explains the total absence of backward waves, but also suggests the origin and proportionality of the commonly neglected transverse components of momentum in the longitudinal compression waves.

Thus, the transverse components of longitudinal compression pulses and the general phenomenon of kinematical interference serve as some new ingredients for re-interpreting Young's '*imperfect explanation of polarization without departing from the genuine doctrine of undulation*'.

Since this periodical transverse momentum requires no transverse oscillation of the particles in the medium, the ideal-gas-model of Aether can be re-admitted, and the hypothesis of transversally oscillating electric vectors, together with the mysterious abilities of empty space, can be replaced by the humanly conceivable theory of AETHRO-KINEMATICS. – Nevertheless, it should also be shown, that the kinematical procedure applied to polarization, leads to the same mathematical results as the theory, based on the oscillating electric vectors.

## POLARIZATION BY ABSORPTION

There is an empirical law applying to the intensity of polarized light as affected by the polarizing apparatus. If a beam of light is plane-polarized by a polarizer and passed through the analyzer, the intensity (flux density) of the emergent beam falls off as the analyzer is rotated. The intensity is the maximum when the direction of transmission of the analyzer coincides with that of the polarizer and it is zero when the analyzer is at right angles to that direction. Experiments showed, that the final intensity,  $I$ , is proportional to the square of the initial amplitude of the electric vector,  $E_o$  and varies as the square of the cosine of the angle,  $\psi$ , through which the analyzer was rotated.

$$I = I_o \cos^2 \psi \quad (14.12),$$

This equation represents *Malus Cosine-squared Law*, justified by the experimental facts.

From all of the above it can be conjectured that compression pulses are produced by simple harmonic oscillators and propagated in an isotropic compressible medium through the kinematic interference of Huygens distribution. It is the initial forward momentum of the oscillator that acts as a local distur-

bance and dissipated in the isotropic randomness of the fluid.

The momentum of the oscillator is kinematically dispersed into its various components in different directions and amplitudes, the pattern of which is reproducing itself through the secondary wavelets and in their expanding spherical envelopes.

Thus, when it comes to the transverse theory of light and polarization, there is no more compelling reason to assume an exclusively transverse oscillatory motion of the particles of a transmitting medium and it is also needless to hypothesize about transversally oscillating electric fields in empty space.

The new concept of the three dimensional *momentum amplitude* of the longitudinal compression pulse, propagated in a real isotropic fluid can *substitute* the amplitude of the oscillating electromagnetic vector in its role of explaining the characteristic propagation of radiation in empty space. Nevertheless, although the two different concepts are mathematically equivalent, in some respects they predict different results.

The conceptual distinction between the two theories is indifferent as long as light is propagated in



the isotropy of Aether, or that of the nothingness of empty space. When the secondary wavelets merely interfere with one another, the resulting envelope of the longitudinal and transversal components of the initial momentum and its dissipation is in isotropic balance with the general randomness of the medium. This kinetic state of the periodical compression pulses in the Aether is equivalent with the random orientation of the electric and magnetic vectors in the so-called *unpolarized light*. The different theories, however, lead to different explanatory results, when they were applied to the interactions between radiation and matter, where the general isotropy of the kinematical propagation is affected by the presence of the atomic structure of a transparent medium. One of these cases is the phenomenon of *polarization*.

Let us now recall the illustration of [Figure 14-15 \(a\)](#), the two dimensional plotting of the probability envelope of the momentum amplitudes resulting from the possible simple collisions between two equal masses. In an isotropic fluid the forward momentum of a disturbance is distributed symmetrically in three dimensions and superimposed on the initial random motions of the particles.

It is important to realize, that this pattern does not represent the momentum amplitude of a wave front on a macroscopic level, but only that of an infinitesimal volume of the medium at the order of magnitude of Huygens' secondary wavelets. The total interference result of these wavelets is the next tangential envelope of the pulse, which then reproduces the same pattern of momentum amplitude in the new secondary wavelets.

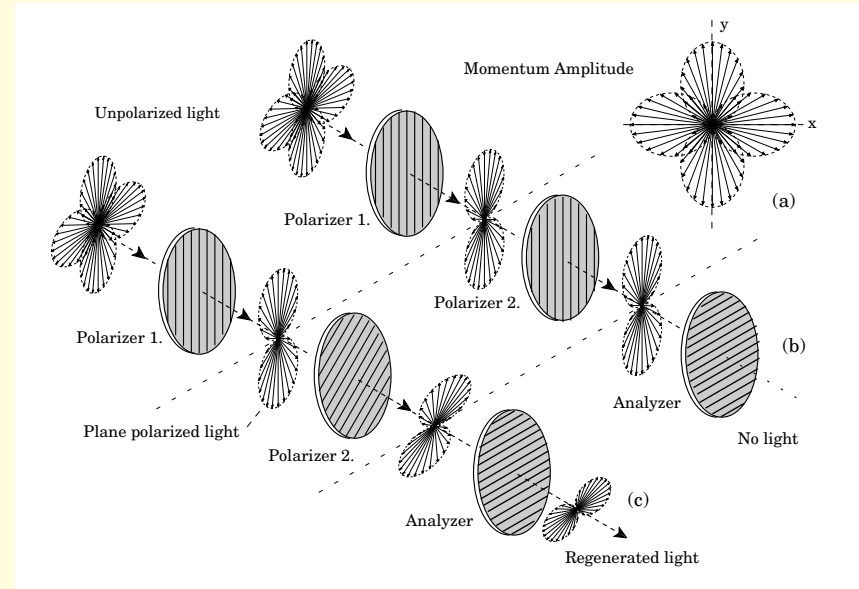


Figure 14-16.

Illustration Figure 14-16 (a) shows in two dimensions the symmetrical pattern of the transverse momentum amplitude of the secondary wavelets of a compression pulse, equivalent to unpolarized light. Illustration (b) depicts the result of an experiment with natural, unpolarized light, that passes through a polariscope.

The transmission axes of both Polarizer 1 and 2 set in the vertical direction and let only those components pass.

Evidently, the strictly horizontal component of the momentum has been absorbed. The Analyzer is set in the horizontal direction, therefore the angle  $\psi$  is  $90^\circ$  and it absorbs the remaining vertical components; therefore no transversal momentum survives and propagates beyond the Analyzer. However, it can also be seen from the pattern of the momentum amplitude right before the Analyzer, that if the angle  $\psi$  is smaller than  $90^\circ$ , the Analyzer would pass part of the transversal components.

Thus, there are two angles involved in the description of the phenomenon with different meanings. Figure 14-17 shows the roles of the angles  $\theta$  and  $\psi$  in the explanation of polarization.

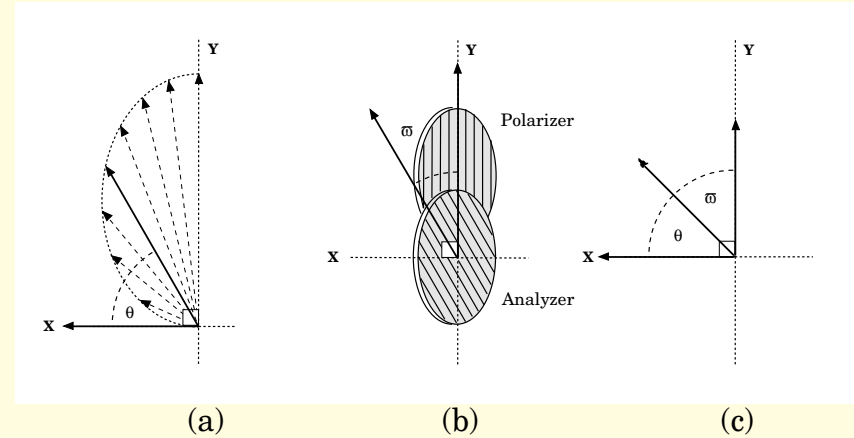


Figure 14-17

Both angles are measured in the  $x, y$  coordinate system, where the direction of  $y$  equals  $0^\circ$  and the direction of  $x$  equals  $90^\circ$ . (a) shows that  $\theta$  measures the magnitude and direction of the momentum amplitude. (b) illustrates the angle between the transmission axes of the Polarizer and Analyzer. (c) shows the relation between the two angles, from which it follows, that

$$\theta + \psi = 90^\circ \quad \text{and} \quad \sin \theta = \sin (90^\circ - \psi) = \cos \psi.$$

Substituting  $\sin \theta$  with  $\cos \psi$  in Equ. (14.9), we have

$$mU_1 = mV_2 \cos \psi \quad (14.13)$$

Considering that the amplitude of the electric field,  $E_o$  transmitted by the polarizer is equivalent to the momentum amplitude,  $P_o$ , and considering also that the final momentum amplitude,  $P_f$  beyond the Analyzer is

$$P_f = P_o \cos \psi \quad (14.14).$$

Since the intensity of light is proportional to the square of the amplitude of  $E_o$ , it is also proportional to the square of  $P_o$ , thus,

$$I_o = P_o^2 \quad \text{and} \quad I \cong P_f^2 \quad \text{thus,} \quad I = I_o \cos^2 \psi.$$

With this, Malus' empirical law of polarization has been derived from the kinematic principles of collisions among equal masses; in other words, it is explained by the characteristics of the dissipation of local disturbances in an ideal gas.

This approach not only gives equal mathematical results, but better conceptual understanding of the phenomenon in those cases, where the hypothesis of the transversally oscillating electric vectors has no satisfactory answers.

Recall the struggle of Dr. Goodstein and other modern educators in explaining the partially decreasing intensity in the case of the oblique angle of

the analyzer, and the even more problematic case, when the second obliquely inserted Polarizer 2. regenerates some of the already absorbed components of light.

The source of this inconvenience is the contradictory statement that the polarizer absorbs *all* electric oscillation of un-polarized light which are not parallel to its transmission axis, but when the analyzer is set at an oblique angle, it passes some light because the survived electric vectors, parallel to the polarizer still have some components in the direction of the transmission axis of the analyzer.

The misconception comes from the erroneous use of the concept of vector components. Theoretically a vector, placed into a cartesian coordinate system, in an oblique angle to both the  $x$  and  $y$  axes, can be expressed in its rectangular component along those lines. However, in the above described explanation of polarization in the first part of the statement a specific coordinate system has been set relative to the transmission axis of the polarizer for describing the component vectors for both the omnidirectional natural light before passing, and those for the unidirectional plane polarized light after passing.

In this coordinate system, all component vectors were supposed to be absorbed except those, parallel to the  $y$  axis.

Evidently, there is no logical or in any way rightful reason to rotate the coordinate system from its original direction, and thereby revising the initial vector components. Evidently, it is done just for the sake of the justification of some partially surviving components in the transmission axis of the analyzer.

The contradiction in the regenerated light, by the insertion of a second polarizer, springs from the same misuse of the theory of vector components. If both the polarizers and the analyzer were rotated in the same initial coordinate system, as they should be, the present hypothesis of polarization could hardly explain the partial decrease of intensity and even less the regeneration of light by the insertion of the second polarizer.

Recall illustration [Figure 14-16 \(c\)](#) showing that the kinematic theory neither uses oscillating vectors nor the *total absorption* of all un-parallel components of the initial momentum. It rather shows, in agreement with the Huygens Principle, that beyond the polarizer part of the absorbed components of the

momentum was recreated by the kinematic interference between the Aether particles at different amplitudes in different directions, and only the exactly horizontal component is zero. This is an entirely different conceptual result, which allows the explanation of both the phenomena of the partial decrease and the regeneration of the lost intensity.

And most importantly, in the kinematical description of polarization by absorption all these procedures happen, and being explained unambiguously in the *one and the same coordinate system*, that is initially introduced .

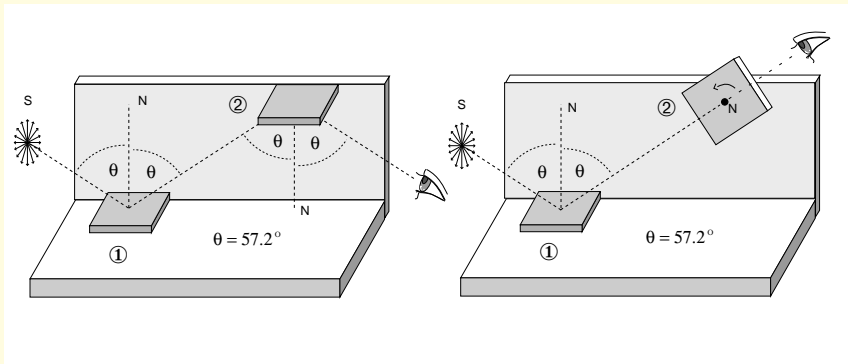
## POLARIZATION BY REFLECTION

It is evident, that this study cannot and does not get involved with all the details of a given physical phenomenon and their presently accepted explanation, but only those aspects, whose clarification is needed or useful for the general reinterpretation of the phenomenon by AETHRO-KINEMATICS.

The phenomenon of *polarization by reflection* is merely another form of that by absorption and it is fully covered by the above conceptual and mathematical argument. Still, it is worthwhile to analyze kine-

matically, for it brings up a different aspect of the nature of interactions between light and transparent matter. Also, for the sake of the plausibility of the *ideal-gas-model* of the Aether, it is important to find the exact logical conclusion, which lead to the transverse wave theory of light. The following text, which describes this logical procedure is quoted from M. Ference: Analytical Experimental Physics, 1956 [539]

"Suppose we take a plain piece of ordinary glass, ① having a refractive index  $\mu = 1.55$ , and use it as a mirror to reflect light from a candle flame or lamp bulb, S. We will furthermore make a special selection of the angle of incidence measured from the normal of the glass,  $57.2^\circ$ . (Figure 14-18 (a))



(a)

Figure 14-18

(b)

"We next take another piece of glass, ② and arrange it parallel to the first, but placing it in a way that the reflected beam from the first glass is incident on the second again at  $57.2^\circ$ .

"Looking at the light source reflected from both mirrors, nothing unexpected can be found: the reflections are entirely clear, bright, and distinct.

"Next we rotate the second mirror through  $90^\circ$  with *the ray between the two mirrors as an axis* (Figure 14-18 (b)). If we had been precise in making the angles as indicated, *no trace of the light source remains ! One cannot form a virtual image of a virtual image with two mirrors in these positions.*

"Our choice of  $57.2^\circ$  for the angle of incidence on the glass ① of index  $\mu = 1.55$  resulted in *the refracted rays taking a direction at right angles to the reflected ray*. This results in *some sort of modification* of the reflected light beam, so that it cannot be reflected when at the next reflection it encounters the mirror ②, where the *PLANE OF INCIDENCE is at right angles* to that of the first reflected ray from mirror ①.

"To understand how this can be, *we have but to assume that the light contains no longitudinal com-*

ponents, i.e., that its vibrations are exclusively transverse.

"Natural light has vibrations in all directions perpendicular to that of its propagation. Since any of these directions can be resolved into its components along any arbitrary rectangular axes, we can represent natural light as consisting of only two vibrations at right angles (Figure 14-19 (a)).

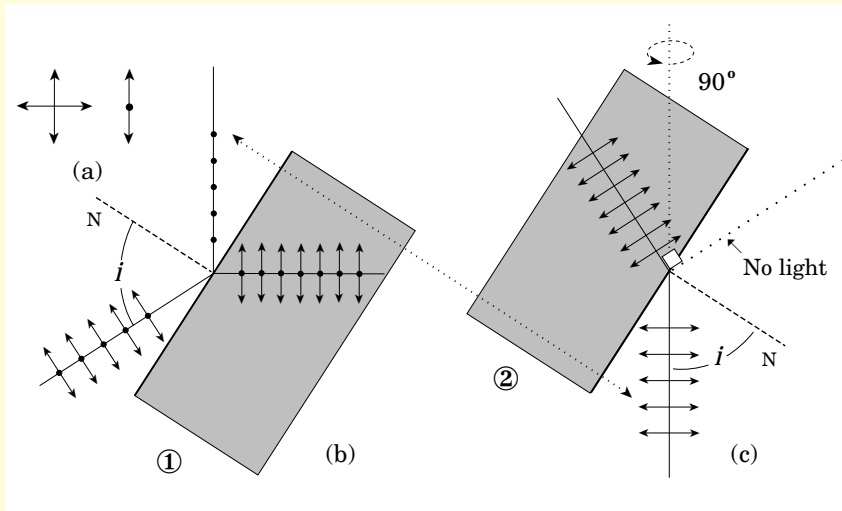


Figure 14-19

"On encountering the glass of mirror, ① on illustration (b), the direction of the reflected ray is such as to

be identical with that of one of the two components of the vibration of the light as it becomes refracted at the surface.

"If this vibration were transmitted, it would be longitudinal in character, i.e., have the direction of the wave's propagation. If it were not transmitted, the reflected ray would contain vibrations at right angles to the plane of the figure only, i.e., would be *plane polarized*.

"Upon the second reflection, (c) with the plane of incidence now  $90^\circ$  from its previous position (b), the residual beam now encounters the mirror ② so that, if it is reflected its *only remaining vibration direction* lies in the direction of the reflected ray. Light thus reflected would consist *exclusively* of a longitudinal component. The complete *absence* of any light in this direction clearly establishes the *complete inability for transmission of any LONGITUDINAL components in radiation*.

"Thus the experiment establishes the *transverse character of light*. If the angle of incidence,  $i$ , of Figure 14-19 is such that the reflected and refracted rays are at right angles to each other, then it follows from the geometry of the figure that

$$\mu = \tan i. \quad (14.15)$$

"This equation is known as *Brewster's law*, which states that the angle of incidence for complete polarization is that critical angle whose tangent is equal to the index of refraction of the reflecting material."

Note some of the conceptual ambiguity in this description:

a) The foundation of the above conclusion is, that the transverse components of light can be resolved in any two dimensional rectangular coordinate system. This assumption already omits any longitudinal component, which would be in the third dimension. This is, of course, false, since it is accepted by both classical and modern physics, that light delivers linear momentum, which is called *light-pressure*.

b) The final conclusion is based on the second reflection, where it is expected, that the remaining transverse components should continue in the direction of reflection, which would also be in the direction of propagation; that is, it would be a longitudinal component. This is equal to the expectation that one of the two-dimensional components should enter into the third dimension. Thus, the conclusion is based on an absurd expectation.

The empirical facts merely show, that at Brewster's angle one of the transverse components of natural light which is parallel to the plane of incidence, is totally refracted. Therefore, the emerging reflected beam from the first mirror contains none of those refracted components. This fact does not exclude the possibility of a longitudinal component, which was partially refracted and partially reflected, changing directions differently. Since the second mirror is rotated relative to the beam, it totally refracts the remaining transverse component and propagates in the glass by the remaining longitudinal component. Obviously, no light could be detected in the direction of reflection.

Attempting a kinematic analysis of the problem from this point of view, the first inquiry should be about a plausible explanation of the phenomenon of refraction.

In classical physics most optical phenomena, like reflection, refraction, diffraction and dispersion are simply analyzed and predicted by the Huygens principle and its geometrical construction. Two of these, refraction and dispersion are closely related and their analysis require the special assumption, that

the speed of propagation of light is lower in a transparent medium than in vacuum. This *retardation* in the speed of propagation of light is not only proportional to the density of the medium, but also proportional to the frequency of the light.

Comparing to the speed of light in vacuum the retardation of the propagation is directly proportional to the density of the transparent medium and the magnitude of the frequency. These are the empirical facts, which were accepted by both classical and modern physics as simply the nature of light. Neither of the languages that describes the phenomena attempts to explain the cause, or mechanism of this selective retardation based on frequency.

In fact, the same phenomena also exist in simple mechanical waves, like water-waves or sound and used as explanatory analogies for the refraction and diffraction of light but without giving a mechanical explanation for themselves. (Figure 14-20.)

Consider the following quote from Joseph & Leahy, Programmed Physics, 1966 (Optics 174):

"The speed with which waves travel through water depends on the depth of the water. When waves are

generated at C in a ripple tank, they travel from C to A and from A to B at different speeds."

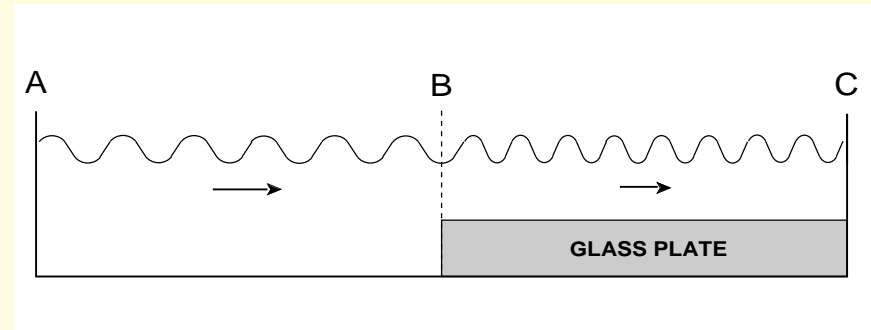


Figure 14-20.

"When waves travel at different speeds in the same substance (such as water), we say that they are travelling in *different media*. When water waves travel from water at one depth into water of greater or less depth, we say that they are moving in different media." (The speed is lower in shallow water.)

"Waves generated at the bottom of the [Figure \(14-21, next page\)](#) are moving through a ripple tank into which a rectangular plate of glass has been placed. The water above the plate glass represents a second medium. The incident waves strike it obliquely and bend away from their original direction.



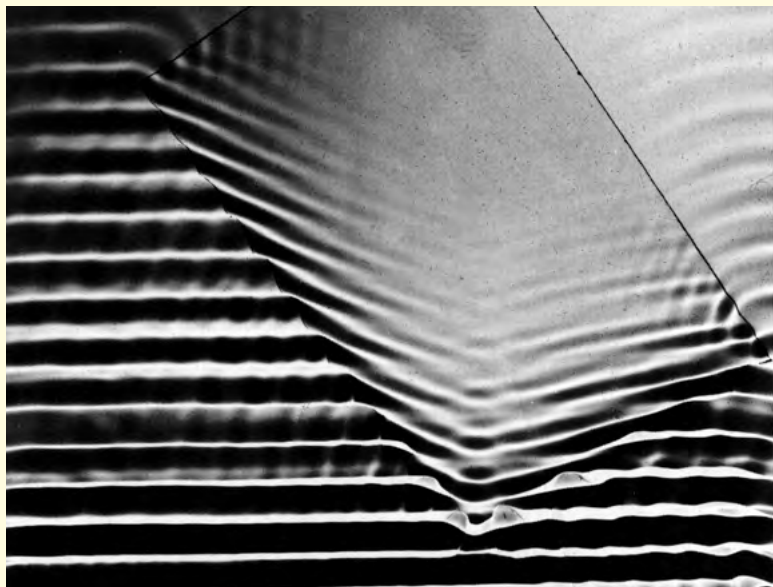


Figure 14-21

The incident waves are bent when they pass over the glass plate because water waves travel at different speeds in water of different depths. This is analogous to the refraction of light rays as they pass obliquely from one medium to another."

The *diffraction* of water waves in a ripple tank, another analogy, seems to be a phenomenon of entirely different character. Consider Figure 14-22, illustrating the diffraction of plane water waves of

same wavelengths, passing through gaps of different widths.

The empirical fact is, that the extent of the diffraction, that is, the spreading of the waves into the geometrical shadow of the barrier depends on both the width of the gap and on the wavelength of the waves. When the size of the gap is several times that of the wavelength, there is only a small *bleeding* into the geometrical shadow beyond the barrier.

As the width of the gap is decreased, the diffraction phenomenon increases and the emerging water-waves show proportionally more spreading and curving into the geometrical shadow. When the

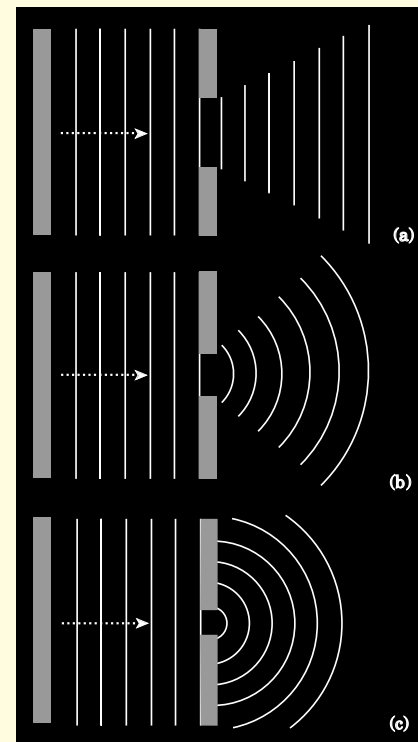


Figure 14-22

width of the gap is *compatible with the wavelength* of the waves, the diffraction effect is maximum, and the gap becomes a point source. In this case the waves propagate in half circles, covering the whole space beyond the barrier.

Augustine Fresnel showed experimentally that the result is exactly analogous when a train of plane electro-magnetic waves pass through a slit, which is comparable with their wavelength. – The scientific knowledge of these phenomena is purely empirical and there are no real attempts in classical physics to explain its mechanical origin. It has been simply accepted as the nature of the waves. Nevertheless, a detailed analysis of this phenomenon brings up some reasonable questions and possible answers.

First, note that the width of the gap is *transverse* to the direction of propagation, and the fact that the size of the gap can alter the extent of diffraction suggests that there is an interaction between the solid barrier and the *transverse components* of pressure carried by the longitudinal compression pulses.

Also recall the kinematical analysis of the momentum amplitude of Huygens wavelets which shows that just by the random probability of the col-

lision parameters, each point source ought to produce some transverse pressure within the longitudinal compression pulse.

Searching for some mutual characteristics between the refraction and diffraction experiments with water waves, it can be found that in this case of refraction, the depth of the water acts as a *vertical gap*, and determines the extent of the diffraction, just like the width of the horizontal gap did it before.

In both cases the deciding factor is *the transverse restriction of the volume of the medium, through which the longitudinal compression pulse must pass*. Evidently, this restriction has a major effect on the formation of the continuing waves.

For a general simplification of the problems, hydrodynamics assumes that water is incompressible which, in this case, cannot be allowed, since the very existence of the wave phenomenon is a result of compressibility. All fluids are compressible, and the slightest change in their local density increases the internal and external pressure of the volume involved. It is therefore plausible to assume that the retardation of the propagation of the waves in the shallow water and the flaring out of the waves by the

smaller gaps in the barrier, are both caused by the extra density produced within the restricted volume of fluid by the transverse components of pressure, carried in the compression pulses and reflected by the obstacles.

When a train of plane pulses reach a solid barrier at a normal angle, they are simply reflected and propagated backward in the opposite direction. The Huygens Construction guarantees that all components of the momentum amplitude are reproduced by the elementary point sources in the opposite direction. This guarantee should also work when there is an opening in the barrier, where parts of the pulses are reflected, while other parts can pass beyond. What happens in this case of the transverse components of momentum?

The flaring out of the pulses beyond the barrier suggests that their restriction by the gaps exaggerate the transverse pressure which is inversely proportional to the ratio between the size of the gap and the wavelength of the pulses.

The reflections from the edges rapidly dissipate in the medium, and therefore when the gap is great, the transverse reflections only effect the behavior of

the passing pulses in the vicinity of the edges. But, when the width of the gap is comparable with the wavelength, the reflections of the transverse components fill up the medium from both sides of the gap. The resulting density fluctuation within the gap produces local variation in the index of refraction of the medium and causes the diffraction of the passing compression pulses.

Quite certainly, some of the transverse components will be reflected parallel to the barrier and if the gap is small enough, they will be trapped in the medium within. The wavelength dependence of the magnitude of both refraction and diffraction effects suggests that there is a possible formation of standing waves within the gap by the transverse reflection of the pulses.

In this respect, not only the restricted volume of the medium is a factor, but also the transverse propagation of the standing waves which, being a function of time, must be dependent on the frequency of the periodical arrival of the compression pulses.

According to AETHRO-KINEMATICS light is a train of periodical compression pulses, carrying both longitudinal and transverse momenta, transmitted

by the isotropic ideal gas of Aether, through all space, including that, within the interstitches of the atomic structure of macroscopic matter. Thus, applying the above analogies to the *refraction and diffraction of light*, in transparent media, the only necessary association is to realize, that for the compression pulses of light the atomic and crystalline structure of macroscopic matter is a mash of gaps and channels, filled with the ideal and compressible gas of Aether.

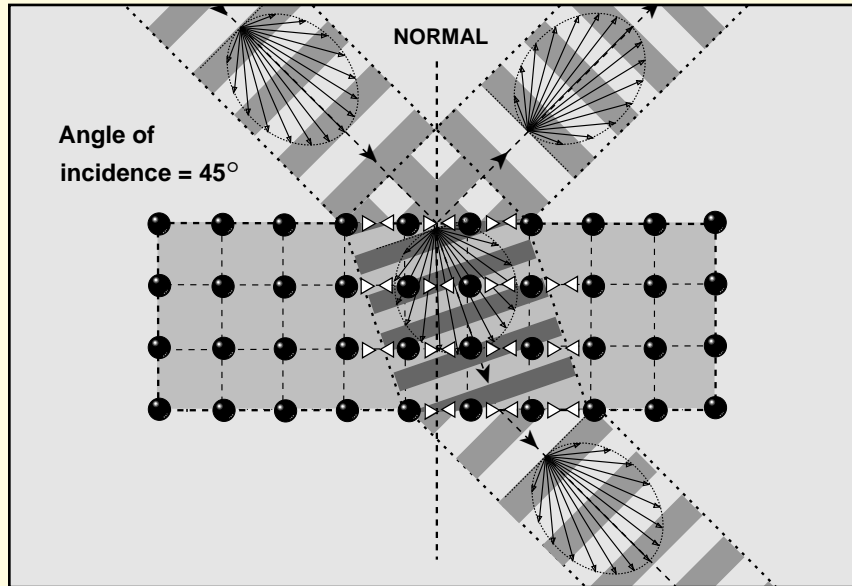


Figure 14-23

Figure 14-23 illustrates the optical phenomena of reflection and refraction, as the compression pulses of light enters obliquely from air to glass and back to air. All space is filled with Aether of different densities, including the space of air and the space of the atomic structure of the glass. The small white arrows between the atoms represent the transverse reflection of the pulses, the resulting excess local density of the medium, and the consequent retardation of the propagation of the pulses.

The denser the transparent medium is, and the more pressure is forced through the crystalline channels, the greater the retardation in the speed of propagation. It simply follows, that the excess pressure *delivered per unit time* is also a factor and consequently the higher frequency light is retarded more and deviated more than the lower ones. This is then the kinematics of the phenomenon of *dispersion*. (In App.IV there is a detailed discussion of this topic and its cosmological importance.)

The general hypothesis can be strengthened by the recollection of the AETHRO-KINEMATIC interpretation of the *Lorentz Formula*, that the resistance against the motion of a body through Aether is pro-

portional to the speed of the body and the speed of dissipation of the disturbances in the medium.

The kinematic reason for these effects has been established by the theory of the Mach-number of Aero-dynamics. When the speed of a body approaches the speed of dissipation of the disturbances, the medium can no longer carry away the excess density and its resistance increases by the ratio between the two velocities. In this case the speed of dissipation in Aether is the speed of light and the moving body is the excess momentum carried by the compression pulses, which also propagates with the speed of light. *The result is an excess density and a local retardation in the speed of propagation of the pulses and consequently a change in the local index of refraction.*

Finally, getting back to the kinematics of *polarization by reflection*, some further assumptions must be considered. – From all sources the general scientific description shows, that compared to their own dimensions, the atoms are at immense distances from each other even in the most dense chunks of macroscopic matter. The volume occupied by the atoms compared to the total volume of the matter they form, is negligible.

Nevertheless, atoms are kept together in molecules and those in crystals by electromagnetic forces, acting over relatively great distances. According to AETHRO-KINEMATICS these forces are communicated by organized and interconnected dynamic patterns within the otherwise isotropic Aether medium. When this picture is rendered for the various interactions between radiation and matter, some possibilities emerge for plausible, though extremely simplified, kinematic explanations.

It has been described above how the compression pulses, when entering into the mesh of crystalline structure, create some excess pressure within the gaps and by retarding their own propagation in the medium. Similar should be the case with the phenomenon of reflection. A beam of light cannot be reflected by the *minimal bodies* of the atoms, but at most merely scattered by them. Thus, reflection must be done by something else.

Based on all above, it is plausible to assume, that light is reflected from matter by a *boundary layer*, which separates the internal and external medium. This layer acts similarly as the *surface tension layer* between air and water. Again, the compression puls-

es themselves deliver the momentum to this layer, which bounces back the oncoming pulses according to the kinematics of the Huygens distribution. Thus, visualizing a simplified version of both refraction and reflection and the momentum amplitude of compression pulses, an attempt can be made to explain polarization by reflection through the changing effects of the various angles of incidence of light on its own propagation within the gaps and grids and channels of the structure of macroscopic matter.

Figure 14-24 (a) illustrates the three-dimensional version of the momentum amplitude, characteristic of the propagation of locally induced disturbances in isotropic fluid media. All the transverse components of momentum are resolved in the two rectangular planes of  $ZX$  and  $ZY$ . Illustrations (b), (c), (d) are separated into two parts, showing the *side view* and the *top view* of a single atomic layer, or a single crystalline plate of the transparent material.

On illustration (b) the angle of incidence,  $q = 0$ , which is normal to the surface. The top view, from the direction of the source shows that the width of the channels between the atoms are equal in both the  $X$  and the  $Y$  directions.

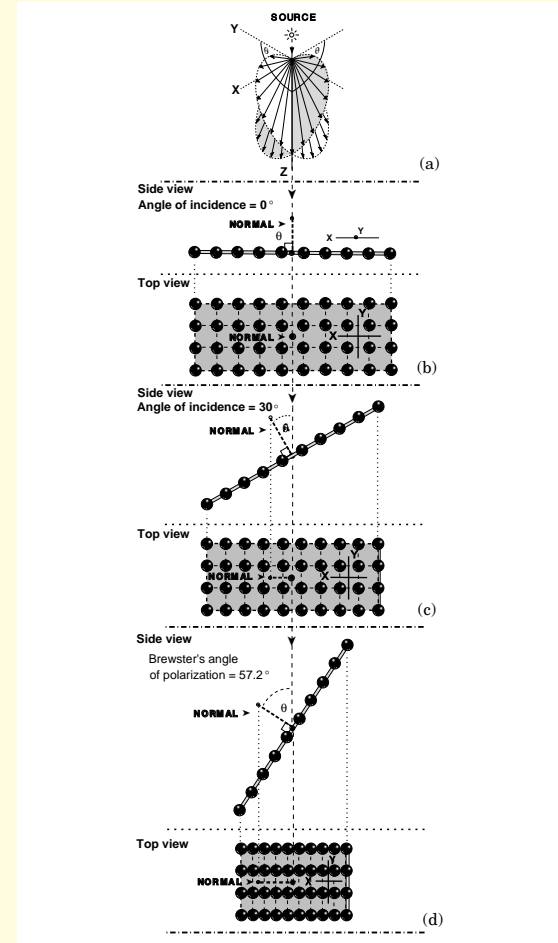


Figure 14-24 (a)-(b)-(c)-(d)

(c) illustrates that, keeping the source in the same position, when the plate is tilted to  $\theta = 30^\circ$ , there is a considerable decrease in the width of the crystalline channels in the  $Y$  direction, while the gaps in the  $X$  direction remain the same.

At  $\theta = 57.2^\circ$ , on Figure 14-24 (d), the  $Y$  channels are practically closed. The  $X$  channels are still unchanged. Thus, the  $X$  components of the momenta were mostly refracted, while the  $Y$  components were mostly reflected. – All the above suggest, that depending on the density of the transparent medium and on the specific angle of incidence, there exists a *total refraction* of the transverse component, which is parallel to the plane of incidence and leaving the reflected beam with the  $Y$  component only.

This light is called, plane polarized. As for the longitudinal components of momentum in the  $Z$  axis, the actual forward momentum which drives the pulse in its propagation, it has been shown by the three dimensional plotting of the momentum amplitude, that the genuine  $Z$  component is a very small percentage of the total. However, without exemption, all vectors in both the  $Z$ - $X$  and  $Z$ - $Y$  planes are composed from much greater longitudinal than trans-

verse components of the total initial momentum. In the free Aether these compositions of the longitudinal and transverse momentum produce the spherical expansion of the compression pulses.

When light enters into the internal Aether, that pervades the gaps and channels of transparent matter, the resulting excess density of the boundary layer separates the total momentum according to the oblique angles of the components.

One part produces Huygens secondary wavelets within the glass, where they are retarded and consequently the beam is refracted. The other part of the components rebound from the compressed boundary and the Huygens wavelets reproduce the pulses in the proper angle of reflection.

Thus, the kinematics of Malus' polarization by reflection can be described as follows:

Both mirrors are tilted to an angle with the direction of propagation of the beam in such a way that the channels of the crystalline structure are only open for the transverse components which are parallel to the plane of incidence. This part of the beam enters into the body of the glass to be refracted. The rest of the beam continues in the reflection. In the

example, at the first glass all  $X$  components were refracted and only the  $Y$  components were reflected. By tilting the second mirror into the same angle, but *rotating rectangular to the initial plane of incidence*, the channels were only open for the  $Y$  components, and they were refracted in total. Since in the beam, at that stage there were no surviving  $X$  components, there was nothing to be reflected. The light was totally polarized.

As it has been established earlier, in the case of polarization by polaroid sheets (or crystals) the theory of the kinematical distribution of the transverse and longitudinal components of the momentum gives equivalent mathematical results with those of the presently accepted theory. The same is valid for Malus' polarization by reflection, or rather, that of *polarization by refraction*. The difference is the conceptual understanding gained by the derivation of them from kinematic or dynamic principles.

This heuristic hypothesis of polarization, right or wrong, is presented with the intention to make one major point:

The presently accepted explanation of polarization is ambiguous and blocking all plausible models

of the Aether, as a transmitting medium for electromagnetic waves. The ruling hypothesis paralyzes the search for alternative explanations of the more general and major physical phenomena, like gravitation, inertia, electricity, magnetism, and also those of the postulated and accepted relativistic mysteries, like absolute speed of light, space curvature and mass increase, etc.

At the very least, the presently accepted solution of polarization should be suspended until a reasonable doubt about *all* other possible alternatives has been established. The polarization file of wave-optics should not be left closed and forgotten, as so many others, but kept wide open for the inquiry of open scientific minds to search alternative solutions for the crucial ambiguities of modern physics. – Prejudice is the same retarding force, whether it has been formed centuries ago or a day before yesterday.



## **CHAPTER FIFTEEN**

### **THE UNDULATION OF LIGHT**

#### **ELECTROMAGNETIC OSCILLATION**

Let us assume, that the foregoing chapters have established the admissibility of the isotropic, all-pervading, *ideal-gas-model* of the Aether as the conveyer of light and, in general, all electro-magnetic radiation. Thus, based on the above presented kinematic theory of wave-motion, and in strict analogy with sound, AETHRO-KINEMATICS suggests that radiation is a train of locally induced periodical density

disturbances, or compression pulses, which kinematically dissipates in the all-pervading isotropic gaseous medium of Aether.

Thus, the task of this chapter is to describe the kinematical equivalent of *electromagnetic oscillation*, its role in producing the local compression fluctuations, and to uncover the kinematics of the resulting resonant oscillation at the receiving end.

In the following, an heuristic theoretical attempt is offered to describe the origin of the compression pulses of radiation based on the earlier suggested kinematic theory of wave-motion, together with the logically connected circulatory patterns of the Aether, derived through the kinematic description of electric and magnetic phenomena, presented in Chapter Twelve.

Since Maxwell and Hertz, light is taken as a certain range of electromagnetic waves and its origination is usually introduced by the description of electromagnetic oscillations.

Two spherical metal conductor separated by a space that does not conduct electricity represent a device, which can store opposite electrical charges and called a *capacitor*.

A most modern and somewhat mysterious description of this phenomenon is found in Gamov's, *Matter, Earth and Sky* (121):

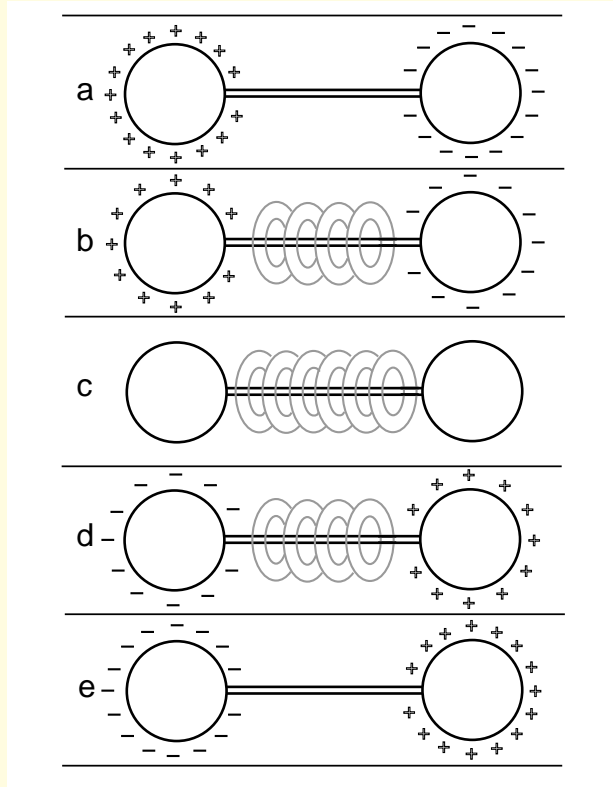


Figure 15-1.

"If we take two spherical electric conductors and give their surfaces opposite electrical charges, we will have to do work in some way to pull electrons off the surface we charge positively and to force excess electrons onto the surface we charge negatively. If we look to see where this work has gone, we will find that it is stored in the *electric field* which now exists between the two conductors. Suppose we connect these conductors by a piece of wire (Fig. 15-1 (a)).

"The opposite charges on the spheres will begin to be neutralized by the flow of electric current from one to the other, and as the charge on each sphere becomes less, the electric field between them will also decrease.

"We may ask now, what happens to the energy stored in the electric field as the field becomes weaker? The answer is that we can find this missing energy stored in a *magnetic field* that has been created by the current in the connecting wire (b). In (c) we see the situation when the charges have been completely neutralized; the electric field vanished and all of its energy is now in the magnetic field. There is no difference in charge to keep the current flowing, and if this were all, the current would stop.

"But Le Chatelier's principle now goes to work to maintain the status quo, i.e., to prevent the current from stopping.

"Hence, the magnetic field delivers its stored energy back into the wire to keep the current flowing, (d), and the charge begins to build up on our spheres in the opposite direction. Finally, when the magnetic field has been reduced to zero, the current stops, and we have the same situation, (e) we had in the beginning, except that the sign of the charges has been reversed.

"Now, of course, the whole cycle will repeat itself in the reverse direction, and again, and again, and so on.

"Part of the energy of our oscillating electric circuit will go into creating 'electromagnetic waves' radiating into space. From the point of view described in the previous section, we can say that the 'lumps' of jelly-like electromagnetic field material vibrating in the space surrounding the two spheres are torn away and travel freely in the space beyond.

"Here again, a propagating electromagnetic wave should be visualized as *a vibrating lump of electromagnetic field material flying through empty space*

rather than as the propagation of an elastic deformation in some all-penetrating medium."

Before getting into the details of an alternate kinematical description of the phenomenon, some of the already established AETHRO-KINEMATICAL concepts should be recapitulated.

One of the general conclusions has been formulated through the kinematical descriptions of the battery, the electric current, and the magnetic field around a current carrying conductor. The general classical assumption of the existence of the *action-at-a-distance forces* of attraction and repulsion between opposite electric charges was shown not to be necessary for the kinematic explanation of the *electron current*. Once the circulation of the Aether in the conducting circuit and the battery was conceptually justified by the chemically induced sink and source system, both the continuous circulatory drift of the free electrons, and the magnetic field around the conductor was fully explained.

In fact, this kinematical description resolves several confusing contradictions of the old theory, including the mysterious migration of the electrons through the liquid back to the negative terminal in

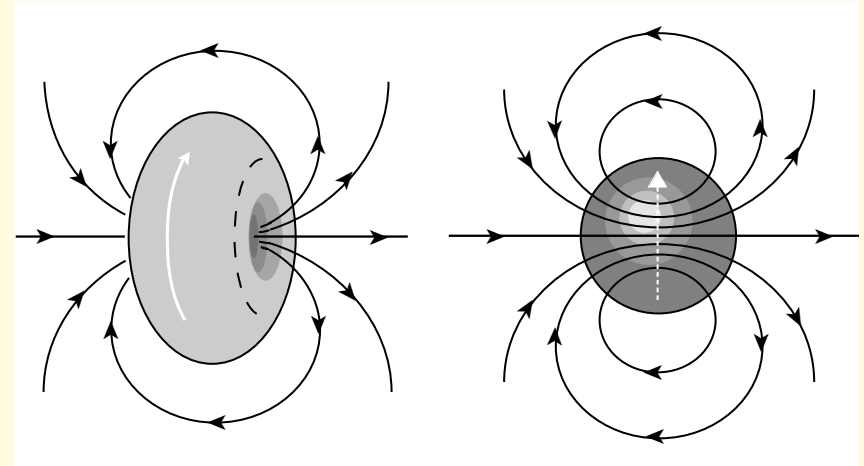
spite of the alleged attraction by the protons of the positive terminal and in spite of the increasing repulsion of the excess electron density at the negative terminal.

From these conjectures it follows, that the assumption of the classical electro-magnetic theory, that the attraction between opposite charges moves the electrons, and in turn, the motion of the electrons creates the magnetic field around the conductor, was mistakenly based on a *reverse order of cause and effect*,

The kinematic theory arrives to the conclusion that both the *electromotive force*, that moves the electrons, and the *magnetomotive force*, that effects the compass needles originate from one and the same cause; the sink and source system created by the locally induced density differences of the Aether and the resulting *cylindrical sink-vortex*, within and around the battery and its current and rotation within and around the external conductive circuit.

Consequently, the following description of electromagnetic oscillator should also be based on the sink and source system of a dipole and understood by the resulting circulation of Aether.

Figure 15-2 shows the fundamental AETHRO-KINEMATICAL concept; the *Donut-vortex* (a), the simplest evolutionary form of a *permanent* circulatory pattern, originated and maintained by the internal kinetic energy of the Aether. This kinematical unit is, in all aspects, equivalent with the most modern scientific visualization of the elementary particle, called *electron* , (b).



(a) Figure 15-2 (b)

The Donut-vortex represents a directional circulation, which is equivalent to a dipole moment, thus it is inter connectable and capable to form higher order systems. The same sink and source circulation

can evolve in different orders of magnitude on atomic and molecular level. Similar circulatory patterns can explain the electromagnetic kohesional forces of macroscopic matter.

Hence, it can be assumed, that any macroscopic chunk of matter should be surrounded by some kind of *circulatory boundary layer* to equilibrate between the dynamic energies of the circulatory fields of the peripheral atoms and the random kinetic energy of the isotropic static pressure of the external medium.

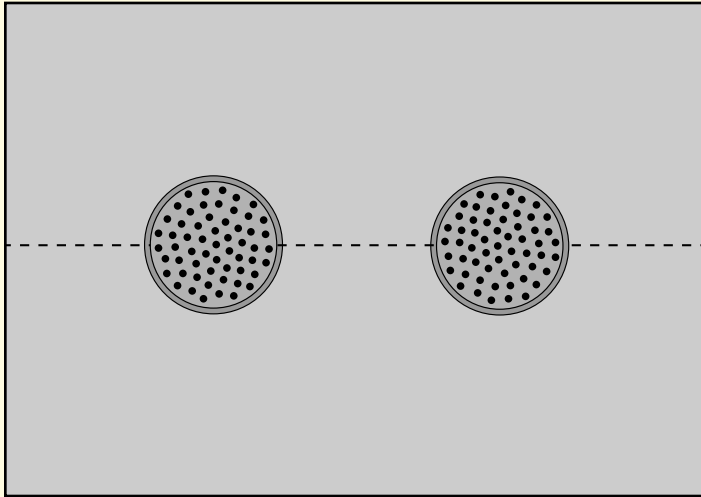


Figure 15-3

Figure 15-3 is a schematic illustration of the starting state of a capacitor with the two uncharged metal spheres submerged in Aether and filled with electron gases of equal density.

Neglecting the complex atomic structure, five different states of the Aether can be defined in the system of a capacitor.

1. The external isotropic Aether of fundamental density.

2. The medium that fills the space within the metal spheres, which is slightly rarefied by the effect of sharing the space with the atomic lattice and the isotropic gas of conduction electrons, (donut-vortex) schematically represented by the coarser dots.

3. The circulatory boundary layers, which equilibrates between the external and internal medium, represent a third density and act somewhat similar to the *surface tension* of a liquid.

4. The dynamic circulatory units of the individual electrons, the donut vortices.

5. The global behavior of the free electrons, which are in constant random motion (drift), and together have the characteristics of a compressible, ideal gas.

This medium is locked into the the spheres by the dynamics of the boundary layers.

In the next step the two spherical conductor is being oppositely charged by temporarily connecting the left sphere to the negative, and the right sphere to the positive terminals of a battery by a conductor.

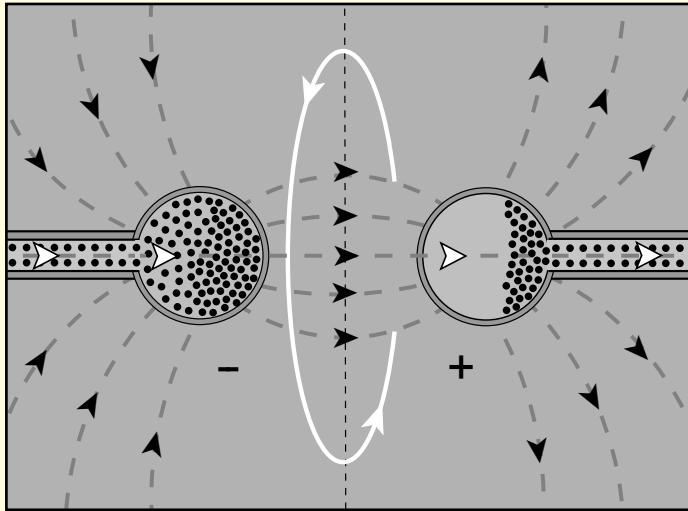


Figure 15-4

Figure 15-4 illustrates the five different states of the Aether while the spheres are being charged. The connection of the spheres with the battery creates a temporary current, that is, the sink and source system

of the battery produces a cylindrical sink-vortex in the Aether within and around the capacitor.

This circulation of the Aether through the conductors and in spite of the gap between the spheres (Maxwell's concept of displacement current) forces additional electrons on the left sphere and removes the same amount of electrons from the right sphere. The result is a density difference between the electron-gases of the two spheres; equivalent to an electric potential difference.

Part of the cylindrical vortex represents a *magnetic field* around the system, which rotates in a given direction (white arrow). The temporary circulatory pattern in the capacitor points from the negative to the positive terminal of the battery and through the external circuit. The circulation of the Aether exerts a directional pressure on the electron gases trapped within the boundary layers, which ceases when the circuit is broken.

Figure 15-5 represents the situation after disconnection. The left sphere is filled with excess electron density which also creates an increased density of the Aether and plausibly an expansion of the boundary layer.

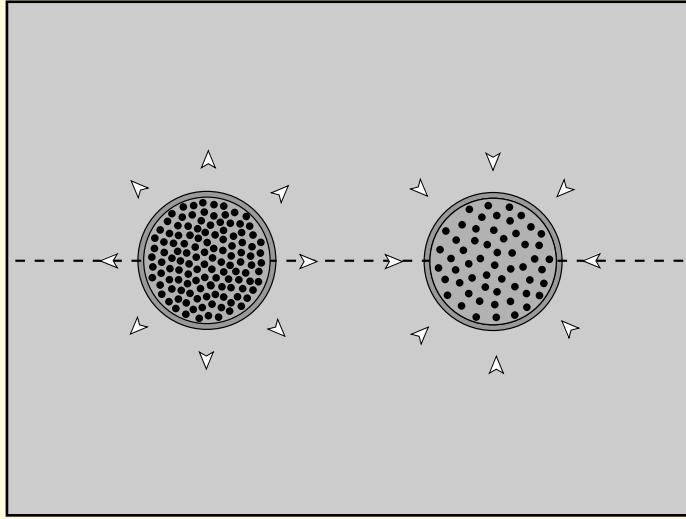


Figure 15-5

The state of the right sphere is exactly the opposite. This reciprocal pressure in the two spheres serves as the fundamental kinematics of the *electric potential difference* between the plates of the capacitors. The periodical release of these pressure differences through the 'elastic' boundary layers is the kinematical equivalent of a *static electric field*.

Figure 15-6, A-B-C-D illustrate four phases of the oscillation of the electric and magnetic fields of the capacitor after connecting the two spheres by a metal

conductor. These phases are repeating at high frequency, and because of the loss of the excess pressure through the radiation of compression pulses, the potential energy of the system soon dissipates.

(A) illustrates the capacitor when the two oppositely charged spheres are connected with a conductor. Through the wire the released electron gas tends to fill the whole available space. This tendency creates a rarefaction in the Aether of the left sphere which becomes a *sink*. The cylindrical vortex around the conductor establishes a circulatory pattern through the right sphere which becomes a *source*.

(B) shows that, the dipole moment of the Aether circulation exerts a directional pressure on the electron-gas, condensing it in the right sphere. From here on the density of the electron gas gradually decreases and eventually blocks the Aether flow at the right end. At this stage, within the boundaries, the remaining circulation condenses the Aether itself, until the excess pressure finally overcomes the strength of the boundary layer and escapes into the external medium in the form of an *Aetherial compression pulse*.

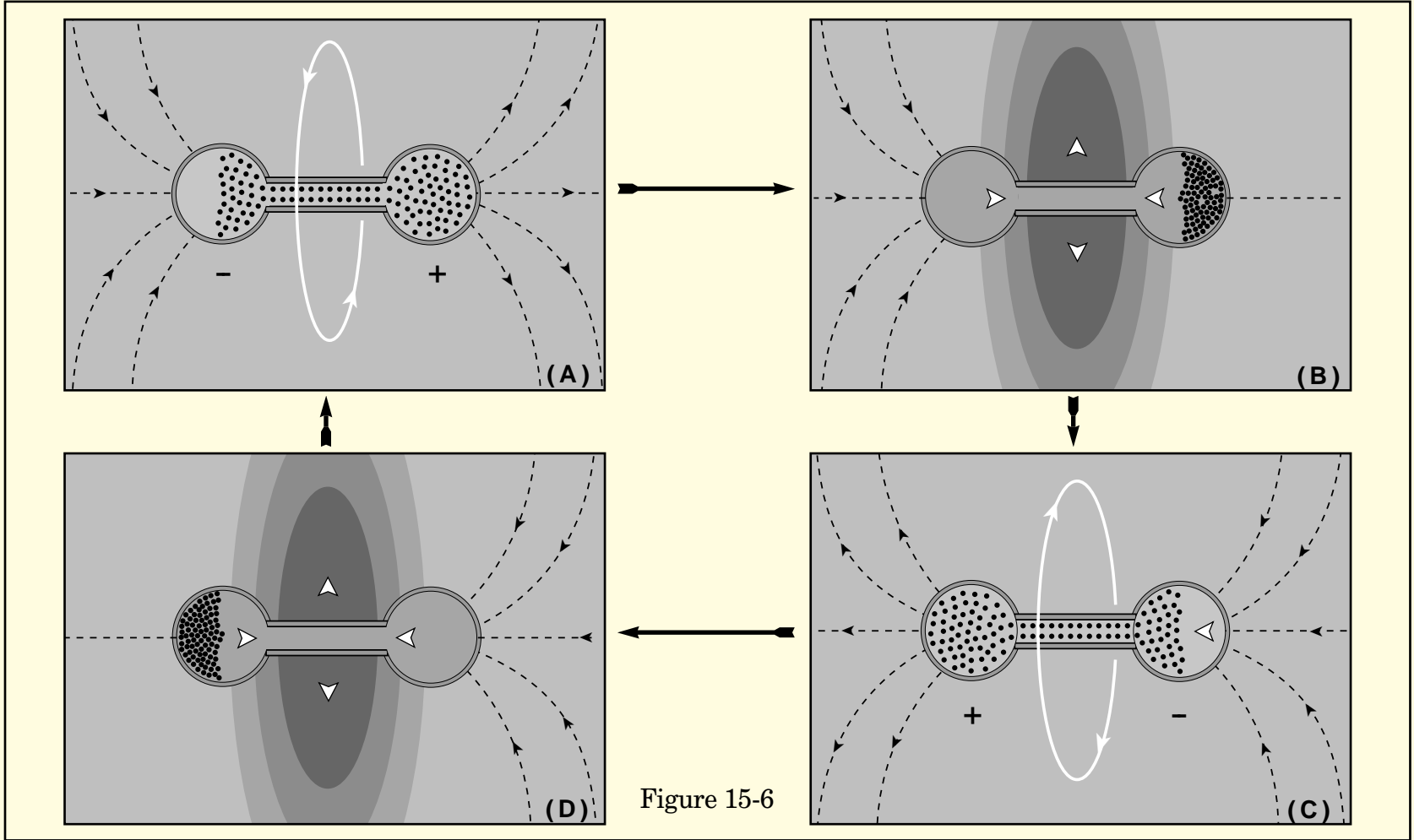


Figure 15-6



(C) shows the reciprocal tendency of (A). This time the condensed electron gas is released by the ceasing of the circulation and by the energy radiated away via the compression pulse. The free expansion of the electron-gas creates a sink at the right sphere, which in turn starts up the Aether circulation in the opposite direction and creates a source at the left end. The spheres changed signs in the procedure; the right sphere became *positive*, the left sphere *negative*. Both the *electron current* and the rotation of *the magnetic field* have changed directions.

(D) illustrates the reciprocal state of (B) as the reversely directed Aether flow creates a new compression pulse. Evidently (A) is the direct continuation of (D) and the whole procedure starts all over again. The oscillation has been established.

The compression pulses are propagated in the isotropic Aether through space as a train of periodical disturbances, the frequency and wavelength of which depends on the dimensions and the resulting periodicity of the capacitor.

As Hertz discovered, a resonant oscillation can be produced through space in another capacitor, provided that it has exactly the same dimensions as the

oscillator. The requirement of dimensional equality is an important clue in that respect, that electromagnetic oscillators and receivers just like tuning forks, are only resonant to their own frequencies. This also means, that their oscillation is determined only by their *own restoring forces* and not on the oscillation of the particles of the medium.

It is again a justification of the conclusion, had been reached before, that like in the case of sound in air, the harmonic back and forth or transverse oscillations of the particles of the Aether is not required for the transmission and reception of harmonic oscillation. A train of the periodical forward force of compression pulses, produced in a harmonic oscillator is adequate to create resonant harmonic oscillation in a dimensionally equal receiving system. The elastic restoring forces of an electromagnetic oscillator and receiver is rendered by the compressibility and internal kinetic energies of both the electron-gas, and that of the Aether contained within the boundaries of the conductors.

The classical theory of light is given in two department of physics. Geometrical optics is based on Huygens' intuitive principle and the hypothetical

concept of the *light rays and secondary wavelets*. The physical character of light and radiation, described by Faraday's and Maxwell's electromagnetic theory, was initially based on the physical reality of a transmitting medium, however, due to the relativistic influence, it acquired the fundamental obscurity of all other physical theories; the acceptance of the action at a distance through empty space.

The above presented AETHRO-KINEMATIC radiation theory is an attempt to extend and correlate the classical methods of geometrical and physical theories of light and radiation. The Kinematical Theory of Wave-motion renders a conceptional understanding for Huygens' intuitive geometrical construction and with the admission of the Aether medium as an ideal gas, it dismisses all related mysteries of the action at a distance.

Nevertheless, some radiation phenomena have been discovered toward the end of the last century, which stubbornly refused to fit in all previous theories of classical physics. The modern solutions for these problems are contained in Quantum Physics. The analysis and explanation of these new mysteries, profoundly changed our world picture, forced an

epistemological revolution and the acceptance of the theoretical duality of light and that of matter. These are the topics of the next chapter.

This topic, as the kinematic description of the phenomenon of *electrostatics*, will be discussed in AETHRO-KINEMATICS III.

## **CHAPTER SIXTEEN**

### **QUANTUM AND KINEMATICS**

As it has been described in Chapter Three, in the course of resolving the discrepancies between the observed energy spectrum of black body radiation and the predictions of the classical theories, Max Planck was led to the hypothesis that a system executing simple harmonic oscillations only can have energies which are integral multiples of a certain finite amount of energy (1901). A closely related idea was later applied by Einstein in explaining the photoelectric effect (1905), backed up by Compton's collision hypothesis. In 1913 Bohr published his theory based on the new concept of the quantum, which pre-

dicted with great accuracy many of the complex features of atomic spectra. The work of these physicists, and the subsequent developments by de Broglie, Schrodinger and Heisenberg (1920–30), constitute what is known in general as the *Quantum Theory*. Today's highest level of theoretical physics, which is mostly complex mathematics of probability, is called *Quantum Mechanics*.

While the theories of relativity originated from the inability of classical physics to explain the empirical facts of the absolute speed of light (Michelson's null result), the quantum theory originates from the incapability of classical principles to explain the transition of energy between radiation and ponderable matter, which is closely related to the structure of the atoms and their spectra, and the peculiar behavior of elementary particles.

There are eight major innovations, through which the modern Quantum Theory has affected the conceptual foundations of classical physics and philosophy. Each of the revolutionary ideas is tied to the name of the innovator and to a group of phenomena, which have been found unexplainable by classical theories:

1. Planck's Quantum Theory of black-body radiation.
2. Einstein's Photon Theory of the photo-electric effect.
3. Bohr's quantized Theory of the Hydrogen atom, and spectra.
4. The collision hypothesis of the Compton effect.
5. DeBroglie's theory of the existence of matter-waves.
6. Heisenberg's discovery of the Uncertainty Principle.
7. Schrodinger's equation of quantized waves of probability.
8. The discovery of matter and antimatter by Dirac.

This chapter is a continuing attempt to give alternative explanations for the insolvable problems of classical physics within the reach of human perception, and by the original and intelligible, single language of classical science and epistemology.

Instead of re-iterating the classical problems and their quantum solutions in full details, if necessary, the reader may refer back to Chapter Three.

## PLANCK'S FORMULA

In his striving to produce a mathematical formula of radiation that fits the experimental curve, Planck was forced to the following deviations from the standard procedures of classical physics:

a) At a given stage of the derivation of the average energy of an oscillator, according to the classical rules the increment of the integration must approach zero. This method had been used by Raleigh and predicted the probability of the ultraviolet catastrophe. Planck noticed that by keeping this increment as an extremely small, but non-zero quantity, Raleigh's faulty end-result can be eliminated. This constraint created the constant  $h$ , which in turn, resulted in the concept of *discontinuity* of the average energy levels of the atomic oscillators.

b) The universal constant,  $h$  achieved the granularity of electromagnetic energy, but in order to correlate this constant with Wien's empirically proven Displacement Law, Planck had to assume that the finite quantity of energy exchange between radiation and matter is proportional to the frequency,  $\nu$  of the emitted or absorbed radiation; i.e., a quantum of energy,  $\epsilon = h\nu$ .

Accordingly Planck's *semi-classical* conceptual interpretation of his final formula assumed that the distribution of energy among electromagnetic harmonic oscillators in thermal equilibrium cannot vary continuously, but must always be an integral multiple of a certain quantity and therefore take on one of the discrete set of quanta;  $E = 1h\nu, 2h\nu, \dots, nh\nu,$ , where  $n$  is an integer,  $h$  is a universal constant, and  $\nu$  is the frequency of radiation. It follows, that *an oscillator must have a discrete set of energy levels, and the emission and absorption of radiation must also be associated with the discontinuous transitions, or jumps between levels, which always happens by the loss or gain of a whole quantum of radiant energy of magnitude,  $h\nu$ .*

c) Finally, to eliminate the initial deviations of Wien's curve from the experimental facts, Planck has elected to modify Boltzmann's method of counting the probabilities of the energy distribution among the different frequencies. He also attempted to give a conceptual explanation for this modification by reasoning that it takes more time for an oscillator to accumulate a quantum of the higher frequencies, than that of the lower ones and consequently, the

probability of accumulating lower frequencies is greater than higher ones.

Undoubtedly, the resulting mathematical formula gave a perfect match to the experimental curve for the distribution of radiant energy at all temperatures. Nevertheless, Planck's retroactive attempt to construct a conceptual theory of the physical meaning of the formula was not that successful.

In the 'Introduction to Modern Physics' Richtmeyer [128] presents a condensed summary of the situation at this critical stage in the evolution of the quantum theory:

"The problem of the absorption and emission of radiation, in fact, presented serious difficulties for the new theory. If the energy of an oscillator can vary only discontinuously, *the absorption and emission of radiation must likewise be discontinuous processes.* As long as the oscillator remains in one of its *quantum states*, it cannot emit or absorb radiation according to the laws of classical physics, for the classical theory absolutely requires an isolated, accelerated electric charge to radiate energy.

"According to Planck's new theory, *emission* of radiation occurs only when the oscillator jumps from one

energy level to another (lower one) ... the energy,  $h\nu$  that it loses, is emitted in the form of a short pulse of radiation. *Absorption* was also assumed at first to be discontinuous.

"An oscillator can absorb a quantum  $h\nu$  of energy, and jump *instantaneously (or nearly so)* up to its next-higher energy level. This assumption met with special difficulties, however. For the quantum of radiant energy emitted, according to the classical wave theory, would spread out over an ever expanding wave front, and it is hard to see how another oscillator could ever gather this energy together again so as to absorb and thereby acquire the energy for an upward quantum jump. To avoid this difficulty, Planck later modified his theory so as to allow the oscillator to absorb in a continuous manner, and only the process of emission being discontinuous. This came to be known as the *second form* of Planck's quantum theory.

"Having read thus far, the student may perhaps have reached a state of confusion as to *what were* the essential assumptions of Planck's quantum theory! This confusion can not be worse than that which existed in the minds of most physicists in the year,

say 1911. The situation was made still more puzzling by the success of Einstein's theory of the photoelectric effect; for Einstein assumed not only that radiation came in quantized spurts but that each spurt was closely concentrated in space, contrary to the classical wave theory."

This is then the exact stage in the evolution of the quantum theory, where it breaks away not only from the principles of classical physics, but also from the fundamental epistemological requirement of the conceptual coherency of a physical theory.

Einstein's method to solve the problem of the photoelectric effect was the same as in the case of the perplexing problem with Michelson's *null result*. In both cases, he simply and boldly postulated the insolubility of the problem based on classical principles. To explain the photo-electric effect, he reinstated Newton's corpuscular theory of light and declared the unavoidable necessity for a dual language to describe the dual nature of light; one for the case when light is manifesting wave nature, and one for those when it behaves like it was a particle.

No doubt, if there exists a way to rehabilitate the validity of common sense and the fundamental faith

of science in humanly conceivable physical laws then, besides the theories of relativity, this issue is the other major cross-road, where science, and epistemology must attempt to find an alternate solution.

From the standpoint of AETHRO-KINEMATICS, in the most general sense, the fundamental conceptual problem with the *continuity* of the classical electromagnetic energy is eliminated by the acceptance of *the ideal gas model of the Aether*. In spite of the difficulty to imagine the supermundane order of magnitude of this medium, it is still materialistically granular. The discontinuity of Aether is represented by the fundamental units of *the size, mass, velocity and the momentum of the Aethron, all of which are related to the velocity of the propagation of disturbances in Aether, which is that of light and radiation; c*.

As it was discussed earlier, there exists a non-zero collision free path among the Aethrons, and just like in the case of sound- or water-waves, there exist a minimum possible wavelength, and therefore a maximum frequency, for any periodical disturbance that is kinematically producible in this medium.

Planck's intuitive analogy between radiation and water waves and the role of the water molecule, or

the atom of a monatomic gas as the limiting factor in the dispersion of the kinetic energy, is also valid in the ideal gas of Aether. Thus, the Huygens-Maxwell undulatory theory of radiation, based on Aether, does not demand an infinite range of frequencies and consequently it is free from the danger of Raleigh's ultra-violet catastrophe.

Nevertheless, Planck's analogy was not entirely correct. As the shortest possible water- or sound-waves are not represented by the kinetic energy of a single atom, similarly the energy of the shortest wavelength of radiation cannot be represented by the kinetic energy of a single Aethron. The granularity of the energy is not equivalent to that of the medium.

The foregoing kinematical thought-experiment about the periodical compression pulses of sound led to the conclusion that both the frequency and amplitude of the simple harmonic oscillator of a sound source are reproducible in the resonant oscillation of the ear-drum without requiring that the particles of the medium also perform simple harmonic oscillation. The following quote is presented to clarify the validity of the exclusively forward momentum in the kinematical wave-theory:

"...with regards to the momentum carried by waves, you would conclude prematurely that since the momentum of the mass oscillates and thus whose average value is zero, the sinusoidal wave cannot carry net momentum.

"This, however, is a wrong argument. As a mass moving with constant velocity has both kinetic energy and momentum. Thus any waves, (mechanical and electromagnetic) should carry both energy and momentum. If we stretch a spring, the mass density decreases, if we compress it, the mass density increases. The quantity we have to watch carefully is the variation in the *mass density*. Thus, in the presence of a wave at any point in the medium *the momentum density* (the momentum per unit length) is also varies.

"After defining a 'density wave' we find the important conclusion, that the

$$\text{Momentum density} = \frac{\text{average energy density}}{\text{wave velocity}}.$$

"Note that the momentum transfer rate is equivalent to a force. Thus, electromagnetic waves can indeed carry momentum and the force exerted by

them is called *radiation pressure*." (Akira Hirose, Introduction to Wave Phenomena [66])

Hence, the propagation of the individual, periodical compression pulses forming all wave-motions represents a *discontinuous delivery* of a force in the form of a periodical forward momentum transmitted through the medium. This discrete amount of periodical force might as well serve as Planck's concept of discontinuity. – For the clarification of this suggestion, consider the detailed mechanics of the production and reception of compression pulses by a simple harmonic oscillator in an isotropic gaseous medium.

First examine the structure and mechanics of the ideal simple harmonic oscillator of a frictionless piston of given *mass*, oscillating in empty space under the influence of the restoring force of the coil springs with a given *force constant*.

The distance between the center of oscillation and one of the points of extreme displacement represents the *amplitude*. The time it takes to complete a full cycle, which also includes the return of the oscillator to its initial point of displacement, is the *period*. The *restoring force* of the springs is directly proportional to the displacement and therefore with greater



displacement the piston is forced to move and accelerate faster. Consequently the period of oscillation is independent from the amplitude. It follows, that the frequency of the oscillator depends exclusively on the structure of the oscillator. In this ideal example there are two determining factors; the *mass* of the piston and the *force constant*, i.e. the restoring ability of the spring. The ratio between the mass and the force constant clearly determines the natural frequency of the oscillator.

Thus, in order to produce different frequency oscillations one of these mechanical factors must be altered. Decreasing the mass of the piston or increasing the restoring force of the springs result in higher frequencies, and increasing the mass or decreasing the restoring force results in lower frequencies.

Figure 16-1, (Fr.-0) illustrates the isolated system of an oscillator, which is initially at rest. The small sphere that is approaching the piston from the right represents an external force in the form of a projectile of a mass, say  $1/10$  that of the piston.

This projectile moves to the left with a given velocity. After collision at mid-point (Frame-1), the projectile transfers part of its momentum and

rebound while the oscillator moves in the initial direction with velocities in accordance with the law

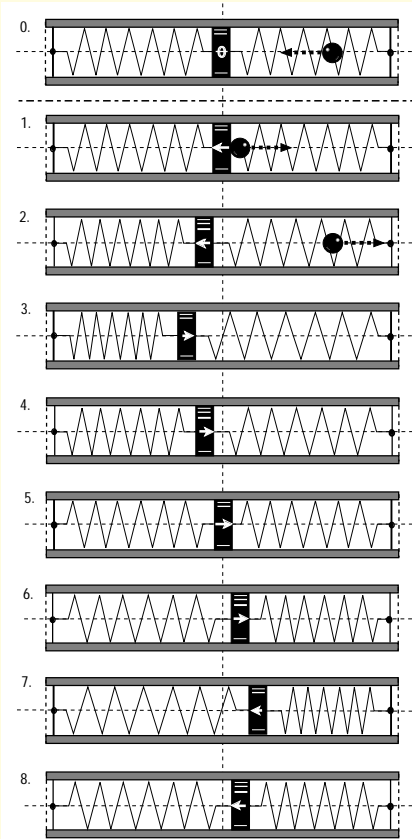


Figure 16-1.

of the conservation of momentum. Due to the increasing restoring force of the springs the piston gradually decelerates to zero, then changes direction, and accelerates toward the mid-point where it reaches its maximum initial velocity.

However, due to its inertial properties, it overshoots to the right. From here on, if nothing else happens with the system, there will be a steady oscillation at the given natural frequency of the oscillator, which depends on the ratio between the

mass of the piston and the force constant of the springs.

The amplitude of the oscillation, i.e., the maximum displacement from the center, depends on the initial momentum of the projectile. In each cycle, the piston passes through the original position, at mid-point, with its highest velocity. – This example can be extended with the repetitions of the external force by sending identical projectiles into the system with such frequency, that each collision happens while the piston moves to the left and at mid-point. From each of the periodical impacts the piston will gain the same increment of momentum, which will take it to a larger maximum displacement, producing a greater amplitude in its natural frequency.

In general, one can conclude, that the oscillator absorbs energy in a discontinuous manner by discrete increments (momentum of projectile) and that the amplitude of oscillation, or the energy level of the system is also altered by 'jumps' of finite quantities.

Next consider the case when this oscillating system produces compression pulses in an isotropic compressible medium. The illustration of Figure 16-2 deliberately starts with the extreme left position of

the piston at zero velocity, because the cycles of the production of periodical compression pulses start and

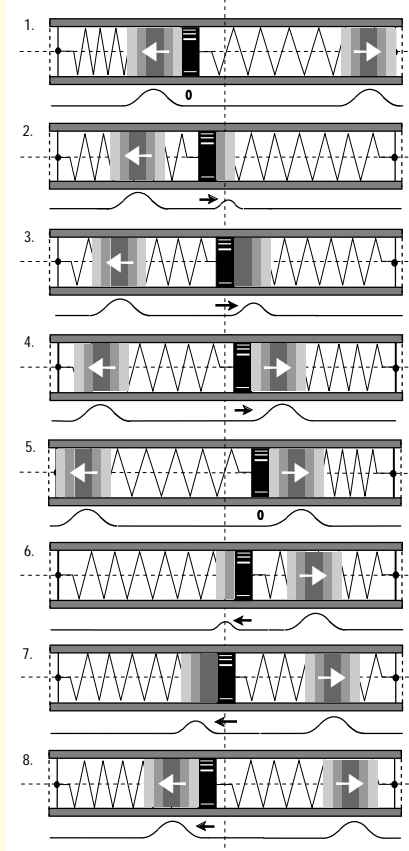


Figure 16-2.

end at the extreme displacement points of the oscillator. The reason for this follows from the consideration that the compression of the medium starts when the velocity of the piston becomes greater than zero.

In this two dimensional oscillating system, two separate compression pulses are produced in opposite directions during each complete cycle starting at one of the extreme displacement points. Thus, the motion of the piston produces periodical compression puls-

es, propagating in opposite directions with the speed of the dissipation of disturbances in the medium. This produces a frequency determined by the structure of the oscillator.

There is also a discrete amount of forward momentum in each pulse, characterized by the mechanical structure (mass and spring) of the simple harmonic oscillator.

It follows from all above, that the momentum density of a single compression pulse is proportional to one half of the energy of a single total cycle of the oscillator, and therefore the 'emission' of the energy, or the transference of the forward momentum from piston to medium must also be represented by discrete quantities.

Finally, the reciprocal of the above example can be conjectured. When an oscillator at rest receives individual compression pulses, carrying discrete quantities of forward momentum, it moves out from its equilibrium position in proportion to the force and begins to perform simple harmonic oscillation. If the frequency of the pulses matches the natural frequency of the oscillator and synchronized with it in phase, each pulse will increase the displacement, of the pis-

ton, i.e., the amplitude, or *energy level* of the oscillator by a discrete increments of energy.

The final limit of the accumulation of energy is reached at the extreme displacement when the restoring force of the spring is equal to the momentum carried by the pulse.

By direct analogy, the same mechanism is applicable to the radiating energies transmitted by the Aether to the simple harmonic electromagnetic oscillators. The acceptance of an all-pervading granular medium, and that of the kinematic theory of periodical compression pulses and its correlation with the momentum density of classical electromagnetic theory create a kinematical explanation for the discontinuity of the electromagnetic fields.

Further more, it opens up a variety of plausible theoretical schemes to fill the conceptual vacuum of Planck's mathematics. With this the kinematical role of the *quantum*,  $h\nu$ , as it will be discussed later, may become humanly conceivable.

Nevertheless, historically, before anything enlightening has been given for Planck's conceptually unclear discovery, a new problem, and with it, a new source of confusion occurred.

## THE CORPUSCULAR WAVES OF RADIATION

In 1887, while conducting experiments on electromagnetic waves, the German physicist Heinrich Hertz happened to observe that a metal surface can emit electric charges when ultraviolet light shines on it. The phenomenon has been named, the *photoelectric effect*. The later discovery of the *electron* suggested the hypothesis that the photoelectric effect is due to the ability of radiating energy to liberate free electrons from the metal.

In 1902 Philipp Leonard, Hertz's assistant published a detailed account of his experimental study of the effects of radiation on metal surfaces. Figure 16-3 illustrates the schematic of Leonard's device for observing photoelectric effects.

Leonard allowed light of different frequencies to fall on a clean metal surface in a vacuum tube. The electrons liberated from the surface of the positively charged *cathode* were accelerated toward the negatively charged *anode*. Some passed through the opening and reached the plate and the electrometer (1), by which the *photoelectric current* was measured. Their velocities could be measured by adjusting the electric potential, and attracting the electrons to the

Meter 2, via electric and magnetic fields.

After the thorough examination of the experimental facts the following conclusions were reached:

1. The ejection of the *photoelectrons* occurs only when the frequency of radiation exceeds a certain

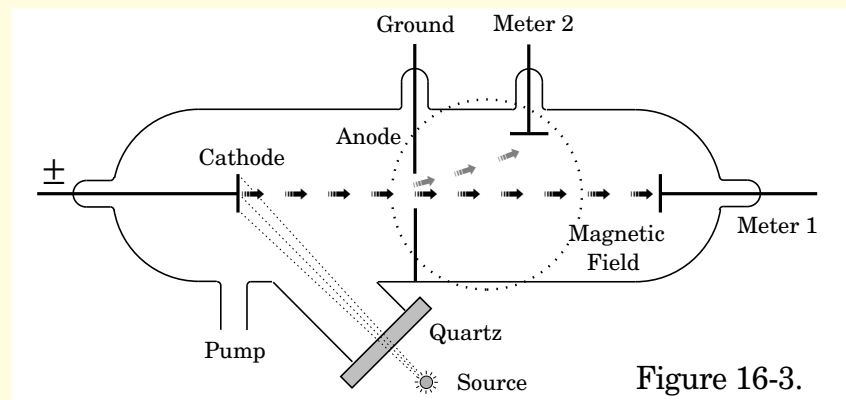


Figure 16-3.

minimum value. This is called the *threshold frequency*, which is characteristic of the emitting metal. The threshold energy is independent from the intensity of the radiation.

2. The effect is a surface phenomenon and the threshold frequency varies considerably with the state of the surface. Highly polished surfaces decrease the threshold frequency of emission.

3. Electrons, liberated from the cathode, move in all directions with various velocities. The emission of the electrons are distributed randomly in *time*. The *average rate of emission*, or the kinetic energy of the total number of ejected electrons per unit time is proportional to the *intensity* of the radiation.

4. When *negative potential* applied to the cathode, which repels the electrons, the photoelectric current increases up to a limit. Above 'about 15 or 20 volts negative' there is no more increase in the current. This is called the *saturation value*.

5. A positive, *retarding potential* decreases the photoelectric current, but upon reversal it does not immediately drop to zero. This proves that the electrons are emitted from the cathode with a finite, *non-negligible kinetic energy*.

6. By the gradual increase of a retarding potential to the exact point where the current stops,  $V_e$ , the value of the *maximum energy electrons* can be found. The magnitude of the stopping potential, or the *velocity of the maximum energy electrons* is independent from the *intensity*, but *directly proportional to the frequency of the radiation*.

7. A variation in the intensity of the radiation is

proportional *only* to the number of electrons emitted from the photocathode.

8. The time delay between the incidence of radiation and the ejection of the first electrons does not exceed  $10^{-9}$  sec and independent of both the frequency and the intensity of the radiation.

Most of the above listed empirical facts and conclusions are completely at variance with the classical electromagnetic theory and the efforts to find a mechanism for the photoelectric effect encountered great difficulties.

It was early assumed that conducting metals contain a great number of free electrons which are in random motion within the crystalline structure, similarly to the atoms of an ideal gas. Electric currents are due to the drift of these free electrons through the conductor under the influence of the electric field. It was also assumed that, when electromagnetic waves incident on the surface of a metal, the oscillating electromagnetic field exerts a force on the free electrons, which thereby set into oscillation with steadily increasing amplitude.

Eventually, some electrons would acquire enough kinetic energy to overcome the attractive force of the

metal and succeed in breaking through the surface with considerable velocity.

There are some contradictions between this mechanism and the empirical facts. For example; the amplitude of the oscillating electric field is proportional to the square-root of the intensity of radiation. Therefore the energy accumulated by the electrons should be dependent on the intensity. However, this is not the case.

Another problem with the gradual accumulation of energy by the electron is that, based on the spread-out energy of the waves and on the size of the electron, it would take a long time to absorb the required kinetic energy. Experiments shows, however, that the time interval between the incidence of radiation and the ejection of the first photoelectrons is exceedingly small. Finally, based on the classical theory, radiation far below the threshold frequency should still be capable to eject electrons, provided it is given enough time to build up the necessary amplitude in the oscillation of the electron to escape. This, however, does not occur.

Such unavoidable contradictions led to another classical hypothesis, namely, that the ejected photo-

electrons are not the free electrons, but coming from inside the atoms, and their release is of the nature of a *resonance mechanism*.

Thus, the light of a given frequency might function merely as a *trigger* releasing the electrons tuned to the same frequency, which thereby already possess proportional kinetic energy. However, this alternative was also refuted, based on the unlikely pre-requisite that atoms must contain resonating systems of all frequencies for which photoelectric emission was observed.

Experimental facts thus seem to demand the conclusion that *the photoelectric energy must come directly from the energy of the incident electromagnetic radiation*.

In Chapter Three it has been quoted in Einstein's own words, how he established the philosophical insolubility of the problems of the photoelectric effect, and what train of thoughts led him to the seemingly only possible solution; the unavoidable acceptance of two incompatible languages for describing the dual nature of light, being waves in certain phenomena and photon-particles in others.

In the following, Einstein's mathematically justified explanation of Leonard's empirical conclusions will be given:

Planck's quantum hypothesis assumed, that electromagnetic oscillators can only emit or absorb energy discontinuously in discrete quanta,  $h\nu$ , but the propagation of this energy still happens according to the wave theory. Einstein extended Planck's quantum concept to the mechanism of electromagnetic radiation itself. He boldly postulated that the burst of energy, which is initially localized in a small volume of space when emitted by the quantized oscillator, *remains localized* and moves through space like a particle instead of spreading out its energy in a spherical form like moving waves do.

a) The energy content  $\varepsilon$ , of such burst, or *photon*, is related to Planck's constant  $h$ , and to the frequency  $\nu$ , (rho) of the oscillator by the equation  $\varepsilon = h\nu$ . In the photoelectric process one whole concentrated photon of the incident light beam is completely absorbed by a single free electron. In other words, the total energy of the photon is transformed into the kinetic energy,  $E_k$  of a free electron in a collision-like event. Thus,  $E_k = \frac{1}{2} m v_e^2 = h\nu$ .

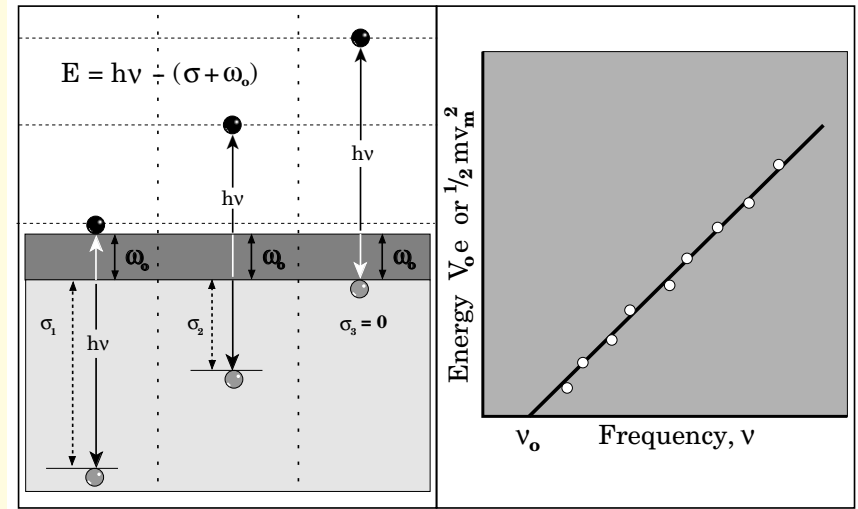


Figure 16-4

b) The intensity of a beam of monochromatic light is equivalent of the *flux*, or the number of photons passing through per unit area per unit time. Since all photons have the same energy  $h\nu$ , and one photon can only strike one electron, the intensity, or the photon density, of the beam only affects the number of ejected photoelectrons but not their kinetic energies.

c) In order to explain why the ejected electrons show a whole spectrum of kinetic energies in spite of the uniform energy of the absorbed photons, it was assumed that the absorption of the photons happens

at different depths in the metal and therefore the electrons might lose various amounts of energy by internal collisions with the atoms before they reach the surface.

On Figure 16-4 (a) this variable loss of energy is represented by the symbol, ( $\sigma_1 - \sigma_3$ ).

d) A photo-electron, which absorbed the photon-energy *just at the surface*, does not lose energy through collisions, ( $\sigma_3=0$  and omitted). The electron still has to spend part of the photon's energy to overcome the attraction of the metal, and therefore its energy after escape will be the energy of a photon,  $h\nu$  less the *work function*,  $\omega_0$ .

Therefore Einstein's photoelectric equation for the final energy of the *maximum energy electrons* is:

$$E_{max} = h\nu - \omega_0 \quad (16.1),$$

where  $\omega_0$  is a constant for all frequencies, and varies only with the chemical composition of the metal of the photocathode.

Based on experimental facts, a simple linear relation has been found to exist between the maximum energy photoelectrons and the frequency of light that causes the emission.

As was shown by Millikan in 1916, Figure 16-4 (b), if the curve is plotted for the maximum kinetic energy,  $1/2 mv_m^2$  and frequency,  $\nu$ , the result is a straight line which shows an intercept,  $\nu_0$  on the frequency axis. The physical meaning of this is that light of frequency less than  $\nu_0$  (the threshold frequency) cannot cause electron emission. The equation of the curve may be written

$$1/2 mv_m^2 = h(\nu - \nu_0) = h\nu - \omega_0 \quad (16.2),$$

where  $h$  is a constant and  $\omega_0$  is the work-function, or the energy spent on liberating the electron from a given metal. Thus, it can be stated that the energy of the maximum energy electrons is directly proportional to the frequency of the light.

Since  $h = (1/2 mv_m^2 + \omega_0) / \nu$ , if the kinetic energy is expressed in ergs and the frequency in cycles/sec, as found by Millikan,  $h = 6.56 \times 10^{-27}$  erg sec, which is in good agreement with the magnitude of Planck's constant explaining black-body radiation.

(For future references, it should be bared in mind, that Millikan's calculation was based on the assumption that the maximum energy electrons absorbed the *total energy of a photon*.)



Thus, Leonard's experimental facts and the conclusions drawn from them have been fully explained by Einstein's bold photon hypothesis and its mathematical description.

Nevertheless, as it is described by Ritchmyer and co-authors, 'Introduction to Modern Physics' in 1954 [99], the scientific situation was not entirely clear and simple:

"The difficulties with such a radical theory of light, however, are many. For one thing, if we regard light as a shower of photons, what can possibly be the meaning of frequency? There is nothing periodic about a falling raindrop, for example.

"As a matter of fact, *in order to find the frequency of a beam of light (a shower of photons), we must measure the velocity  $c$  of the light and its wavelength  $\lambda$  on the assumption that light consists of waves, and then we compute the frequency as  $\nu = c / \lambda$ . Thus, we have to rely on the wave theory of light to give us the energy value  $h\nu$  of the photon.*

"The situation thus created was perhaps the most puzzling one that has ever arisen in the whole history of physics."

And the puzzle only deepened at a later stage when Compton, (1923) announced that photons also possess momentum. Then it became clear that Einstein's initial idea, that photoelectrons were free electrons liberated by radiation, is quite impossible.

For if a single free electron would absorb the entire energy of a photon, it would have, at least temporarily, – still within the boundary, – a kinetic energy  $h\nu$  and also a momentum equal to  $h\nu/c$ .

If, however,  $\frac{1}{2}mv_{max}^2 = h\nu$  and also  $mv = h\nu/c$ , then  $v$ , being the velocity imparted to the electron, would be  $2c$ , double the velocity of light, which is impossible, of course, on account of the postulate of the special theory of relativity.

The remedy to this problem came in the form of the revision of the initial assumption about the origin of the photoelectrons. For if the electron is not free in the metal, but attached to one or more atoms, *part of the photon's momentum could be absorbed by the atoms* and by that the velocity of the extracted electron would not have to exceed the speed of light.

Nevertheless, there are serious problems with this hypothesis, too. It contains still another *unknown factor*, that is, *the ratio between the energies*

absorbed by the atom and by the electron. This ought to cause an uncertainty in the evaluation of the final energy of the maximum energy electrons, thereby causing some unavoidable doubts about the credibility of Millikan's derivation of Planck's constant from the photon theory. – Further developments in the theory of free electrons in metals brought up even more contradictions, due to problems originated in connection with *specific heats*.

According to the classical theory free electrons have the usual Maxwellian distribution of velocities, proper to a gas of electrons at a given temperature of the metal.

Thus, because of their light mass, free electrons would have much higher velocities than the atoms due to thermal agitation. Several lines of evidence also indicated that the number of free electrons should be of the order of magnitude as the number of atoms; according to the *principle of equipartition*, a free electron should have the same average kinetic energy as an atom.

This theory had some success in accounting for the electrical and thermal conductivities of metals. A serious difficulty was encountered, however, in con-

nection with *specific heats*, where the total thermal energy was fully accounted for by the energy of the atoms only.

Therefore, it was necessary to suppose that the heat energy of the free electrons must either be very small, or even totally independent of temperature.

This difficulty was eventually resolved by *wave-mechanics*, a simplified form of which was proposed by Sommerfeld (1928), reproducing the most important features and conclusions so far as they concern photoelectric and thermionic emission. Sommerfeld retained the concept that free electrons form a gas in the metal, but because of the light mass and high density of the electrons, he assumed that it is a *degenerate gas*, which should be treated by the *Fermi-Dirac distribution of energies*. This formula attributes a much greater average kinetic energy to the free electrons than the Maxwellian theory, but also states that *the rate of increase of the electronic energy with temperature is much less than it is predicted by the classical theory*.

In view of all these difficulties and new developments, modern physics had to introduce a somewhat different explanation of the photoelectric effect and a

revised mechanism for the emission of photoelectrons, which requires some correlation with the closely related phenomenon of the *thermal emission* of electrons.

It has been long known that metals emit free electrons in a cathode-ray tube filled with gas due to the bombardment of the surface of the cathode by the energetic ions and atoms.

Emission of electrons can also be produced by the increase of the internal *thermal* energy of a cathode. The process is called *thermionic emission*, and the emitted electrons are called *thermions*. A *thermionic current* can be produced and the kinetic energy of the thermions can be measured.

Through such experimentation it has been found that the energy of the thermions at constant temperature varies with the chemical composition of the emitter, which shows that thermions, like photoelectrons, must spend part of their energy on the attraction of the metal and escape through the surface boundary. At a given temperature,  $T$ , and internal thermionic energy,  $E_T$ , with the adjustment of a retarding potential, the kinetic energy of the *maximum energy thermions* can be found;

$$\frac{1}{2} m v_m^2 = V_0 e = E_{th-max} = E_T - \Phi \quad (16.3),$$

where  $E_{th-max}$  is the energy of the maximum energy thermions and  $\Phi$  is the *thermionic work function* of escaping.

It was early assumed that thermions and photoelectrons come from the same source inside the metal, the two types of emission differing chiefly in the mechanism by which an electron acquires sufficient energy; in the first case by thermal agitation, in the second by the absorption of radiant energy. On this view, the work-function  $\Phi$  in the thermionic equation ought to be at least approximately the same as the quantity  $\omega_0$  in Einstein's photoelectric equation. It has been also found that the thermionic maximum energy at room temperature is not much different from that of the maximum energy of the photoelectrons.

Because of the increase of thermionic kinetic energy, predicted by the Fermi-Dirac distribution of thermal energy, it follows that the already existing initial thermal energy of the free electrons cannot be neglected in the derivation of the photoelectric energy. The question thus arises, where is this internal

thermionic energy of  $E_T$  in the photoelectric equation?! This is discussed and illustrated (Figure 16-5) by Ritchmyer's Introduction to Modern Physics [103]:

"If a free electron in the surface of a metal already has thermal kinetic energy  $E_i$  and absorbs a quantum  $h\nu$ , it will have a total kinetic energy  $h\nu + E_i$ . If

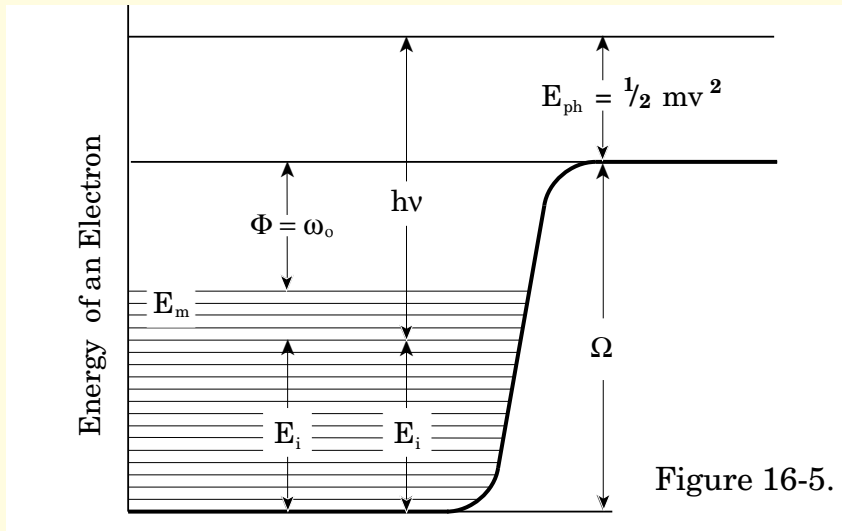


Figure 16-5.

this energy exceeds the work  $\Omega$  that must be done by any electron against attractive forces in escaping from the surface of the metal, the electron will emerge as a *photoelectron* with kinetic energy

$$\frac{1}{2} mv^2 = E_i + h\nu - \Omega.$$

"Since  $E_i$  cannot much exceed the limit of the maximum energy thermions,  $E_m$  the photoelectric energies will thus have a fairly definite maximum value given by the equation

$$\frac{1}{2} mv_m^2 = h\nu + E_m - \Omega. \quad (16.4)$$

"Comparison with Eq. (16.11) the constant  $\omega_0$  in Einstein's photoelectric equation must have the approximate value

$$\omega_0 = \Omega - E_m."$$

There are, however, some ambiguity in this representation.

a) It is quite evident from the above that the newly introduced work-function,  $\Omega$ , has little or nothing to do with experimental facts, but is merely an invention to preserve Einstein's equation from the effect of the uncalculated thermionic energy.

b) But even with  $\Omega$ , looking for the maximum energy photoelectrons, there is no reason to add the quantum,  $h\nu$  to the average energy  $E_i$  but rather, it should be added to the maximum thermal energy electrons  $E_m$  at variance with the above schematic illustration.

If in spite of these, the new work-function,  $\Omega$  is still sufficient to preserve the original photoelectric equation then, merely due to the lack of factual arguments, it must be simply adjustable.

Adding the impossibility of finding the ratio of the absorption of the total energy of a photon between the electron and one or more of the atoms, it seems quite clear that the quantitative derivation of Planck's constant by Millikan from Einstein's originally simple photoelectric equation has been founded on too many unmeasurable, and therefore easily adjustable factors.

Hence, it is hard to accept that the theories of Planck and Einstein can justify one another, or that together they do establish the *universality* of one of the same single *constant*.

## THE PHOTO-THERMIONS

Now, in the fashionable style of modern theories it is hereby *boldly stated* that the presently accepted photon theory of photoelectric effect not only totally incompatible with the rest of physical knowledge and still in its quantitative operation must revert to the classical concepts of the electromagnetic wave theory,

but that there are also irreconcilable ambiguities within itself.

Further more, contrary to its modern presentation, the ambiguous derivation of *Planck's radiation constant*,  $h$  justifies neither one of the two theories. Hence, there is an obvious need for an alternate description of the effect, preferably in a better corroboration with the principles of the rest of physics.

Accepting the basic assumption of AETHRO-KINEMATICS that all space filled by the ideal gas of Aether, and applying the kinematic revision of the mechanical wave theory, consider an alternative heuristic hypothesis:

First, let us deliberately disregard all complications and confusions generated by the *concentrated, localized and instantaneously transmitted photon energy*. Instead, we revert back to the simple and sensible idea, that the kinetic energy of the gas of free-electron in the cathode originates solely from *thermal agitation*. Also assume that the essential difference between thermions and photoelectrons is merely in the different mechanisms of their *liberation* from the body of the metal.

The following quote is given for re-iterating this assumption:

"It was early assumed that thermions and photo-electrons come from the same source inside the metal, the two type of emission differing chiefly in the mechanism by which the electron acquires sufficient energy to enable it to escape from the emitter against the action of attractive forces of some sort.

"The agreement between the values of the work-functions determined photoelectrically and thermionically seems good enough to warrant the hypothesis that the photoelectrons and thermionic electrons have a common origin." (Richtmyer-Kennard, Introduction to Modern Physics [95])

Thus, three different mechanism can cause electron emission:

1. In the gas-filled cathode-tube by the bombardment of the surface of the metal by the atoms of the gas.
2. In a vacuum-tube, by increasing the temperature of the cathode, thereby increasing the thermal kinetic energy of the electrons.
3. In the thermionic equilibrium of a vacuum-tube, by high frequency electromagnetic radiation, which liberates photo-electrons .

Consider then the following:

As it was presented in Chapter Fifteen, by the description of the capacitors, any macroscopic chunk of matter is surrounded by a *special circulatory layer* of the Aether, which equilibrates between the uncompensated dynamic flow-patterns of the force fields of the *peripheral atoms*, and the random kinetic energy of the isotropic pressure of the external medium.

This boundary layer represents a buffer between the geometrically periodical circulatory flow-patterns within the crystalline structure, and the randomness of the external medium. As such, the flow-patterns of this boundary layer must be in a plane parallel to the surface of the metal between the internal and external pressures, assimilating to the geometry of the crystalline structure both in its kinematics and its local density fluctuation.

Here, it is assumed that instead of '*attractive forces of some sort*', this *kinematical barrier* is responsible for the *internal reflection* of the free electrons in the transverse directions to the plane of the surface, thereby trapping them within the boundaries of the metal. Thus, the possibility of escape depends on two factors: the velocity of the electron,

and the opposing strength of the kinematical barrier, called the work-function.

In scientific descriptions of thermionic emission, the mechanism of this barrier are often compared with the *surface tension* at the boundary between liquids and gases, and the escape of the electrons with the *evaporation* of the molecules of the liquid.

"Thermionic emission is a term used to describe the emission of electrons (and/or ions) from a solid when it is heated in vacuum. Thermionic emission can be viewed as an evaporation process,.....depending on temperature.....and the related work-function, can be interpreted as an electron latent heat of vaporization." (Lerner-Trigg, Encyclopedia of Physics, [1251])

The analogy between evaporation and electron emission may seem to be far fetched by present theories. However, but once the existence of a *kinematic medium* is accepted as a general conveyer of energy between micro- and macro-cosmos, a definite mechanical resemblance is found between the effects of surface tension and those at the boundary between two different media.

Thus, the analogy justifies the attempts for further correlation.

Consider, therefore, that a metal of certain chemical composition at a given temperature,  $T_o$  shows zero thermionic emission, but by a very small increase in the temperature some thermionic current is detected.

Thus, at  $T_o$  the system is in *thermionic equilibrium*, meaning that the internal kinetic energy of the electrons  $E_{T_o}$  is equal to and not greater than the strength of the barrier, which is represented by the work-function,  $\Phi$ , thus

$$E_{T_o} = \Phi,$$

where  $T_o$  can be taken as the thermionic *threshold temperature* and  $E_{T_o}$  as the thermionic *threshold energy*.

In this state of thermal equilibrium, thermionic emission can be produced by external forces, like the bombardment of the cathode's surface by the energetic gas atoms. This suggests that the thermionic emission is not resulting from the increase of the kinetic energy of the internal electrons, but rather from the decreasing strength of the boundary barrier.

Let us recall Murphie's artistic rendering (Fig.14-6), but this time as an analogy with an electromag-

netic boundary layer between the atomic construction of metal and the external isotropic pressure of the Aether (a). Instead of a stone falling into a pond, atoms plunge through the this special medium, each producing spherical compression waves which interfere with one another.

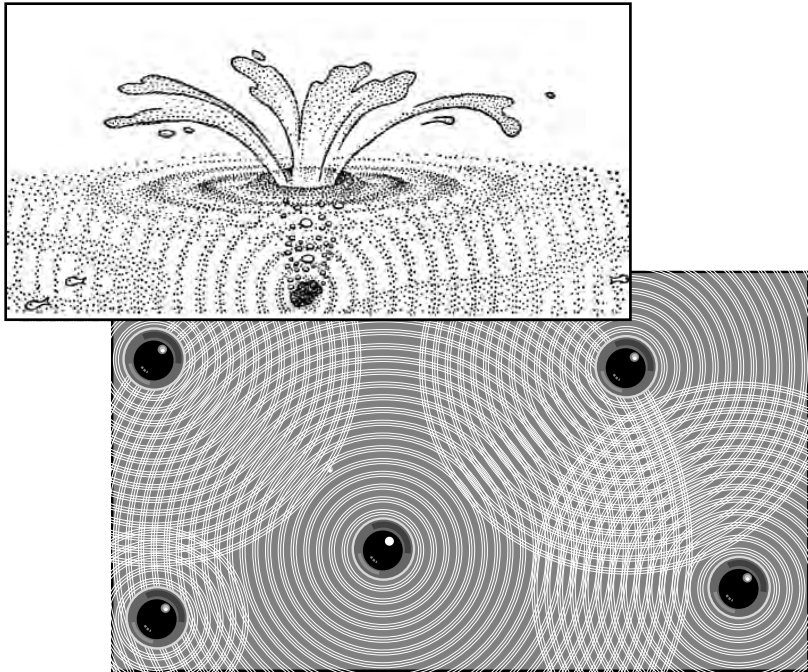


Figure 16-6

Because of the resulting random pattern in the blocking strength of the boundary, some thermions that were trapped before now are capable of escaping through the weakened points of the layer and being emitted into the external medium.

At a constant temperature of the system, the total energy of the emitted thermions,  $E_{th}$  is proportional to the *density* of the gas in the tube, that is, the number of atoms hitting the surface per unit area. Therefore, the *work-function is not a constant anymore*, but rather clearly, it is inversely related to the kinetic energy and the density of the bombarding gas atoms.

It follows that, as the work-function decreases, the electrons spend less energy on escaping, thus the thermions emerge with increasing external kinetic energy;  $E_{th} = E_T - (\phi - \beta)$ , where  $\beta$  represents the negative effect of the gas atoms on the strength of the barrier, or that of the magnitude of the work-function.

Going back to the thermionic equilibrium, but this time in a vacuum tube, consider the production of thermionic emission by the increase of the internal thermal energy of the electrons.



Recall the two quotes relating to the ratio between the thermal kinetic energies of the electrons and the atoms.

On the one hand: "The *thermionic current* from a given emitter is found to *increase very rapidly* with increasing temperature."

On the other hand, however, according to the Fermi-Dirac theory, "*The total energy of the free electrons changes very little with the rise of the temperature*". Ritchmyer, Introduction to Modern Physics [96-102]

There seems to be a contradiction between the two statements if the thermionic emission is thought to be a result of the increasing internal thermal kinetic energy of the free electrons.

This contradiction can be relieved by assuming that this is also a case where the value of the work-function is not a constant but, this time, the strength of the barrier is negatively affected by the *internal thermal excitation of the peripheral atoms*. The result is again a decrease in the thermionic work-function.

Both classical and modern theories are based on the assumption that the thermionic work-function,  $\Phi$

is a constant, and the increasing thermionic emission results solely from the increase of the internal thermal kinetic energy of the electrons. This idea of the *constancy* of the work-function and the role of the increasing kinetic energy of the electrons was naturally inherited by Einstein's description of the photoelectric effect.

In the application of the photon theory of the emission of photoelectrons, Einstein's work-function,  $\omega$ , also became a constant, determined only by the chemistry of the metal. The emission and the energy of the photoelectrons,  $E_{ph}$  or  $E_{ph-max}$  was thought to be dependent solely on the kinetic energy absorbed by the electrons from the incident photons of given frequencies.

Totally at variance to this view, the alternative hypothesis of AETHRO-KINEMATICS is based on some well known phenomena of ultrasonics. Following the established direction of the alternate hypothesis of thermionic emission, consider the analogy between the present subject and the macro-cosmic phenomena, discussed in the following quotes (Benson Carlin, Ultrasonics; The physical effects of ultrasound. [239-244]).

"Among the most outstanding effects of ultrasound are cavitation, local heating, local pressure, and production of fog. At present *cavitation* is a generic term applied to a number of ultrasonic effects characterized by the formation and collapse of bubbles in a liquid. These bubbles may be empty or filled with gas or vapor. Among the factors which govern the onset of cavitation are....intermolecular bond, *frequency*, *system pressure*, etc. Cavitation usually forms at the point of greatest intensity, .....*in standing waves systems the bubbles are trapped in the nodes.*

"*Fog production* happens when intense waves hit the interface between a liquid and air, a jet of liquid is thrown up, and a fine mist or fog is produced. The intensity of the fog is a function of the *surface tension* and the power of focusing, etc. Mist has been produced with water, molten metals and other liquids. *The size of the particles seems to be a function of frequency.*

"The term *degassing* is applied to the expulsion of gases from liquids or solids. Ultrasonic waves can bring a degassing action. However, *the application is influenced by frequency* and operates better at lower frequencies (about 200 kc). *The degassing appears to*

*be caused by the collection of the gas at the nodes of the waves and by cavitation.*"

Based on all the above and on the existence of the ideal gas of Aether, consider the following heuristic postulates:

1. *The only source of kinetic energy for all the emitted electrons is the thermal energy accumulated by the electron-gas within the boundary of the heated metal. If the maximum thermal energy of some electrons exceeds the thermionic work-function,  $\phi$ , then thermions are ejected. If the thermal energy of even the most energetic electrons is under the value of the work-function,  $\Phi$  there is no thermionic emission.*

*However, when in this thermionic equilibrium ( $E_{T_0} = \Phi$ ), sufficiently high frequency radiation is incident on the surface of the metal, it decreases the strength of the boundary barrier and the maximum energy electrons can escape by their initial thermal energy. In modern theories these electrons are called 'photo-electrons', but according to this hypothesis, due to the origin of the electrons and the mechanism of their emission, the name 'photo-thermions' would be more fitting and clarifying.*

2. It is kinematically plausible that between the geometrical periodicity of the internal surface of the boundary layer and the pressure fluctuations exerted on its external surface by the incident periodical compression pulses of radiation, a related 'standing wave system' is generated in the plane of the barrier. The standing waves create nodes and antinodes, compressions and rarefactions, by which it decreases the strength of the barrier and decreases the magnitude of the thermionic work-function. Evidently, the standing-wave-effect should be in proportion to the frequency of the incident radiation.

3. It follows, that the resulting external kinetic energy of the emitted maximum energy photo-thermions is:

$${}^{1/2} m v_{ph-th-max}^2 = E_{ph-th-max} = E_m - (\Phi_0 - \beta v) \quad (16.5),$$

where  $E_m$  is the energy of the maximum thermal energy electrons in a given metal at a given temperature, and  $\Phi_0$  is the original constant thermionic work-function.  $\beta$  is a new constant, and  $v$  is the frequency of the incident radiation. The expression  $(\Phi_0 - \beta v)$  represents the photo-thermionic variable work-function, where  $\Phi_0$  is the initial strength of the retarding force

of the boundary which is reduced by the negative effect of the incident radiation  $(-\beta v)$ .

Equation (16.15) can also be expressed as

$$E_{ph-th-max} = (E_m - \Phi_0) + \beta v = E_m + \beta v - \Phi_0 \quad (16.6),$$

which is exactly equivalent to the relations stated by Einstein's equation,  $h\nu - \omega_0$  (16.12), except a mere difference in the notation, where

$$\Phi_0 = \omega_0 \quad \text{and} \quad \beta = h.$$

Hence, the energy of the maximum energy photo-thermions is exactly in the same linear relation with the frequency of radiation, as it was demonstrated by Millikan's plotting. (Fig. 16-5.b)

4. The variation in the intensity of the radiation should not affect the geometrical periodicity of the standing wave system which is responsible for the attenuation of the barrier. Based on the analogy with supersonic effects, it is feasible that the strength of the barrier only depends on the density of the nodes, that is, the wavelength of the standing waves.

Higher intensity merely creates higher amplitude and proportionally greater cavitations at the nodes, through which a greater number of photo-thermions, possessing maximum energy, are capable to escape.

5. *The artificial assumption that all electrons absorb the exact total quantum of energy of a photon, but they lose more or less of that by colliding with the atoms at different depths of the metal, is not needed, since in the electron-gas the thermal energies are distributed randomly through the whole spectrum.*

6. *Naturally, there is no 'time-lag' either between the incidence of radiation and the emission of the photo-thermions, since the formation of the standing waves proceeds with the velocity of light, and the kinetic energy of the emerging photo-thermions is not a matter of time-consuming accumulation, since it was already in existence within the electron-gas.*

7. *The Fermi-Dirac-Sommerfeld distribution of the thermal energies between atoms and electrons explains the experimental facts showing that the photoelectric energy is independent from the temperature.*

The value of the new constant,  $\beta$  can only be found experimentally by establishing the fluctuation of the value of the work-function at constant temperature at various frequencies. Since this constant represents *the energy content of a single compression pulse* of the radiation, which creates and maintains the standing wave system in the barrier, its quantita-

tive value may resemble to Planck's black-body radiation constant,  $h$ .

Hence, by the derivation of the same mathematical relations from the above postulates, based on the simple kinematics of the wave theory, Einstein's photon theory and the accompanying *dual nature of light*, at least, as being the *only possible solution* for the photoelectric effect, has been found superfluous and therefore avoidable.

At about this stage of the conceptual development of the quantum theory, (1913) Niels Bohr attempted to explain the inner structure of the hydrogen atom and its discontinuous spectrum based on Planck's quantum and Einstein's photon theories. For purposes of conceptual continuity, this development will be discussed after the description of an alternate explanation of a closely related subject; Compton's electron-photon collision theory.

## THE COLLISION OF LANGUAGES

If Einstein's photons are rightfully described as *bold and astonishing*, then some new superlative adjectives must be designed for describing the unique theories of the *Compton-effect*.

The actual experiments on the subject started out as research on the phenomenon of X-ray scattering. Eventually they were designed, executed and interpreted as proving not merely the existence of Einstein's light corpuscles, but even to demonstrate that, in suitable circumstances, a collision can be arranged between a photon-corpuscle and an electron which is like that, between two billiard balls on a pool table. That is, in both events the Laws of the Conservation of Energy and Momentum are upheld. By the year 1927, this goal had been achieved by expertly juggling between two or more totally incompatible languages.

Instead of pointing out where one language ends and the other starts in every paragraph or even within each sentence, the reader should be made aware of the following. Whenever the words or the underlying concepts of *mass, inertia, momentum, collision, etc.* appear in the text, the language is based on the thousands of pages of scientific description of the concept of a *material particle*, or a conglomerate of them. Whenever the words or concepts of *wavelength, frequency, phase, speed of propagation* and the phenomenological concepts of *refraction, diffraction,*

*dispersion, interference, Doppler shift,* appear the language in use is based on the thousands of pages of scientific description of the phenomenon of *wave-motion*.

Modern physics, especially quantum mechanics, were founded on the alternate use of these two languages, which was legitimized by Niels Bohr's *Principle of Complementarity*.

"This principle states, that for the description of Nature both languages are necessary, but the wave aspect and the particle aspect of a given phenomenon can *never be observed at one of the same time*. If the wave theory provides an explanation then the particle theory will not, and vice versa. The wave theory and the particle theory thus complement each other in the interpretation of natural phenomena. (Feren- ce-Lemon-Stephenson, *Analytical Experimental Physics*, [563]).

Nevertheless, in practice complementarity is not exactly justified. Even the switching between the two languages is different in each phase of the modern quantum theories; Planck's quantum of action is different from Einstein's photon, which is different from Compton's billiard balls, which is different from

Bohr's, and that from DeBroglie's, Heisenberg's, Sommerfeld's. Depending on what sub-language is needed to achieve some conceptual compliance with the mathematical formula that fits the experimental facts. An astonishing example of this method is the quantum interpretation of the experimental facts of the *Compton effect*:

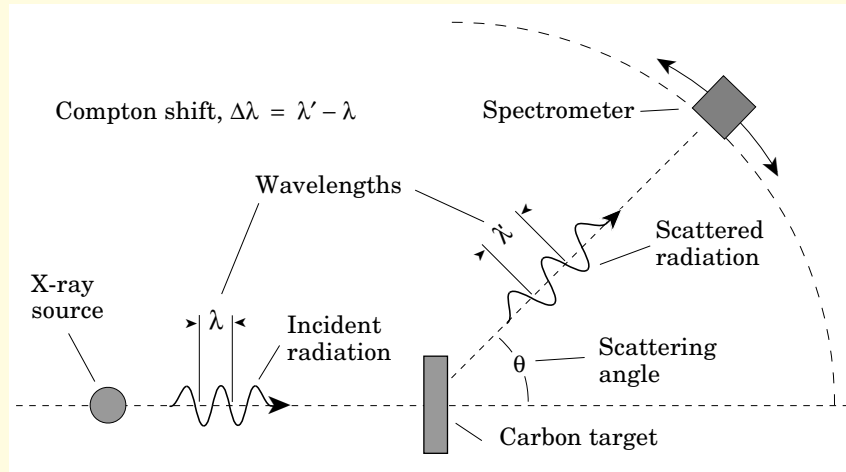


Figure 16-7

When fairly high voltage of the order of 20,000 volts is applied to a gas-discharge tube, the heated filament of the *cathode* produces high velocity electrons which accelerate toward the positively charged

*anode*. When the electrons hit the metal block of the anode, *X-rays* are produced.

Until 1912 scientists believed that X-rays consist of energetic particles, but Laue showed that they could be *diffracted and polarized*, just like light. He thus *established the wave nature* of this radiation. Measurements on the diffraction patterns showed that the wavelength of X-rays are in the order of  $10^{-5}$ , about 10,000 times shorter than the wavelength of ultraviolet light.

Figure 16-7. schematically illustrates the experimental device by which in 1923 Compton allowed a beam of mono-chromatic X-rays, of well defined wavelength, to fall on a block of carbon and, by a crystal spectro-meter, measured the intensity of the different wavelengths of the scattered X-rays in all directions.

As illustrated by [Figure 16-8](#) Compton found that for any scattering angle two predominant wavelengths were present: the *unmodified wave*, which had the same wavelength,  $\lambda$  as the incident beam, and the *modified wave*, which was observed always to be a longer wavelength,  $\lambda'$  and to increase with the increasing angle of scattering.

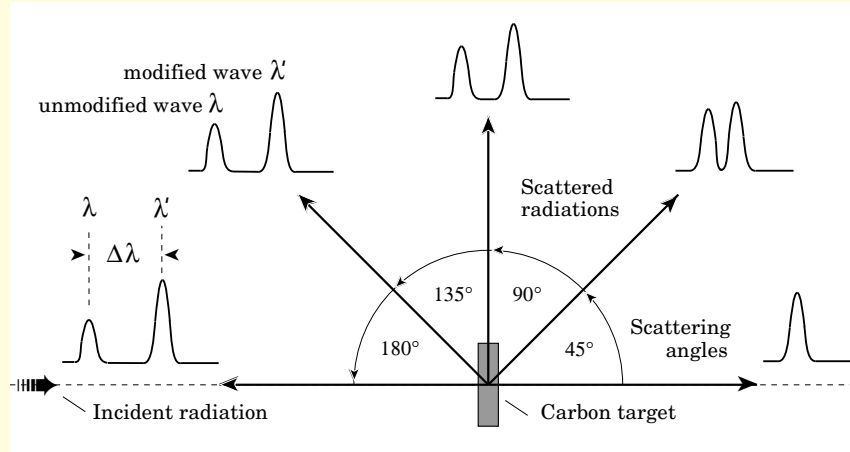


Figure 16-8

Thus,  $\Delta\lambda = \lambda' - \lambda$ . At  $\theta = 90^\circ$ ,  $\Delta\lambda = 0.0243 \times 10^{-8} \text{ cm}$  (Angstrom). The wavelength shift is the maximum when the scattering is measured in the opposite direction of the incident beam, i.e., at  $\theta = 180^\circ$ ,  $\Delta\lambda = 0.049 \times 10^{-8} \text{ cm}$ . Expressed by the general Compton equation,

$$\Delta\lambda = 0.0243 (1 - \cos \theta) \quad (16.7),$$

which states that independently from the material of the scatterer, the wavelength of the scattered radiation is greater than the incident radiation by the quantity of  $0.0243 (1 - \cos \theta) \text{ A}$ . For a given angle  $\theta$ ,

this quantity is a *constant* and independent of the wavelength of the incident radiation. This constant is called the *Compton shift*.

Seemingly, the scattering, demonstrated by Compton, does not have an evident explanation based on classical principles.

"According to the classical theory, when a monochromatic electromagnetic wave interacts with a charged particle, it will be acted upon principally by the sinusoidally varying electric field of the wave. Under the influence of this changing electric force the particle will oscillate in *simple harmonic motion* at the same frequency as that of the incident radiation, and since it is accelerated continuously, it will radiate electromagnetic radiation of the same frequency in all directions. The charged particle neither gains or loses energy, since it re-radiates at the same rate as it absorbs. The classical scattering theory agrees with experiment for all *visible or longer wavelength* of radiation.

"A simple example of the unchanged frequency of coherent scattered radiation is this: light reflected from a mirror (a collection of scatterers) undergoes no apparent change in frequency." (X.Y.Z, Particle

Aspects of Electromagnetic Radiation, [134])

Thus, there was no clue in the classical approach which would suggest that higher frequency X-rays could produce a shifted scattering, and Compton was forced to look for a solution different than the classical scattering theory of electromagnetism.

"At first he attempted to account for this observed softening of the secondary radiation within the framework of classical conceptions and thus took recourse to the *Doppler effect*, (one of the most typical undulatory phenomena in optics).

"He found, however, that *in order to account for the observed shift, all of the electrons in the scatterer would have to be moving in the direction of the incident radiation with a velocity of about half that of light. Since such an assumption was obviously unacceptable, Compton concluded that the classical theory was irreconcilable with experience.*"

"Since neither Thompson's theory of scattering nor the Doppler effect could explain the experimental facts, Compton decided to examine *'what would happen if each quantum of X-ray energy were concentrated in a single particle and would act as a unit on a single electron?! Thus, finally he boldly applied the*

*extreme quantum picture of the radiant energy.*" (Max Jammer, *Conceptual Development of Quantum Mechanics*, [168])

"Planck introduced the idea that radiation must be *emitted* by bundles of energy, although he believed that once emitted, the energy spread in waves. Einstein extended Planck's idea to the *absorption* of radiation and added the assumption that once the quantum of energy was radiated, it *preserved its identity as a photon* until it was finally absorbed. In the special theory of relativity it was shown that mass and energy are identical. Since photons have energy, they must have mass. This gradually developing concept that the *photons are true particles throughout their life* comes to its *climax* in Compton's assumption that the photons had the very '*mechanical*' *property of momentum*, and solved the problem of impact of a photon and a material particle by means of relativistic mechanics." (X-rays [204])

Hence, from here on, Compton's theoretical goal was to make his description of X-ray scattering by electrons as analogous as possible with the collisions between billiard balls. First, in order to justify the application of the conservation laws, *both 'particles'*;



the electron and the photon must have qualitatively compatible energies and momenta. This can be achieved as follows:

"In a collision between a photon and an electron, the electron assumed to be *initially at rest and essentially free*, that is, not bound to the atoms of the scatterer. Let us apply the law of conservation of energy to this collision. *Since the recoil electrons may have a speed,  $v$  that is comparable to the speed of light, we must use the relativistic expression for the kinetic energy of the electron.*" (Halliday, Physics [1101])

(Bear in mind that the Doppler effect interpretation was dismissed, based on the unacceptable requirement of electron velocities up to *about half that of light.*)

Based on Einstein's fundamental equation,  $E = mc^2$ , the relativistic kinetic energy of a particle,  $K = mc^2 - m_0c^2$ . The initial energy of a photon is  $h\nu$ , which is also the total energy of the system before collision. Therefore, after collision we may write

$$h\nu = h\nu' + (m - m_0)c^2. \quad (16.8),$$

in which  $h\nu'$  is the energy of the scattered photon after collision and the second term on the right is the

relativistic expression for the kinetic energy of the recoiling electron,  $m$  being the relativistic mass and  $m_0$  the rest mass of the electron.

"Substituting  $c/\lambda$  for  $\nu$  (and  $c/\lambda'$  for  $\nu'$ ), and eliminating the relativistic mass  $m$ , leads us to

$$hc/\lambda = hc/\lambda' + m_0c^2 (1/\sqrt{1 - (v/c)^2}) - 1. \quad (16.9)$$

"Now let us apply the (vector) law of conservation of linear momentum to the collision of Figure 16-9.

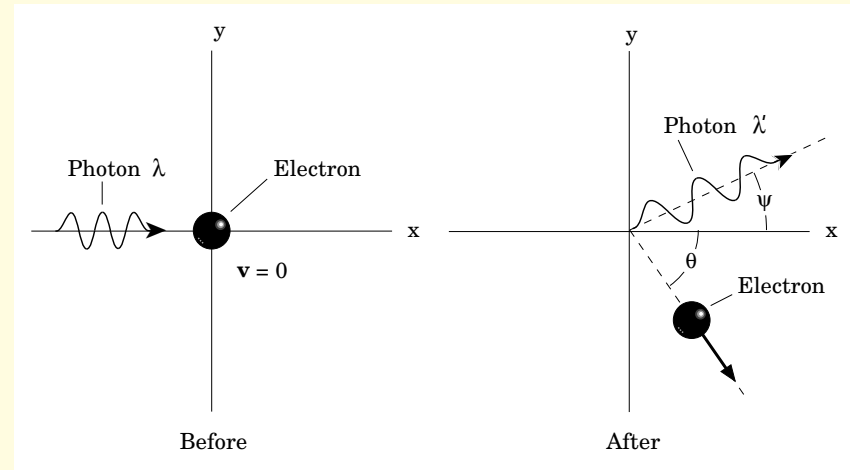


Figure 16-9

"We first need an expression for the momentum of the photon. Earlier we saw that if an object complete-

ly absorbs an energy  $U$  from a parallel light beam that falls on it, the light beam, according to the wave theory of light, will simultaneously transfer to the object a linear momentum given by  $U/c$ ."

(Note, that this electromagnetic transfer of wave momentum, or light pressure is measured per unit area per unit time.)

"On the photon picture, we imagine this momentum to be carried along by the individual photons, each photon transporting (its concentrated) linear momentum in the amount  $p = h\nu/c$ , where  $h\nu$  is the photon energy. Thus, if we substitute  $\lambda$  for  $c/\nu$ , we can write the momentum,  $p$  of the photon as

$$p = \frac{E}{c} = \frac{h\nu}{c} = \frac{h}{\lambda}. \quad (16.10)$$

"For the electron the relativistic expression for the linear momentum is given by

$$p = m_0 v / (\sqrt{1 - (v/c)^2}). \quad (16.11)$$

"Our immediate aim is to find  $\Delta\lambda (= \lambda' - \lambda)$ ", the wavelength shift of the scattered photons. Carrying out the necessary algebraic steps leads to this simple result:

$$\Delta\lambda = h/m_0 c (1 - \cos \psi). \quad (16.12)$$

"Thus the Compton shift,  $\Delta\lambda$  depends only on the scattering angle  $\psi$  and not on the initial wavelength  $\lambda$ . Compton's experiment did not involve observations of the recoil electron in the scattering block."

"Note from the equation that  $\Delta\lambda$  varies from zero (for  $\psi = 0$ , corresponding to a 'grazing' collision when the incident photon being scarcely deflected) to  $2h/m_0 c$  (for  $\psi = 180^\circ$ , corresponding to a 'head-on' collision, the incident photon being reversed in direction). " (Halliday, Physics [1102]

Further more:

"Because the incident and scattered photons have different frequencies, the latter is not to be thought as merely the incident photon moving in different direction; rather the incident photon is annihilated and the scattered photon is created." (Particle aspects of electromagnetic radiation [137])

To make the conceptual content of these conclusions perfectly clear, consider the following quote from Kompaneyets, Basic Concepts in Quantum Mechanics [136]:

"The relationship between the frequency and the angle of scattering may be obtained immediately if the laws governing the collision of two *elastic spheres* are applied. *One 'sphere' is the particle and the other is the photon.* ...The greater the angle of scattering of the photon, the more energy it imparts to the electron. Thus, the energy of the photon reduced: i.e., its frequency is lowered."

"Classically, the wavelengths of the incident and scattered radiations are essentially equal; hence, Compton scattering agrees with classical scattering in the region of  $\Delta\lambda / \lambda \ll 1$ . We see here an example of the *correspondence principle* as applied to quantum effects." (J. Patrick, Particle Aspects of Electromagnetic Radiation, [139])

"The presence of the *unmodified line* may be accounted for as follows. In setting up our equations, it was assumed that the electron with which the photon collides is free. It is possible, however, that another kind of collision may occur in which the electron remains bound to the atom. Such a collision may be regarded as taking place between the photon and the atom as a whole. If the mass of the atom is substituted for  $m$ , the computed change of wavelength is

found so small as to be beyond the possibility of detection. It may well be that, in the scattering of photons, the electron sometimes behaves as if it bound to the atom and sometimes as if free." (Ritchmyer, Introduction to Modern Physics [389])

"Compton's experiment confirmed that X-rays can scatter from electrons as particles. However, there is a *remarkable ambiguity* in the experiment, which Compton himself points out:

"The crystal spectrometer measured a *wavelike property*, the wavelength, and measured it by means of a characteristically wavelike phenomenon, *interference*. But the effect of the graphite scatterer on the value of that wavelike property could be understood only in terms of a *particlelike behavior*. Thus X-rays behaved as both particles and waves in the same experiment." (M. L. Warren, Introduct. Physics, [511])

Figure 16-10 is recalling Fig. 14-12 from the kinematic analysis of the probable *momentum amplitude* due to various collisions between two *elastic, spherical, equal masses*. This illustration is a visual statement about the total absurdity of Compton's collision hypothesis. It shows what his *casual assumption* about the collision between spherical 'billiard balls',

one being the electron and the other being the photon, must mean conceptually.

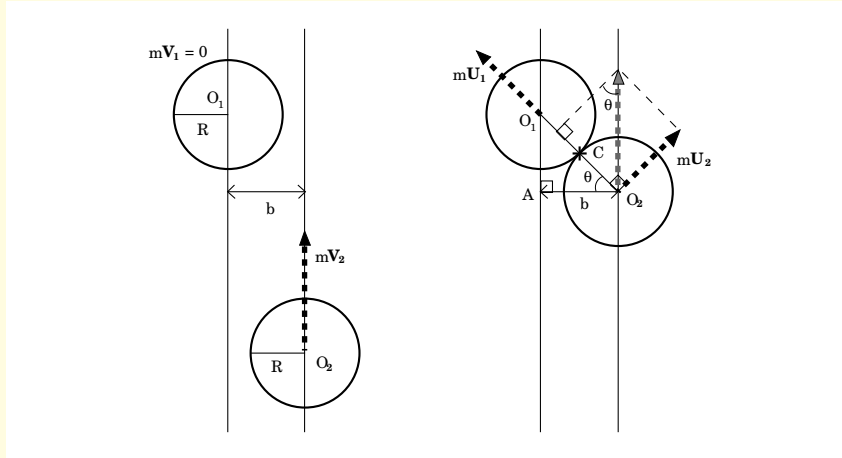


Figure 16-10

As it has been presented in Chapter Fourteen, the concepts of 'grazing' and 'head-on' or 'in-between' collisions there is an infinite variety of impacts, which *explicitly depend on the collision parameter, b*, that is, on the distance between the centers of the two spheres and there is *absolutely no substitution in our minds for these concepts*.

Further more, it is an unavoidable mathematical requirement, that the conservation laws must con-

sider the quantity of both rest masses, or both linear momenta involved to determine the after collision angles of the particles. Adding to this, that the unthinkable '*spherical zero mass*' cannot even exist in mathematics, one may try to fathom, not the picture, not the concept, not the languages, but merely the incompatible words put together incoherently in this description: *a massless spherical X-ray wave concentrates itself in time and space, into a spherical zero mass, called a photon. Collides grazingly or head-on with the greater spherical mass of the electron and elastically rebounds in the proper angle, as a perfect sphere should, or is annihilated and re-created, but with a lower than its initial frequency. The resulting energy shift can then be measured by interference when the X-ray photons spread out again in space and time, back into their original form of spherical electromagnetic waves.*

"In other words, a hypothesis, supported by uncontested experimental evidence, became physically significant only by the use of its own negation." (Jammer, Conceptual Devmnt. of Quantum...[173])

What then is the use of the words, if the only possible comprehension gained by them is that *when*

*certain mathematical symbols perform certain algebraic operations, they result to some quantitative approximation of certain experimental facts?!*

## THE DOPPLER EFFECT REVISITED

Thus, Planck's semi-classical quantum concept, which survived the photoelectric effect as the energy content of a single compression pulse in the Aether, in the Compton effect became a physical body of spherical extension, and the elasticity of solids.

As it has been quoted above, at first Compton attempted to account for the observed softening of the scattered X-rays by means of the most typical undulatory phenomenon, the Doppler effect. However, later he discarded the idea based on two basic arguments; a) In order to comply with the experimental facts, based on the classical Doppler effect theory, the scattering electrons would have to be receding from the X-ray source with a velocity of about one half that of light. b) For the same reason, *all* electrons would have to be moving in the same direction as that of the incident radiation.

As it has happened in a later stage in the development of the photon-collision hypothesis, for the

need of establishing the mass and momentum of the wave-particle, Compton was forced to justify the use of relativistic treatment by proposing that the recoil-velocity of the electrons could approach that of light. With this assumption, however, he negated one of his basic reasons, a) for discarding the Doppler interpretation of the experimental facts.

It should also be noted here that the real requirement for the Doppler recession velocity of the electrons is less than one quarter of the velocity of light.

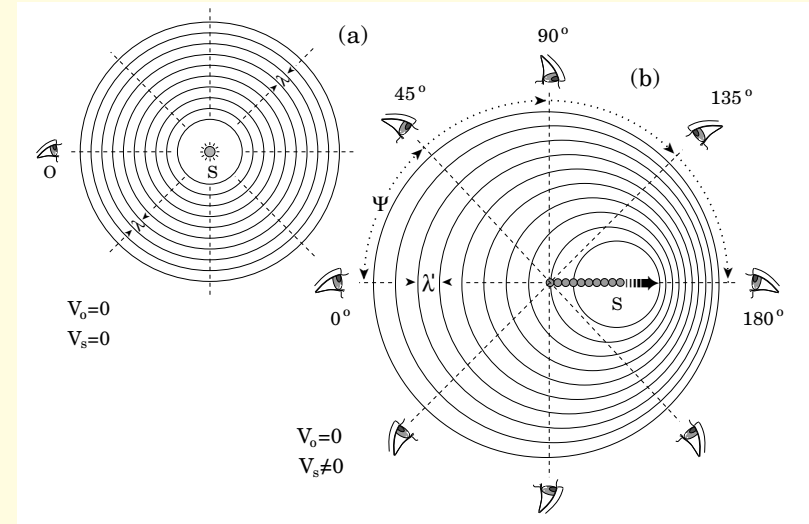


Figure 16-11

Compton's second argument b), will be defeated at a later stage in the description of the *Compton scattering* by the alternate theory of AETHRO-KINEMATICS.

Figure 16-11 illustrates the well-known mechanism and the simple explanation of the typical undulatory phenomenon of the Doppler effect.

Part (a) shows a source, being at rest in the medium and produces periodical compression pulses which are propagated in the form of expanding spheres in the isotropic medium with a given velocity. Since the pulses are generated at equal time intervals, the distance between them, or the wavelength,  $\lambda$  of the pulse train, is all the same. Because of the spherical propagation, the wavelength, observed by any stationary observer is the same in all directions.

Part (b) illustrates the special case, when the source is in motion relative to the medium. It can be seen from the exaggerated diagram that, due to the motion of the source, the wavelength is found to be different by stationary observers observing from different directions. The magnitude of the so-called Doppler shift depends on the ratio between the speed

of the source and the speed of propagation, and on the angle between the line of sight of the observer and the direction of motion of the source.

Commonly, in the mathematical treatment of the mechanical waves of sound, the conveying medium is the idealized gas of air. In AETHRO-KINEMATICS the waves, or the periodical compression pulses of light, are conveyed by the ideal gas of the Aether.

In the following *Doppler interpretation* of the Compton scattering, the only effect involved is the recession of a source from an observer (spectrograph) at rest relative to the isotropy of the medium. The simple mathematical expression for this effect is

$$\lambda' = \lambda (1 + (V_s / c)) \quad (16.13),$$

where  $\lambda'$  is the increased, observed wavelength,  $c$  is the velocity of light and  $V_s$  is the velocity of the source.

It is also evident from the diagram, that the changes are proportional to the various angles,  $\psi$  between the *line of sight of the observer* and the direction of motion of the source.

By to the rules of elementary trigonometry,

$$\lambda' = \lambda (1 + (V_s \cos \psi / c)) \quad (16.14).$$

Thus, in the case of a receding source, the Doppler shift,  $\Delta\lambda$  between the initial, and the observed wavelength is

$$\begin{aligned}\Delta\lambda &= (\lambda' - \lambda) = \lambda(1 + (V_s \cos \psi / c) - \lambda) \\ &= ((\lambda V_s) / c) \cos \psi \quad (16.15).\end{aligned}$$

As quoted above, one of the reasons given for the incapability of classical physics to explain the Compton scattering of radiation was that, according to the electromagnetic theory of light, a mirror (a perfect scatterer) must reflect or re-radiate the light waves with exactly the same wavelength. The ideal example of this is a mirror, a *collection of scatterers*, which reflects light with no change in the frequency of the incident light. Consequently, the classical theory of scattering of light cannot account for the shift in the wavelength or frequency decrease of the scattered radiation demonstrated by the Compton effect.

Nonetheless, using the same analogy, it will be shown that the reflected radiation produced by a *receding* mirror results in a Doppler shift, or the lengthening of the incident wavelength, which is mathematically equivalent with that derived from the Compton collision hypothesis.

Consider first, the well-known nature of the reflection of light. When one stands at one meter from a mirror with a camera, the focus must be set for two meters to achieve a sharp picture. The mirror-image is the same distance behind the surface of the mirror as the real object is in the front of it.

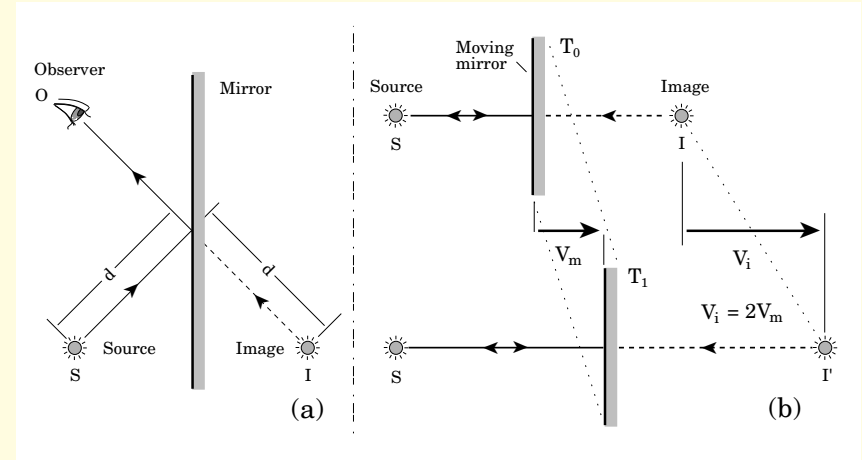


Figure 16-12

Figure 16-12 (a) illustrates that when an observer is looking at a source in the mirror in an angle, the image appears at the same distance behind the mirror, as the source does before it. As illustrated by (b), if the mirror recedes from the source with a velocity  $V_m = 1 \text{ m/sec}$ , then the velocity of the image relative

to the source will be  $V_i = 2V_m$ . Thus, looking at the image from the direction of the source one will observe that it recedes with a velocity of  $2m/sec$ .

Applying the Doppler effect to this case, we can conclude that the shift in the wavelength of the received light from a receding mirror is greater than that produced by a receding source.

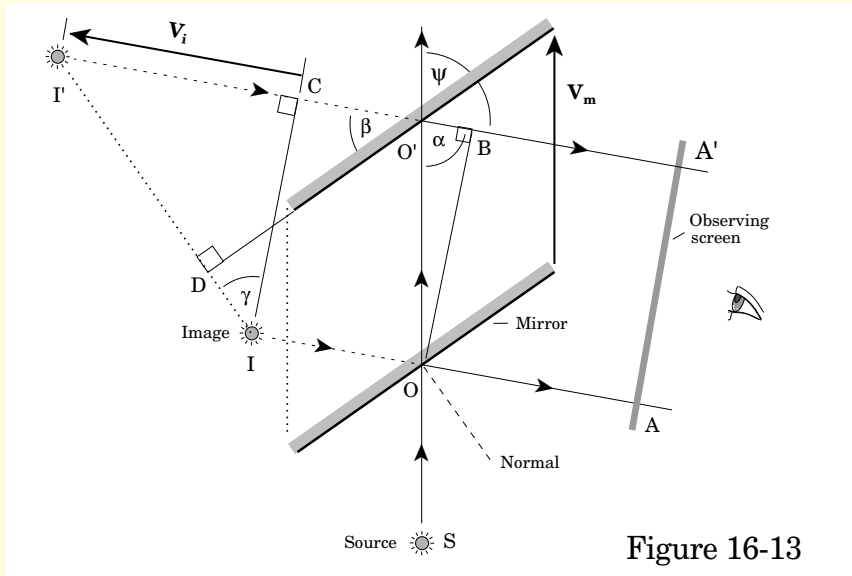


Figure 16-13

If the recession of the mirror is *in the line of sight*, the shift is twice as great as in the case of a receding source.

Figure 16-13 shows a diagram for deriving the general formula of the Doppler shifting of radiation when a scatterer is in motion relative to the transmitting medium and receding from a stationary source and observer. In the illustration, a mirror is receding from a stationary source. It is turned at any random angle relative to the direction of the propagation of light and its own motion. The mirror is receding with uniform velocity,  $V_m$ .

In one second, the mirror moves from the position  $O$  to the position  $O'$ . During the same interval of time, the image of the source moves from  $I$  to  $I'$ . As the diagram shows, the vector drawn between  $C$  and  $I'$  represents the velocity of the image,  $V_i$ . In order to find out the length  $I'C$ , first the other side  $IC$ , of the right triangle  $I'IC$  must be found. It can be seen that in the right triangle  $OBO'$   $\alpha = 180^\circ - \psi$ .

$$OB = OO' \sin \alpha = V_i \sin (180^\circ - \psi) = V_i \sin \psi.$$

Since  $IC = OB$ ,

$$IC = V_i \sin \psi \quad (16.16).$$

Furthermore, it can be seen that  $\beta = \frac{1}{2} \psi$ , and because the triangle  $O'TD$  is similar to  $I'IC$ , so  $\gamma = \beta = \frac{1}{2} \psi$ .



In the right triangle  $I'IC$

$$I'C = IC \tan \gamma = IC \tan \psi/2 \quad (16.17).$$

Substituting Eq.(25) into (26), we have

$$\begin{aligned} I'C &= V_i \sin \psi (\tan \psi/2) \\ &= V_i \times (2 \sin \psi/2 \cos \psi/2) \times [(\sin \psi/2 / (\cos \psi/2))] \\ &= 2 V_i \sin^2 \psi/2 \\ &= V_i (1 - \cos \psi) \quad (16.18). \end{aligned}$$

Using the Doppler formula Eq. (16-22) for a source receding from a stationary observer,

$$\lambda' = \lambda (1 + V_s / c)$$

since, in this case, the image is equivalent with the source, after substitution we have;

$$\begin{aligned} \lambda' &= \lambda (1 + V_i (1 - \cos \psi) / c) \\ &= \lambda + \frac{\lambda V_i}{c} (1 - \cos \psi) \\ \Delta \lambda &= \lambda' - \lambda = \frac{\lambda V_i}{c} (1 - \cos \psi) \quad (16.19), \end{aligned}$$

where  $\Delta \lambda$  is the Doppler shift produced by the image of a source, receding from a stationary observer with the velocity  $V_i$ .

At a given recession velocity, this result totally agrees with the experimental facts for all angles of scattering, for a given wavelength or frequency of radiation. In comparison with Eq. (16-21), Compton's final result derived from the laws of conservation of energy and momentum,

$$\Delta \lambda = \lambda' - \lambda = \frac{h}{m_o c} (1 - \cos \psi), \quad (16.20),$$

it is evident that the two equations are very similar and the only difference seems to be that, while in the Compton expression  $(h/m_o c)$  all members are constants, in the respective expression in the Doppler interpretation  $(\lambda V_i / c)$ , the two factors,  $\lambda$  and  $V_i$  are seemingly independent variables. Nevertheless, as far as the mathematical derivation is concerned, it is easy to prove otherwise. In Newtonian mechanics, momentum is expressed by the equation  $p = mV$ . According to Maxwell, the momentum carried by electromagnetic radiation is  $p = E/c$ . Since in the quantum theory,  $E = h\nu$ , the momentum carried by the radiation is  $p = h\nu/c$ . But  $\nu = c/\lambda$ , therefore

$$p = \frac{hc/\lambda}{c} = \frac{h}{\lambda},$$

Thus the quantum theoretical expression for the velocity of the electron, we get

$$V = \frac{p}{m} = \frac{h}{\lambda m},$$

substituting the quantum form of the velocity into the expression of the Doppler interpretation,

$$\frac{\lambda V}{c} = \frac{\lambda (h / \lambda m)}{c} = \frac{h}{mc}.$$

This purely mathematical result shows that the general equation derived from the Doppler interpretation is exactly equivalent to that of Compton's, and that the expression  $(\lambda V/c)$  is also a constant, just like Compton's  $(h/mc)$ . However, while the independence of the shift from the frequency was conceptually '*surprising*' for the collision theory, here it is a logical consequence of the basic concept that *the receding velocity of the scattering electron is a result of the momentum of the incident radiation and therefore directly proportional to its frequency:  $V \propto \nu$ .*

*Consequently, the Doppler shift,  $\Delta\lambda$ , measured at any given angle is a constant for all frequencies.*

For the conceptual description of the Doppler interpretation of the Compton scattering based on

the fundamental assumptions of AETHRO-KINEMATICS, consider the following:

1) From the stand point of this theory, the physical meaning of Planck's universal constant  $h$  is simply the forward momentum carried by a single electromagnetic pulse. Its multiplication by the frequency simply gives the total energy delivered through a unit area in space by the number of pulses per unit time.

2) Consequently, AETHRO-KINEMATICS agrees with the expression  $E = h\nu$ . This also agrees with the concept of the free electrons as scatterers, except accelerated not by individual collisions with wave-particle photons, but rather by the forward momentum of the electromagnetic compression pulses produced by the Planckian radiators, and kinematically transferred by the Aether. In this hypothesis, too, the laws of the conservation of energy and momentum are still applicable.

3) Hence, the Doppler interpretation of X-ray scattering does agree with the assumption that the scatterers are *free* electrons, but takes them as the members of an randomly isotropic ideal gas, contained within the boundaries of the scattering block.

(This electron-gas acts very similarly to the atomic or molecular gases, where the random velocities of the radiating units and the resulting Doppler shifts affect the sharpness of the spectral lines and cause the well-known phenomenon, called the *Doppler broadening*.)

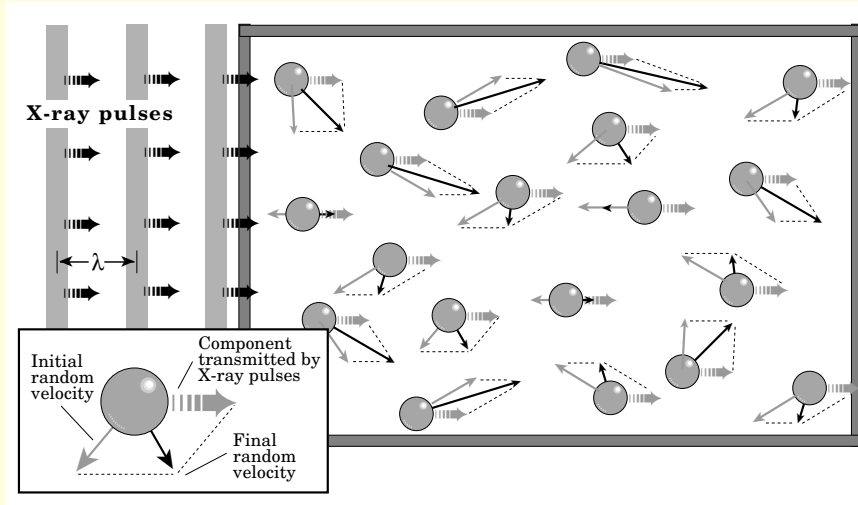


Figure 16-14.

As Figure 16-14 illustrates, in the ideal electron-gas there is a constant and isotropic random motion, where at any instant the same number of particles moving in any direction in any part of the gas. The

acceleration of an individual electron due to the transfer of the forward momentum of the pulses of radiation becomes a *superimposed component* on its initial, random velocity. The result is a general *temporary drift-velocity* of the gas in the direction of the incident X-ray pulses.

This superimposed drift is *temporary*, because the electrons soon lose their individual extra component of velocity in the course of the frequent collisions with the atoms. Nevertheless, they soon after gain some back again from the new pulses. Thus, the component is a constant.

It is, therefore, plausible that the statistical behavior of the electron-gas, relative to its initial isotropic randomness, shows a general recession in the direction of propagation of the X-rays, which is, therefore, also proportional to the frequency of the radiation. This is the answer to Compton's argument for the impossibility of the motion of *all* electrons in the same direction.

In the initial analogy a mirror was used as the scatterer. Now, it can be replaced by a gas of perfectly elastic, spherical particles, the electrons, one of which is illustrated on [Figure 16-15](#).

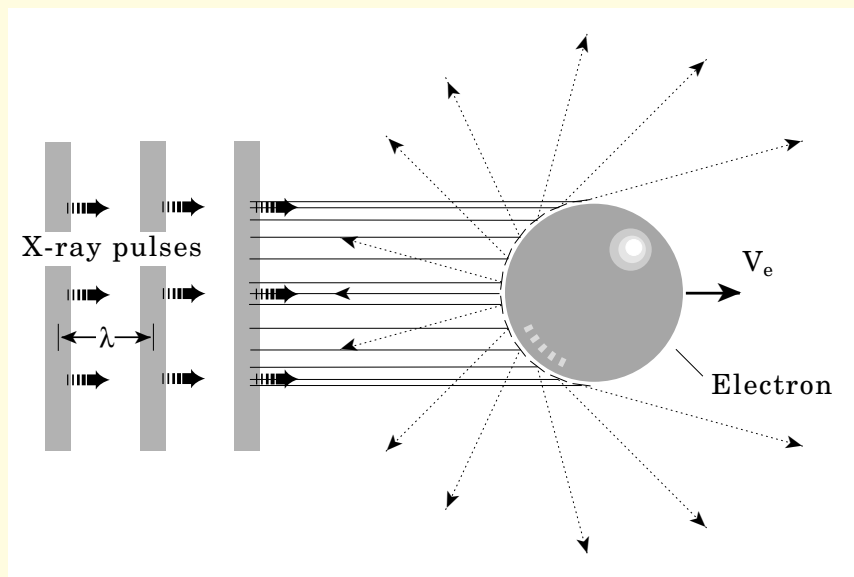


Figure 16-15.

As an aid for accepting this assumption, it should be noted, that, in all sections of science involved with the electron, it is assumed to be a spherical particle. This shape is also the only choice for statistical mechanics in the analysis of any ideal gas. It can be shown that the behavior of a great number of randomly moving and colliding particles is independent from their shape, whether spherical, cubical, or that of a donut-vortex.

The character of elasticity is similarly statistical and therefore the only special assumption required to complete the analogy is that each infinitesimal area of the spherical surface of the electron acts like a section of a plain mirror. Thus it is a perfect scatterer in all directions, as illustrated in Figure 16-15.

The illustration also makes it clear why, in the scattering phenomenon, there exist a Doppler shift even at  $90^\circ$  and beyond.

As for the existence of the *unmodified line*, Compton's assumption is satisfactory; i.e., that the fixed atoms of the crystalline structure, or the bound electrons, do not share the recession drift and do not produce a Doppler shift in the reflected X-rays.

The electron-gas contained in the boundaries of a scattering block, under the pressure of the incident X-ray pulses and with the resulting superimposed recession-drift, is justifiably taken as a receding mirror. Thus, by the simple wave-phenomenon, the Doppler shifting of the wavelength of the reflected image, this alternative interpretation becomes the natural explanation of the phenomenon, in agreement with the classical principles .

It should also be considered that measuring and analyzing the velocity of the recoil electrons were not included in Compton's experiments. Calculating the conservation laws, Compton exclusively concentrated on the energy loss of the radiation ( $\Delta\lambda$ ), and for that goal he needed to consider *only* the mass of the electron. In the latter experiments of Bothe, Geiger and Bless, the post-collision velocity of the recoil electrons has been stated to be *in agreement with the terms of the theory*. However, the complications of such approval can only be realized when the pre-requisites of the experiments were considered in detail.

On the one hand, the intensity of the Compton shift in a given angle is measured through the diffraction and dispersion of the reflected radiation. In Compton's language, this happens by the spectral analysis through the interactions among an immense number of photons.

On the other hand, the velocity of the recoiling electrons can only be found by their individual motion traced through the cloud chamber under the influence of a magnetic field. Hence, for every small change in the observed angle, there is a different

shift produced by the diffracted stream of photons. Therefore, for each resulting *recoil-angle*, there should be a single electron traced in a fractionally different direction with a fractionally different speed. Imagine the task of establishing the simultaneity and the identity of the photon-electron pair before and after the collision in order to match the resulting quantities.

It should be added that the collisions occur within the boundary of the scatterer. Hence, for a true recoil-velocity, the electron must not have any other collisions afterwards, and it should somehow also escape the *work-function* of the metal, which was such a determining factor in the photoelectric effect.

## THE SOLAR SYSTEM OF THE MICRO-COSMOS

Planck's derivation of the experimental curve of black-body radiation by quantizing the electromagnetic oscillators, and Einstein's photon-quantization of radiation itself triggered a general scientific inquiry, as to whether the same concepts and mathematics could be applied to the mechanism and structure of the atom as a natural harmonic radiator.

In 1909, Rutherford gave conclusive experimental verification of the so-called *nuclear atom*, consisting of a very small nucleus surrounded by a number of orbiting electrons.

"At first glance it appears that we can simply allow the electrons to circulate about the nucleus in orbits similar to the orbits of the planets circulating about the sun. Such a system can be stable mechanically because the centrifugal force can be made to balance the Coulomb attraction just as it balances the gravitational attraction in the planetary system. But a difficulty arises in trying to carry over this idea from the planetary system to the atomic system.

"The problem is that the charged electrons would be constantly accelerating (centripetal) in their motion around the nucleus, and, according to the classical electromagnetic theory, accelerating charged bodies must radiate energy in the form of electromagnetic radiation.

"The energy would be emitted at the expense of the mechanical energy (tangential velocity) of the electron, and it would spiral into the nucleus. Furthermore, the continuous spectrum of the radiation, which would be emitted is not in agreement with the

discrete line-spectrum that is known to be emitted by the atoms.

"The difficult problem of the stability of atoms actually led to a simple theory of atomic structure, proposed by Niels Bohr in 1913." (Eisberg: Fundamentals of Modern Physics. [108])

"On the assumption that the hydrogen atom consists of an electron revolving around a nucleus (a single proton) whose charge is equal and opposite to that of the electron and whose mass is very large in comparison with the mass  $m$  of the electron, Bohr first investigated how far classical mechanics could be employed. From Kepler's first law he knew that the orbit of the electron is an ellipse with the nucleus in one of its foci. Calling the major axis of the orbit  $2a$  and the energy which has to be added to the system in order to remove the electron to an infinite distance from the nucleus  $W$ , the charge of the electron  $e$ , and that of the nucleus  $e'$ , Bohr could easily show that on the basis of classical principles

$$\omega = \sqrt{2/\pi} (W^{3/2} / e^2 \sqrt{m}) \text{ and } 2a = e^2 / W \quad (16.21),$$

which indicates that the frequency of revolution,  $\omega$  and the major axis of the orbit depend only on the

value of  $W$  and are independent of the eccentricity of the orbit. Bohr now saw that by varying  $W$ , all possible values of  $\omega$  and  $2a$  could be obtained. The existence of sharp spectral lines, however, shows that the latter quantities have to assume definite values, characteristic for the system." (Jammer: *Conceptual Development of Quantum ...*[77])

In contrast to the continuous spectrum of electromagnetic radiation emitted from the surface of solids, the radiation emitted by the atoms of the hydrogen gas is concentrated at a limited number of *wavelengths* at which the lines of the relatively simple spectrum of the hydrogen atom are found.

As Figure 16-16 illustrates, there is an obvious regularity in the spacing of the spectral lines of the discontinuous spectrum of hydrogen.

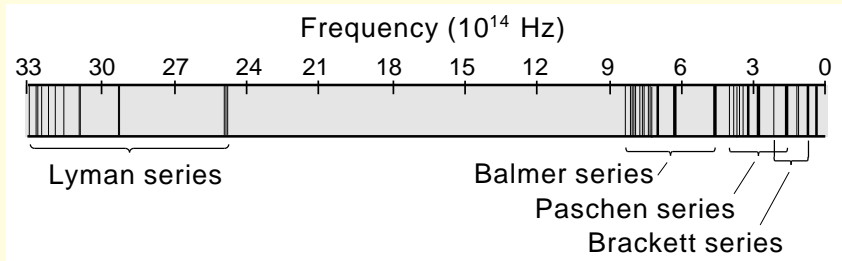


Figure 16-16.

At the end of the last century, several scientist was tempted to look for an empirical formula that would express this regularity. Such a formula was indeed discovered by Balmer in 1885.

The simple relation of the distances between the lines of the Hydrogen spectrum made it evident that the electron can only orbit at certain specific distances from the nucleus, and therefore having only certain discrete mechanical frequencies. It also suggested to Bohr that there is no classical mechanical reasoning to explain these facts. Convinced of the inability of the classical approach, Bohr felt compelled to turn to Planck's quantum hypothesis for a solution. Indeed, eventually he was able to identify the exact relationship that made it possible to incorporate Balmer's Formula, Planck's quantum and Rutherford nuclear model with the Newton-Kepler celestial mechanics.

How, indeed, Balmer's empirical formula suggested a way to Bohr of corroborating classical mechanics with the quantum conceptions, usually described as follows:

According to Balmer's formula, as the distance between the lines decreases toward the shorter wa-

velengths of visible radiation, they reach a *series limit*, at which no more distinction is possible. If the wavelength of radiation is in Ångströms ( $10^{-8}$  cm), this limit is  $\lambda = 3646 \text{ \AA}$ , and Balmer's simple formula can be written as:  $\lambda = 3646 \times n^2 / (n^2 - 4) \text{ \AA}$ , where  $n$  is an integer.

A few years later, Rydberg found that Balmer's formula and its immediate generalization can most conveniently be expressed in terms of frequency,  $\nu$  as:

$$\nu = R_H c \left( \frac{1}{n_2^2} - \frac{1}{n_1^2} \right) \quad (16.22),$$

where  $\nu$  is the frequency,  $R_H$  is the Rydberg constant for hydrogen,  $n_1$  and  $n_2$  are integers, and  $c$  is the velocity of light.

Consequently, Bohr's explicit task was to design an atomic structure for hydrogen in which, based on the above mechanical principles, the possible orbital frequencies of the electron were somehow restricted to certain discrete values, related to Planck's constant and in agreement with Einstein's photon concept, which in turn should lead to the mathematical derivation of Balmer's formula.

Realizing that there was no other conceptually coherent approach to explain the stability of the atom and the discontinuity of the hydrogen spectrum, Bohr, in direct contradiction with Newton's mechanics and Maxwell's electrodynamics, boldly postulated the following assumptions :

"1. *An electron in an atom moves in a circular orbit about the nucleus under the influence of the Coulomb attraction between the electron and the proton, and obeying the laws of classical mechanics.*

"2. *But, instead of the infinity of orbits which would be possible in classical mechanics, it is only possible for an electron to move in an orbit for which its orbital angular momentum  $L$ , is an integral multiple of the Planck constant  $h$ , divided by  $2\pi$ .*

"3. *Despite the fact that it is constantly accelerating, (centripetal acceleration), an electron moving on such orbit does not radiate electromagnetic energy. Thus its total energy,  $E$ , remains constant.*

"4. *Electromagnetic radiation is emitted if an electron, initially moving in an orbit of total energy,  $E_i$ , discontinuously changes its motion so that it moves in an orbit of total energy,  $E_f$ .*



The frequency of the emitted radiation,  $\nu$  ( $nu$ ) is equal to the quantity  $(E_i - E_f)$  divided by Planck's constant,  $h$ .

"These postulates do a thorough job of mixing classical and non-classical physics. The electron moving on a circular orbit is assumed to obey classical mechanics, and yet the non-classical idea of quantization of orbital angular momentum is included. The electron is assumed to obey one feature of classical electromagnetic theory (Coulomb's law), and yet not to obey another feature, the imperative emission of radiation by an accelerating charged body." (Eisberg: Fundamentals of Modern Physics [114])

So, Bohr derived the Balmer's formula as follows:

Assuming a circular orbit of an electron about a stationary nucleus (proton), the total energy of the system,  $E$ , is given by

$$E = mv^2 - ee'/r \quad (16.23),$$

where  $m$  is the electron's mass,  $v$  is its orbital speed,  $e$  and  $e'$  are the opposite charges of the proton and the electron representing the Coulomb force of attraction between them, and  $r$  is the radius of the orbit. Hence, the stability of the atom based on clas-

sical principles can be expressed by the equality of centripetal acceleration and centripetal force:

$$mv^2/r = e^2/r^2 \quad (16.24).$$

Combining Eqs. (2) and (3) we obtain

$$E = 1/2 (e^2/r) \quad (16.25).$$

If the frequency of the orbital motion is  $f$ , then the orbital velocity,  $v = 2\pi r f$ , and from the preceding relations, the orbital or mechanical frequency of the electron is

$$f = \sqrt{2/\pi} (-E^{3/2}/e^2 \sqrt{m}) \quad (16.26).$$

With this, the description of the proton-electron system, based on classical mechanics and electrodynamics, reaches its limitations and suggests no restrictions in the selection of possible orbits. Depending only on the angular velocity and on the radius, all orbits, and therefore all orbital frequencies, are possible.

At this stage of his theory, with some revisions Bohr implied Planck's assumption that electromagnetic oscillators can only emit energy in discrete quantities of  $h\nu$ , where  $h$  is a constant and  $\nu$  is the

frequency of the radiation. According to Planck, the *total energy* of a particle, such as an electron, executing simple harmonic motion under the influence of a *harmonic restoring force* is:  $E = nh\nu$ ,  $n = 0, 1, 2, \dots$  where  $n$  may be any integer value.

Bohr applied the quantization to the *orbital angular momentum*,  $L$  of an atomic electron moving under the influence of the inverse square force of Coulomb's attraction:

$$L = nh/2\pi, \quad n = 1, 2, 3, \dots (16.27).$$

This reveals the essence of quantization; that, for some unknown reason, no other quantities are allowed. The next question is, how can these fixed sizes of the quantized orbits and the resulting mechanical frequencies be related to the specific frequencies of the radiated energy?

(To keep the notations consistent, it should be pointed out that in Bohr differentiation between the two kinds of frequencies, the mechanical or orbital frequency of the electron is  $f$ , and the frequency of the radiation emitted by the electron is  $\nu$ .)

At this point in the theory of the solar atom Bohr had to make the transition from mechanics to quan-

tum theory. As he states in the fourth postulate, for the sake of the mechanical stability of the atom, the electron cannot radiate continuously on a permanent orbit, only at the instant when it jumps from a higher to a lower energy level.

Mechanically, each allowed orbit or angular momentum must represent a distinct frequency of revolution, but the radiation frequency is separated from the orbital frequency by the assumption that the energy is radiated discontinuously *during the jump* of the electron. Thus, a further assumption is needed, namely, that the frequency of the radiation emitted by the electron should be the average between the mechanical frequencies of the initial and final orbits.

For the calculation of this average, Bohr suggested that at the instant of the jump the electron should be taken as *unbound (free) and its orbital frequency should be taken as zero*. After the jump, on its final orbit, the electron is bound, and therefore its orbital frequency is  $f$ . Hence, the average mechanical frequency between the two orbits is  $f/2 - 0$ , or  $f/2$ . Therefore, the relation between the mechanical frequency and the radiated frequency is  $\nu = f/2$ , and the

energy emitted *during the jump* is

$$E = nh\nu = nhf/2 \quad (16.28).$$

Combining Eqs (7) and (5) Bohr obtained the quantized mechanical frequency

$$f = 4\pi^2 me^4 / n^3 h^3 \quad (16.29).$$

Finally, since the radiated energy by Einstein's formula is

$$E_{n_2} - E_{n_1} = h\nu \quad (16.30),$$

the quantized frequency of the radiation is given by

$$\nu = \left( \frac{2\pi^2 me^4}{h^3} \right) \left( \frac{1}{n_2^2} - \frac{1}{n_1^2} \right) \quad (16.31).$$

When selecting the value  $n_2 = 2$ , it gives the radiated frequencies of the hydrogen atom in exact agreement with the Balmer's series of the spectral lines. The first part of the right side of the formula is equivalent to Rydberg's constant.

During experimental verification of the theory, the discovered fine structure of the spectral lines made it necessary to account for the fact that the nuclear mass is actually finite. Based on this distinction, Bohr refined the formula, which then turned

out to agree with the detailed spectroscopic data to within 3 parts in 100,000!

Nevertheless, in spite of its great success, the theory was not fully accepted as is freely quoted from Ritchmyer's 'Introduction to Modern Physics':

..."a hybrid theory of this sort was widely felt to be unsatisfactory. Bohr solved the old problem of the stability of the atom merely by stating that it *did not exist* so long as the electron remained in one of its allowed stationary orbits. But the problem of stability was solved at the expense of throwing away the only picture we had of the mechanism by which the atom could emit spectral lines. For Bohr's postulates provide no picture of the sequence of events *during transitions between orbits*.

"...*Wave-mechanics*, that ultimately replaced Bohr's solar model, leads very nearly to the same quantum states, but suggests a quite different picture of the behavior of the electron while in a quantum state. It is only half true that the electron is in motion in the atom, at least, it cannot be said to follow a definite orbit. Because of the abstractness of this new theory, *the original simple Bohr picture is commonly felt to retain something more than mere historical interest.*"

Nevertheless, Bohr's 'hybrid' model of atomic structure was temporarily accepted and, as for its deep rooted conceptual confusion, the excuse of Modern Physics was simple and superficial:

..."we should not be surprised if the laws of classical physics, which are based on our experience with macroscopic systems, are *not completely valid* when dealing with microscopic systems such as the atom." (Eisberg; Fund. of Modern Physics [115])

Because of the comparatively simple mathematical derivation and its explicit dependence on classical mechanics, Bohr's theory represents one of the most transparent examples of modern epistemology; the method of step-by-step sacrifice of conceptual and logical consistency for the sake of the ultimate goal, at any cost; *an experimentally verified mathematical formula*.

For the sake of a possible alternative hypotheses, it should be noted here that Bohr's solar model of the hydrogen atom has never been disapproved or superseded by later developments of more sophisticated quantum theories. Since, according to the correspondence principle, relativistic mechanics must reduce to Newtonian mechanics in cases of velocities much

smaller than that of light, the most abstract predictions of the latest version of quantum-mechanics still must agree with Bohr's predictions when it deals with the simple case of a one-electron-atom.

Though a confusing mixture of classical and modern concepts, the solar model is, nevertheless, the last humanly perceptible and experimentally justifiable mechanism; a conceptual link between the macro-cosmic and micro-cosmic structure of matter. It is also questionable how much of the original simple Bohr picture has been retained as the conceptual foundation, during the metamorphosis of the theory through matrix- wave- and quantum-mechanics. No matter what tremendous advance modern mathematical theories have made into the conceptual vacuum of modern physics, it can hardly be denied that behind all sophisticated trickery of prediction, the subject still is the solar atom and its orbiting electrons. In fact, at least two explicit points in the most modern level of quantum-mechanics, which are still in firm contact with classical physics.

The most fundamental quantum mathematical equation, the Schrodinger wave-function, has been derived from the ancient formula of the waves on a

taut string, expressing simple harmonic oscillation, which has been found applicable to all wave phenomena and oscillation, including the periodic orbital oscillation of the electrons in the atom.

Buried under the incomprehensibility of the 'probability waves', one can find Newton's whole celestial mechanics when one takes Bohr's solar model analogy somewhat further. It is evident that a considerably more complex macro-cosmic solar-system than ours, with a great number of planets and comets, and a complex *nucleus* sustained by the interactions between several major solar bodies (nucleons), would also call for a replacement of the simple laws of Newton and Kepler, and would require some highly sophisticated, purely mathematical predictions, more likely based on complex perturbational probabilities.

Indeed, "...the origin and development of the mathematical apparatus (matrix-mechanics) under consideration were intimately connected with the techniques of computing planetary motions in astronomy. In fact, just like the mathematics of the older quantum theory and, in particular, the mathematics of its theory of perturbations, the mathematics of matrix mechanics can be traced back to the study of plane-

tary orbits and of the orbits of planetary satellites. Ironically, matrix mechanics, the outcome of Heisenberg's categorical rejection of electron orbits, had to eventually resort to the mathematics of orbital motions....The extension to infinite systems of linear equations with infinitely many variables, which proved to be of extreme importance for the later development of matrix mechanics and quantum mechanics in general, had its origin again, in astronomical computations of orbital motions." (Jammer, Conceptual Development. [225])

Thus, it should be recognized that incomprehensibility and complexity are two different concepts. Comprehending a system requires the whole conceptual ability of the brain, while its complexity is merely a difficulty in the mathematical department.

This distinction might justify an attempt to revise Bohr's hybrid solar-atom, thereby rendering a kinematically conceivable foundation for the already developed complex mathematics.

## A MATTER OF THE ORDER OF MAGNITUDE

Chapter Seven, Eight and Nine described the kinematics of Newton's gravitational force and Kep-

ler's laws of planetary motion through the concept of the Sink-vortex together with the evolutionary theory of ponderable matter. In Chapter Eleven, a hypothetical description of the purely kinematical origin of a donut-vortex was given as a possible formation of an elementary particle, with its inter-connectivity to form a variety of permanent dynamic formations with different intake and output.

No doubt, it would take a great effort of careful design, correlated with mathematical and experimental research, to create a conceptually and mathematically justifiable solar-atom based on the above concepts of AETHRO-KINEMATICS and analogous to the macroscopic solar-system. Nevertheless, the fact is that the only scientific hypothesis available is the Rutherford-Bohr solar-atom structure, based on the Coulomb law of attraction, which is a direct mathematical parallel to the Newton-Kepler celestial mechanics. After all, Bohr's simple conceptual foundation is the last contact with the humanly comprehensible classical world picture and according to his correspondence principle, it is also the only choice of a conceptual foundation no matter how extreme is the complexity of quantum mathematics.

It follows that, for the time being, a heuristic assumption can be justified, and that the difference between the kinematics of the solar system and the kinematics of the internal structure of the hydrogen atom is merely *a matter of the order of magnitude*. By extending this analogy to its kinematic alternative, some contradictions between Bohr's hypothesis and the principles of classical and electromagnetic theories might be resolved

The imperative demand of classical electromagnetism is that an accelerating, charged particle *must* radiate energy. For the sake of the stability of the atom, Bohr elected to oppose this principle and postulated that the energy of the orbiting electron is constant; that is, it does not radiate due to its centripetal acceleration on a permanent orbit. Bohr further postulated that the electron *does* radiate when discontinuously changing orbits, by jumping from a higher stationary energy level to a lower one.

Offering no physical reason, he assumed this emitted energy to be proportional to half the difference between the kinetic energies of the electron on its initial and final orbits.

As discussed earlier, by this assumption not only does the electron jump between two orbits, but the whole theory leaps over from the well-defined principles of classical mechanics and electromagnetism to the physically undefined conceptions of the quantum hypothesis. There is absolutely no conceptual feasibility of why and how the mechanical transition between the two allowed orbits, the energy exchange between the orbital, mechanical frequencies, and the emitted radiation frequencies can happen in physical reality.

Bohr's explanation of the discontinuous spectrum of the hydrogen gas was achieved by the quantization of the electronic orbits; that is, by the simple mathematical statement that the angular momentum of the electron *cannot be* any other quantity than an integral multiple of Planck's quantum of action.

Thus, the fact that, Bohr was able to replicate Balmer's empirical formula from all these incompatible physical and metaphysical concepts and their mathematical symbolism, tells much more about the uncertain values of mathematical derivation, than about the justification of the conceptual theory.

Nevertheless, since even the most advance theories, through all the metamorphosis of the concepts and mathematics, still must revert back to Bohr's simplified quantization of the orbits and their prediction by perturbation mathematics, it seems worthwhile to consider an attempt to revise Bohr's ideas by an alternate, conceptually more consistent hypothesis.

In the AETHRO-KINEMATIC description of the solar-sink-vortex, the average angular momentum of a planet is constant, and its orbit is permanent. According to this hypothesis, the planet is carried by the spiral vortical flow of the sink and therefore, the orbital velocity of the planet does not represent *a relative motion* between the planet and the rotating Aether.

Similarly, in the micro-cosmic solar model of the atom, the orbital revolution of the electron, while it is being carried by the atomic sink-vortex, does not represent motion relative to the medium. Hence, the motion of the electron causes no Aether resistance and, therefore, its angular momentum is a constant.

According to the kinematic theory of electromagnetic radiation, compression pulses are produced by

ponderable oscillators when they accelerate relative to the isotropy of the Aether. The electron can be such oscillator on its orbit if, in spite of its constant energy, it can still perform such acceleration.

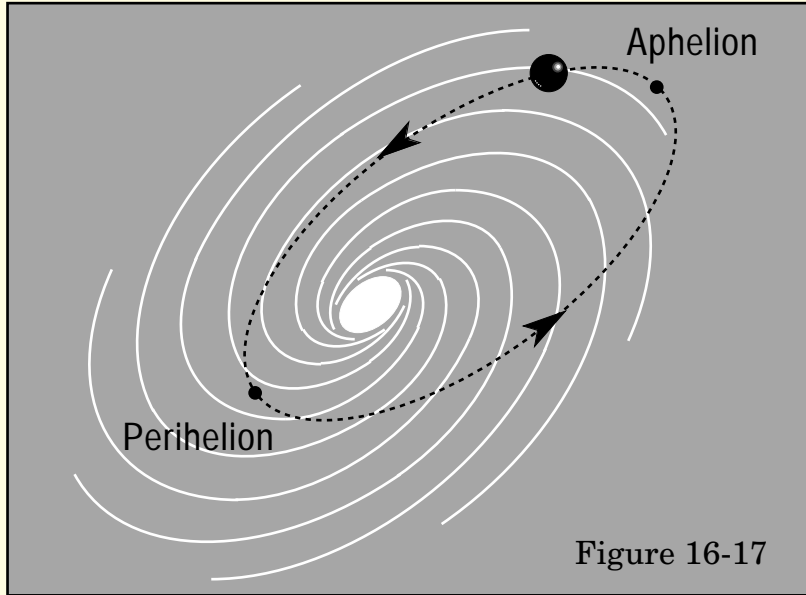


Figure 16-17

As shown it is shown above, by superimposing of an elliptical orbit on the spiraling vortex, for both planetary and electronic permanent orbits, there must be a periodical de-railing from and on-railing to the spiral channels of the vortexing medium.

During these events, the planets and the electrons perform periodical accelerations and decelerations relative to the Aether, according to Kepler's law of equal areas. These accelerations toward the *perihelion* and deceleration toward the *aphelion* represent motion of the electron relative to the general flow pattern of the vortex, therefore causing periodical density variations, or compression pulses in the medium. Superimposed on the vorticity, these disturbances are transmitted to the external isotropic Aether and propagated away with the speed of light.

There is a natural kinematic reason for this de-railing of the planet or the particle from the spiral channels of the vortex during its elliptical orbits. Another empirical discovery which was not explained by celestial mechanics. Newton's description for the cause of the elliptical orbits was based on the ad hoc hypothesis of a *slight accidental mismatch* between the initial tangential velocity of the planet and the centripetal force of the solar mass. (Chapter Six).

The theory of the gravitational sink-vortex includes a *kinematic necessity* for elliptical orbits and the consequential periodical variations of the orbital velocity of the planet, as follows:



Any individual *Aethron*, which is caught in the peripheral vortical flow of a sink will acquire an orbital *drift-velocity* of ever increasing speed and constantly changing direction. In any one of the numberless spiral channels of the vortex, the drift-velocity and centripetal acceleration of the individual *Aethron* will constantly increase, and eventually it will be swallowed by the central mass which, by its evolution, creates the sink.

However, any conglomerates of *Aethrons*, organized into the dynamic pattern of a *ponderable particle*, represents an inertial mass, equivalent to the tendency to preserve its uniform speed on a straight line as a unit. This inertial resistance also represents a centrifugal force which is proportional to the quantity of the organized *Aethrons* in the particle.

Consequently, a particle having inertial mass, that is caught in the vortex, cannot follow the constantly changing direction of the spiral channels. As suggested in Chapter Five, the change of momentum of a conglomerate of *Aethrons* through *one on one collisions* is a *function of time*. The obvious result is that the particle cannot keep up with the constantly accelerating flow of the individual *Aethrons*, and

eventually must derail outward from the in-winding spiral channels.

This derailing, however, also represents a motion relative to the general rotation of the vortex. Thus, the particle experiences an Aether resistance which, in turn, causes its deceleration. It is, therefore, expectable that the decelerating particle will eventually reach a zone of the spiral where its speed and direction are equalized with those of the local channels. From this stage on the procedure of acceleration starts all over again.

Although it is an extremely complex procedure, it is intuitively feasible that equilibrium can exist between the inertial motions of the mass of the particle and the flow of the vortex, where the total time-lag of the accelerations and decelerations of the mass is just equal to the period of the full orbit of the specific Keplerian differential rotation zone of the vortex thus the particle can start the whole procedure all over from the same position at the Aphelion.

Applying this hypothesis to the hydrogen atom, it can be seen that all contradictions between Bohr's theory and the principles of classical electrodynamics are eliminated.

The most important problem, the stability of the atom, is explained because, in general, the electron is being carried by the vortex and only radiates when it accelerates relative to the medium. Thus, the radiation does not come from the electron's own energy, but supplied and withdrawn and supplied again by the angular momentum of the whole of the atomic sink-vortex.

This hypothesis also covers the problem of the permanent elliptical orbit of the electron and its role as a simple harmonic oscillator. It also makes Bohr's distinction between mechanical, or orbital frequency and the frequency of the emitted radiation unnecessary. Furthermore it relieves the solar model from Bohr's discontinuous jumps between orbits, and the unwarrantable bursts of emissions, which were introduced to artificially relieve the problem of atomic stability.

There is, however, a more abstract but intuitively more feasible conjecture to be derived from the above description.

It was generally assumed that Kepler's laws and Newton's universal gravitation allow an infinite number of permanent orbits, provided that the plan-

et has the right tangential velocity at the right distance from the sun.

Now it may be seen that the criterion for a permanent elliptical orbit is not only determined by the masses of the particles, and their distances and tangential velocities relative to one another, but also by the delicate exchange of energy between the orbiting particle and the vortexing medium.

It follows that there is an altogether different criterion; for the permanent orbits in the solar model of the atom, the ratio between the underlying Keplerian differential rotation of the vortex and the inertial acceleration time-lag in the superimposed elliptical orbit of the electron. Evidently, these conceptual factors should render a somewhat better understanding of the physical selection of specific permanent orbits, than does Bohr's *ad hoc* mathematical quantization.

The earlier conclusion, that Planck's constant represents the momentum density carried by a single electromagnetic pulse, should also be considered. Thus, when an electron, accelerated by external radiation, that passes through the atom, revolves on one of its kinematically allowed orbits, it will gain kinetic energy until its angular momentum matches the

requirement of the next allowed orbit. The difference between the two energies will be proportional to the momentum density,  $h$ , of the pulses of the incident radiation.

As for the correlation of this hypothesis with Schrodinger's quantum mechanical wave-function, it can be seen from Bohr's example that mathematicians are ingenious in their methods of deriving the exact result they want to reach.

## A SHIP OF WAVES OR THE WAVES OF A SHIP

Last but not least, it is time to deal with the most recent, astonishingly bold and consequently, most far reaching innovation of modern physics: the matter waves.

As a condensed demonstration of the total conceptual obscurity of this important pillar of wave mechanics let us quote some attempts at clarification from modern educational works:

As described in Halliday's 'Physics' [1117],

"In 1924 Louis de Broglie of France reasoned, that  
(a) nature is strikingly symmetrical in many ways;  
(b) our observable universe is composed entirely of

light and matter; (c) if light has a dual, wave/particle nature, perhaps matter has also. Since matter was then regarded as being composed of particles, de Broglie's reasoning suggested that one should search for a wavelike behavior for matter.

"De Broglie's suggestion might not have received serious attention had he not predicted what the expected wavelength of the so-called *matter waves* would be.

"De Broglie assumed that the wavelength of the predicted matter waves was given by the same relationship that held for light,

$$\lambda = \frac{h}{p} \quad (16.32)$$

which connects the wavelength,  $\lambda$ , of the light waves with the momentum,  $p$ , of the associated photons."

Eisberg, 'Fundamentals of Modern Physics'[139]:

"In classical physics electromagnetic radiation had been considered to be purely a wave propagation phenomenon. However, the work of Einstein and Compton has demonstrated that under certain circumstances it displays properties characteristic of particles (quanta). This being the case, could it also

be true that physical entities which we normally think of particles (electrons, alpha particles, billiard balls, etc.) will under certain circumstances display properties characteristic of waves?

"It is immaterial whether the situation is described by saying that electromagnetic radiation actually consists of waves which upon interacting with matter, are able to manifest particle-like behavior, or by saying that it actually consists of particles whose motion is governed by the wave propagation properties of certain associated waves. In fact, it is somewhat naive even to imply that there is a choice to be made. However, by adopting the latter statement, de Broglie was led to investigate (and postulate) the idea that *the motion of a particle is governed by the wave propagation properties of certain pilot waves* (to use his terminology) *which are associated with the particle.*"

As it has been presented in [Chapter Three](#), there were two immediate major consequences of de Broglie's hypothesis:

1) The conceptual explanation of Bohr's quantization of the electron orbits by the hypothesis that the de Broglie waves of form *standing waves* on the

atomic orbit. Thus, quantization means, that only those orbits are allowed whose circumference are an integral multiple of the de Broglie wavelength.

2) The other inescapable result of deBroglie's standing wave description of an electron is that the position of the electron and the orientation of the vector indicating its linear momentum cannot be exactly specified at a given instant of time. This uncertainty in the position and the momentum of the electron is the general feature of Heisenberg's Uncertainty Principle, which results from the description of the motion of the particle in terms of the propagation of its associated pilot waves.

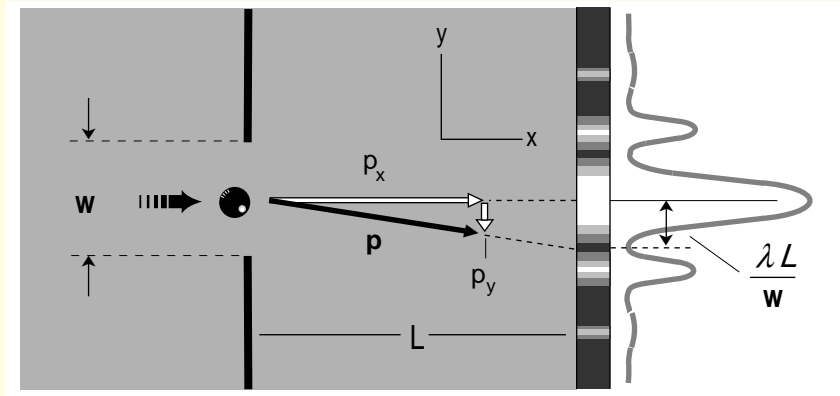


Figure 16-18.

This illustration is a replica of Figure 3-6 (b), giving a schematic explanation of the electron diffraction experiment, the simplest proof of the inescapable uncertainty principle.

As shown, the extent of the diffraction depends on the ratio between the width of the gap and the de Broglie matter-wavelength. The deviation from a straight trajectory increases with the decrease in the width of the gap.

While the smallness of the gap is instrumental in establishing the *instantaneous position* of the electron within the gap, the same is true for the probable changes in the *direction of momentum* beyond the gap. It follows that a minimum uncertainty in the measurement of the position will produce a maximum uncertainty in the direction of the resulting momentum and vice versa.

Mathematically speaking, if the position of the electron on the  $y$  axis is  $y$ , and the  $y$ -component of the momentum of emergence is  $p_y$  then from the de Broglie relation of the momentum and the matter wavelength,  $p = h / \lambda$ , it can be shown that

$$\Delta p_y \Delta y \cong h \quad (16.33).$$

Another angle of the electron matter-waves is described by the author Mashuri L. Warren, in *Introductory Physics* [541]:

"In quantum physics there is much discussion of hypothetical experiments. – In principle, these 'thought' experiments, or *gedanken experiments*, could be performed, but in practice they present real technical difficulties.

"Such *gedanken experiments* are at the heart of philosophical discussions directed toward clarifying the foundations of quantum theory and revealing hidden contradictions in it. One such *gedanken experiment* is the double slit (Young's) experiment, where a beam of electrons passes first through a single slit to form a coherent beam, and through a double slit. The intensity of the electron or photon distribution is then observed on a screen.

"If light illuminates the slits, the outcome of the experiment is clear. Because of its wave character, light passing through each slit spreads out and forms a single diffraction pattern. Light from the two slits interferes, giving rise to a double-slit interference pattern superimposed on the single-slit diffraction pattern. This interference pattern is essentially the

same whether we are treating water waves, sound waves, light waves, or quantum waves. The pattern is determined by the slit width,  $a$ , the slit spacing  $d$ , and the wavelength  $\lambda$ .

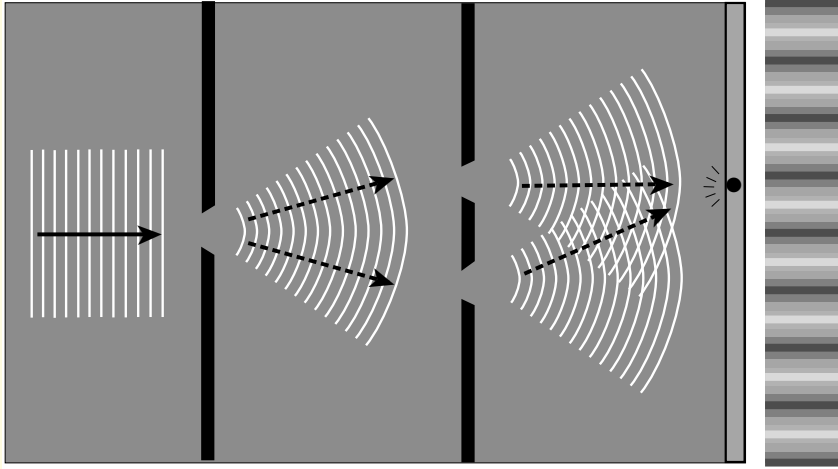


Figure 16-19.

Figure 16-19 shows the "*gedanken illustration*" of the electron double slit *gedanken* experiment. The thin, white straight and curved lines represent the wave character, and the heavy black arrows represent the particle character of the phenomenon.

"If we look at the double slit (*gedanken*) experiment with reference to particles, we get different results.

Suppose the electrons are small particles analogous to bullets. We can allow for the bullet scattering a bit from the edges of the slits, but we cannot allow the bullet to break into pieces. There is no interference effects with bullets; either the bullet arrives at a spot or it does not. How can one bullet cancel another?

"When the photon or the electron passes through the slits, it acts as a wave to produce an interference pattern. But when we detect the electron, we always observe a whole electron, never 1/2 or 3/4 electron.

"The probability of observing these particles is distributed like the intensity of a wave. Thus we have the *wave-particle duality*. Is it a wave or a particle? The answer is *neither* and *both*. This is a *paradox* of the quantum theory."

After some 20 pages of description of the hypothesis of the de Broglie matter waves and its justification by real- and thought- experiments, Berkeley's Physics Course III; Quantum Physics (1965), renders the concluding clarification of the concept:

"Let us tighten up our language a bit. When we discussed the discovery of the de Broglie waves we talked about '*waves associated with a particle*'.

"This is bad language because it sounds as we would have a classical corpuscle traveling together with a wave in some fashion. Some people like to call the de Broglie waves '*guide waves*' or '*pilot waves*', but this terminology is also bad. The de Broglie waves are not waves traveling together with, and '*guiding*' a classical corpuscle. The de Broglie wave and the particle are the *same thing*; there is nothing else.

"The real particle, found in nature, has wave properties and that is a fact. If we want to emphasize this fact we might talk about the de Broglie wave of an electron, but this term is really a synonym for '*electron*'. Our excuse for our previous bad language is that our discussion was at first tentative, as well as historical, and the cautious term '*wave associated with a particle*' was therefore defensible. The time has now come for us to be more precise and definite, and we should reject a terminology which might lead our thinking astray.

"Consider again, the two-slit (gedanken) experiment of electron interference. There is nothing in this experiment which suggests to us that there might be a classical corpuscle passing through one of the slits, '*guided*' by a wave which passes through

*both slits*. Better stated: *Our description of what takes place, in no way improves if we try to introduce this idea!* It is quite enough to discuss the waves only, with the quantum mechanical interpretation (Schrodinger's wave function) of intensities and probabilities.

*"Any talk about the 'hidden' corpuscle is metaphysics, unless the assumption that the corpuscle exists has some definite experimental consequences which cannot be predicted on the basis of the quantum mechanical wave theory alone."*

From Eisberg, Fundamentals of Modern Physics, [170] :

"The wave function,  $\Psi(x,t)$  is an *inherently complex function*.

"We did not know this when we developed some of the qualitative properties of the free particle wave function. However, each of those arguments could be stated again, always replacing the phrase, '*wave function*' by, for example, the phrase '*real part of the wave function*'.

"Recall also that in the discussion of the difference between group and phase velocities, we described the wave function of various coordinates  $x$  at a certain

instant  $t_0$ . This was done simply to provide *something concrete to think about*. If we were to repeat that discussion, we would now have sufficient acquaintance with the idea of wave function to render such an *artifice* unnecessary. We would also realize that the *hypothetical instruments* for measuring the value of the wave function *cannot possibly be exact*, since the value of an inherently complex quantity *cannot be measured* with an actual physical instrument.

"The fact that wave functions are complex functions, should not be considered a weak point of the quantum mechanical theory. Actually it is a desirable feature because it makes it immediately obvious that *we should not even attempt* to attribute to wave functions a physical existence in the same sense that water waves have physical existence.

*"That is, we should not try to answer, or even pose, the questions: Exactly what is waving, and what is it waving in? The reader will recall that consideration of just such questions concerning the nature of electromagnetic waves led nineteenth century physicists to the fallacious concept of the ether. As the wave functions are complex, there is no temptation to make the same mistake again."*

God forbid !

This article was published in 1965. One would expect, that obeying Einstein's order not to mention its name for six decades, the '*you know what*' should not be a threatening ghost anymore. But the above quote could also be raised to the rank of a modern epistemological principle; *a manifestation of how the mathematical machinery, which once merely symbolized the conceptuals, now gained power to outlaw the use of open mind.*

For the AETHRO-KINEMATIC alternative of the de Broglie–Heisenberg matter–wave–uncertainty principle, consider the following fictitious "gedanken-experimental diary":

– I am Captain Smith, commanding officer of the american air-ship squadron, positioned in France (1943). Our primary duty is to fly beyond the front line, investigate the heavy machinery and weapon concentrations of the enemy and give constant information to our air-force. This is not an official military log, but my personal diary, which has nothing to do with the war, but is an attempt to record a kind of scientific discovery.



– The top-secret headquarter and hangars of the surveillance squadron (13 air-ships, maybe called blimps) were built on a foresty mountain plateau, well camouflaged from enemy eyes. As Figure 16-20 illustrates, the 13 hangars were placed in a arch around the sliding gate entrance, built into the great outside wall. A long channel, leading to the gate, was cleared out of the forest for the landing and take off of the blimps.

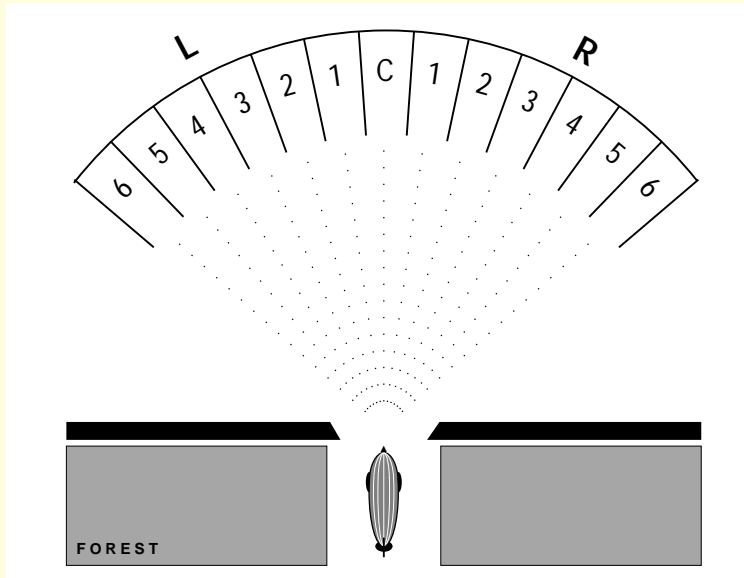


Figure 16-20.

– For additional security, because of the nearby small village, the landing procedure was quite delicate. The blimps only landed at night and had to gain a certain momentum over the forest, then shot the motor shut off and decline into the forest-channel with the right speed and direction. The pilot then had to guide his ship through the main gate into his own hangar in the arch. In each hangar there was an elastic net to decelerate the blimp.

– One night, I was landing my ship according to operational directives. I achieved the right speed and direction, declined into the channel and moved on the inertia of the blimp in a straight line toward the gate. My hangar was R4, the fourth place to the right from the center (C). At some distance from the gate I wanted to make an adjustment in the direction, but noticed that the steering cable broke and I'd totally lost control. There was no reason to panic, since I expected to drift straight into C, and had enough time to communicate the swap with the other pilots.

– However, just before the blimp reached the gate its nose was slowly deflected to the left, and she gradually swayed into a new direction. Finally, without steering, she slipped into hangar L3.

– Later, when I examined the situation I got deeply puzzled, because the steering wing was totally free, so it was not responsible for the turn, and I had not the faintest idea what possible forces made the ship changing its direction.

– Weeks passed and the puzzle begin to fade in my mind when I have received my monthly edition of *Popular Science Digest*, and my eyes got caught on a small article about the '*de Broglie pilot waves*' that were supposed to explain the diffraction of the electron which it was associated with.

– Needless to say, I got really excited. I remembered, from my aerodynamic studies in pilot school, that the motion of an object creates small density changes in air, which are propagated away by the medium in the *form of compression waves* with the speed of sound.

– What would explain my puzzle any better than these pilot waves, produced by the motion of the ship, which was sent ahead in the air and reflected back from the wall against the ship? At once it became clear that the continuous back and forth reflection of the waves builds up pressure fluctuations between the wall and the ship, and the smallest sideways

deviation from the center of the gate must produce an uneven transverse force that will push the nose of the ship in an angle proportional to the width of the gate and the size and the velocity of the ship.

– Fortunately, the German army was falling apart, and during the following weeks I could manage to do various experiments with different velocities and deviations, with different size ships, and adjusting the width of the sliding gate. All ships landed purely on their inertial motion with their steerings left alone.

– The analysis of the records convinced me that there is a definite trace of a diffraction pattern in the *accidental* docking of the blimps with maximum and minimum probabilities for each hangar. The most frequently reached hangars were L2, L1, C, R1,R2. Somewhat less frequent were L3 and R3, and almost none reached L4 and R4, obviously the first minimum. But L5 and R5 again showed some probabilities for a second maximum.

– This strange regularity, however, represented a new puzzle which caused me lots of sleepless nights, until it dawned on me that the pressure fluctuations, created by the moving ship, are not only effective

between the ship and the wall. Those produced by the transverse reflections and interference of the waves within the gap of the gate, and even beyond, inside the space of the arch, could also be a force or a density factor which could guide the ships in any particular direction. Consider that the actual mass and momentum of a gas-filled blimp is not that great relative to the mass of air around it.

– I was so sure that I got it all right, that immediately wrote a letter to the Popular Science Digest about my discovery. After a few weeks of great anxiety I received a very polite and patient letter from the editor. He assured me that my theoretical effort is greatly appreciated by the scientific community and my hypothesis is more than interesting. However, there is one minor problem with the theory, namely that the electron diffraction is neither happening in air, nor in *any other media*. This is an unambiguous fact since Einstein postulated the non-existence of the e - - - r. Furthermore, this astonishing postulate was reinforced by the fact that Schrodinger's wave-function is an inherently complex function, which immediately disallows human minds to attempt to fill space by the '*you know what*'.

– A small booklet was also attached, which described the evolution of quantum mathematics from the simple harmonic equation of *the waves on a taut string*, all the way up to Schrodinger's inherent complexity. I felt really hopeless, because 90 percent of the text was mathematical hieroglyphy. Nevertheless, in the Epilogue I found a sentence that sounded humanly conceivable; 'Quantum mechanics is generally accepted as a complete description of the micro-world. However some scientists still strongly denied *probability waves* and *indeterminism*, among them were Schrodinger himself, and Albert Einstein...'

– Thus, I am not in the worst company when I cannot believe in the dual nature of my blimps, or the idea that the waves are not created by the ship, but the ship is made out of waves.

## BACK TO AETHER AGAIN...AND AGAIN...

Aether is an ideal gas with great internal kinetic energy, represented by the constant random motion of its constituents, the Aethrons. As long as the Aethrons move in total isotropic randomness, the momentum density at any unit volume in any specific direction is zero.

Matter is made up of units of dynamic circulatory patterns of the Aethrons and the conglomeration of those units. Once a circulatory pattern has evolved, it becomes permanent under non-extreme circumstances. The circulatory unit (like the donut-vortex), as established by Bernoulli's theorem, contains a greater number of Aethrons per volume and thus represents a greater inertial mass than that of the isotropic Aether per unit volume.

All interactions between such medium and matter is due to their relative motions. When, for some reason, a mass of Aether drifts in a given direction, it accelerates matter that is caught in the flow. When matter moves in the isotropic Aether, the same consideration for the elasticity of real fluids is valid, which '*indicates that the effects of small pressure changes are transmitted throughout the fluid in the form of waves, which travel with the speed of sound*', (Van Nostrand's Encyclopedia, [48]) in Aether, the speed of light.

Hence, a moving particle creates periodic compression pulses in the Aether, therefore it is equivalent to a moving *point source*. It can also be assumed that, as it has been found in all quantum experi-

ments, the energy density carried by a single pulse is represented by Planck's constant,  $h$ .

As for the wavelength of these *motion-produced* periodical pulses, it stands to reason to assume that the volume of the affected Aether should be proportional to the mass of the moving body, and the magnitude of this effect is proportional to its velocity. Thus, the frequency of the periodical disturbance should be proportional to both the momentum of the particle and  $h$ , in agreement with the Compton-De Broglie formula,  $\lambda = h/p$ .

Temporarily, these conclusions are taken without any inquiry of their underlying kinematics, which will be discussed later.

Electrons are accelerated by an electric potential difference which has been described earlier as the circulation of the Aether in the conductors and through the battery (cylindrical vortex).

An electron experimental device is constructed in such a way that the circulating Aether picks up the electrons from the cathode and accelerates them toward the anode (Recall [Figure16-3](#)). As the Aether flow curves into the body of the anode-conductor, the electrons, under the influence of their inertial ten-

dencies, continue to move with uniform speed on a straight line toward the screen through the isotropic gas of the Aether. In the diffraction experiment, this procedure represents the preparation of the coherent beam of electrons, which moves with uniform velocity toward the gap and through that to the screen.

The description of the AETHRO-KINEMATIC alternatives for De Broglie's matter wave, Heisenberg's uncertainty principle and their consequences, require a procedure of several steps.

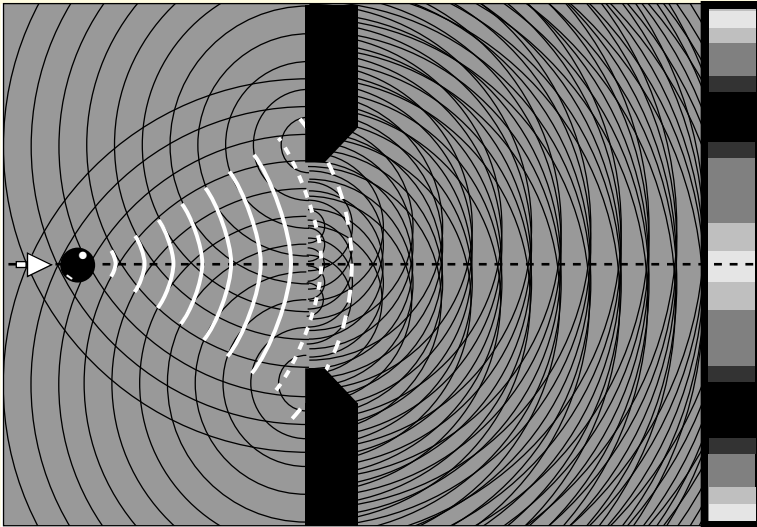


Figure 16-21.

Figure 16-21 gives a long-shot, artistic visualization of the probable wave-formations when a single electron (point source) moves with uniform velocity and affects the isotropic density of the Aether in front, within, and beyond the gap.

The illustrated snap-shot shows the instant when the compression pulses (white curves), produced by the motion of the electron, are already propagated in the medium and reflected back from the wall toward the electron. It is evident that this reflected pressure could decrease the speed of the electron, and if its trajectory is not exactly identical with the *center line* of the gap, the resulting uneven transverse pressure on the electron could also affect the initial direction of its motion.

Within the space of the gap, in the excess pressure due to the transverse reflection of the waves, new Huygens wavelets are being produced, and their envelopes propagate forward. The resulting interference creates Fresnel diffraction patterns in the medium beyond the gap and on the projection screen.

Of course, this is not the diffraction phenomenon of the electrons, but merely the manifestation of the infinitesimal and most likely undetectable pressure

fluctuations formed in the Aether between the gap and the screen. Nevertheless, as the electron moves, the interference of its waves creates some constantly changing, pressure-variant channels which can most plausibly influence the direction of motion of the *light-weight* electron through that whole space.

This is the artistic rendering of a general kinematic picture which could replace De Borglie's hypothesis of pilot-matter-waves in empty space. However, for a closer conceptual and mathematical analysis, a much simpler approach is necessary.

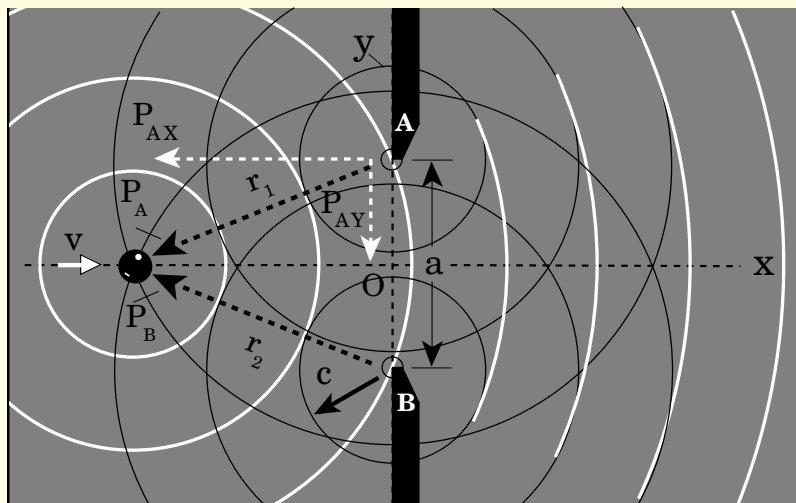


Figure 16-22.

Figure 16-22 below is a simplified schematic representation of a probable wave formation. The electron moves toward the gap with uniform velocity,  $v$ . Its compression waves are propagated away from and reflected back to the barrier with the velocity of light,  $c$ . The width of the gap in the direction of the  $y$  axis is  $a$ .

For simplicity, let us consider first, that the waves are only reflected back by the two corners of the gap,  $A$  and  $B$ . Also let us concentrate only on a single pulse created by the electron, which has a total energy density,  $h$ . It follows that the momentum density,  $p$ , at any point in the front of the electron is:  $p = h/2\pi r$ , where  $2\pi r$  is the circumference of the wave-ring.

Since the light pressure is  $P = E/c$ , which is equivalent with the momentum density, it follows that the pressures,  $P_A$  and  $P_B$ , reflected back to the electron from the two corners, are also equal to the energy density:  $p_A = h/2\pi r_1$  and  $p_B = h/2\pi r_2$ .

Next, as shown in the illustration, let us establish the position of the electron at the coordinates  $(x, y)$ . The origin,  $O$  is at the center of the gap. The corners,  $A$  and  $B$  are at  $(O - a/2)$  and  $(O + a/2)$ , at one half of the gap.

The distances of the electron from each corner are expressed as  $r_1$  and  $r_2$ . Thus, we can write

$$r_1 = \sqrt{x^2 + (y-a/2)^2} \quad r_2 = \sqrt{x^2 + (y+a/2)^2}.$$

Thus the pressures on the electron, coming from  $A$  and  $B$  are

$P_A = h\nu / 2\pi \sqrt{x^2 + (y-a/2)^2}$   $P_B = h\nu / 2\pi \sqrt{x^2 + (y+a/2)^2}$ , where  $\nu$  is the frequency, that is, the number of compression pulses per second, produced by the electron and reflected back by the wall.

It can be seen that the  $x$ -components of  $P_A$  and  $P_B$  represent retarding forces on the electrons motion. These forces not only tend to slow down the electron, but, as shown, the  $y$ -component of  $P_A$  will tend to push the electron downward ( $-y$ ) and that of  $P_B$  will tend to push it upward ( $+y$ ). Thus, both  $y$ -components of these forces will tend to change the initial direction of the momentum.

Evidently, both pressure forces are constantly increasing as the electron approaches the gap. However, it is also evident that the proportion between the  $x$ - and  $y$ -components of the forces is constantly changing too. While the electron is at a great

distance from the gap,  $r_1$  and  $r_2$  are close to parallel and therefore the  $y$ -component is negligible. But when the electron reaches the gap, and the  $x$ -components approach zero, the transversal  $y$ -components become the only forces on the particle.

It also follows that, as long as the electron moves exactly on the center line ( $x$ -axis) of the gap, the  $y$ -components of  $P_A$  and  $P_B$  are equal and opposite in direction. Thus,  $P_{BY} - P_{AY} = 0$ . Consequently, they do not affect the direction or the final  $y$ -component of the momentum of the electron beyond the gap.

Before analyzing the cases when the electron's trajectory is off-center and the transverse pressures become unequal, consider intuitively the magnitude of these forces.

As has been established earlier, the interaction between Aether and moving matter can be most generally expressed by the Lorentz formula of Aether resistance:  $\beta = 1 / \sqrt{1 - (v/c)^2}$ .

From a macroscopic point of view, the magnitude of this force of resistance only becomes measurable when the velocity of the particle approaches the velocity of light. The same is valid in the reciprocal

case, when an Aether flow affects the state of motion of a particle by the same force (Cyclotron). At normal macroscopic masses and velocities the resistance is negligible. However, in case of the electron diffraction experiment, at least two kinds of magnification of this force should be considered:

1) Between the moving electron and each corner, the disturbances are locked into a constant back and forth reflection and re-reflection. Since the distance for these reflections is constantly decreasing, the reflected waves are always out of phase, resulting a complex *interference and beat pattern*, causing some density fluctuations, which changes and therefore, also propagates in proportion with the speed of motion of the electron.

2) Within the space of the gap itself, as [Figure 16-21](#) shows, the waves, transversally reflected from the two corners, cause similar complex density fluctuations. The result is the formation of standing wave patterns which change relatively slowly, again in proportion to the momentum of the electron. These density fluctuations could greatly magnify the transverse component of the forces on the electron while passing through the gap. They are also the bed of the

formation of special Huygens wavelets, the wave trains which fill the whole space beyond the gap. The resulting constantly changing diffraction density channels could also be a factor in the guidance of the electrons.

Getting back to the details of the simplified analysis; at the instant when the electron reaches the horizontal center, the *x-component* of the pressure force on the electron is exactly zero. Thus, the forces acting on its momentum are exclusively in the transverse directions, or in the *y-axis*.

Since the primary interest here is in the changes which might occur in the *direction* of the electron while it moves through the gap, let us now concentrate only on the *y-components* of the pressure forces coming from the two corners, and the possible differences between them,  $\Delta P_Y = P_{BY} - P_{AY}$ . Since the pressures of the reflected waves are equivalent with the force  $F$ , that acts on the passing electron, we can write;  $F_Y = F_{BY} - F_{AY}$ , or

$$F_Y = \frac{h\nu}{2\pi |y + a/2|} - \frac{h\nu}{2\pi |y - a/2|} \quad (16.34).$$



The change of momentum, according to Newton's second law, is  $\Delta p = F\Delta t$ , where  $\Delta t$  is the time interval during which the force acts on the particle. This is again inversely proportional to the momentum of the electron. Consequently, the force is also directly proportional to the wavelength of the initial wave that the electron produces by its motion. That is,  $\Delta t \propto \lambda$ . Therefore,

$$\begin{aligned}\Delta p_y &= \frac{h\nu \Delta t}{2\pi |y + a/2|} - \frac{h\nu \Delta t}{2\pi |y - a/2|} \\ &= h\nu \frac{2y \Delta t}{2\pi (a^2/4 - y^2)} \quad (16.35)\end{aligned}$$

Let us express the position on the y-axis through which the electrons pass the gap as  $y = f(a/2)$ , where  $f$  is the fractional factor, the absolute value of which is smaller than one ( $|f| \leq 1$ ). Substitute this into Equation 16.35:

$$\begin{aligned}\Delta p_y &= h\nu \frac{2 f(a/2) \Delta t}{2\pi (a^2/4) - (a^2/4)f^2} \\ &= h\nu \frac{2 h\nu f \Delta t}{\pi a} \quad (16.36)\end{aligned}$$

Since the frequency of the electron-wave is directly proportional to the momentum,  $\nu \propto p$ , and  $\Delta t \propto \lambda$ , thus Eq. 16.36 becomes

$$\begin{aligned}\Delta p_y &\propto \frac{2 h f \lambda p}{\pi a} \\ &\propto \frac{\lambda}{a} p \quad (16.37).\end{aligned}$$

Thus, the predicted change in the y-component of the momentum, based on this hypothesis, is in agreement with the empirical facts of the single slit electron-diffraction experiment, and with the particle-wave mathematics of de Broglie. Assuming that a coherent, steady stream of electrons is passing through the gap with uniform velocity and uniform density, the y-component of momentum of each individual electron will be affected, depending on its exact position in the gap on the y-axis while passing. It follows that the beam will spread out in the space beyond the gap, and therefore the intensity recorded on the screen, or the number of electrons hitting the photographic plate per unit area, will be represented by the probability predicted by the above relation. The plotting of these probabilities produces a curve equi-

valent to the Gaussian 'normal' distribution curve which is very similar to the intensity curve of diffraction, showing the maximum and the first minima.

It should be noted here, that the same curve would be produced, whether a whole beam of electrons were passing through and being diffracted, or one at a time. Also note that this curve does not show a second maxima, which will be discussed later.

As can be seen, ultimately both theories are reduced to the predictions of *probabilities*. Nevertheless, there is an important conceptual difference between them.

On the one hand de Broglie's ad hoc hypothesis comes from the *philosophical assumption* of the symmetry of nature based on the analogy with the *physical assumption* of the particle nature of light. The wavelength of de Broglie's particle-wave has been made artificially proportional to the momentum of the particle, taken to be analogous to the particle behavior of light, by the total acceptance of the absurd concept of the *massless momentum of the photon*. In this theory of modern physics the role of the wavelength in the calculations of superpositions is exactly the same as it is in Young's constructive

and destructive interference theory. This nature of the waves gives Young a continuous distribution of the intensities. However, in the matter-wave hypothesis it is strictly incompatible with the discontinuity and indivisibility of the physical particle. This is the essential necessity for the flipping back and forth between the languages with the excuse of complementarity, and finally for the mathematical transformation of de Broglie's pilot-wave concept into the probability-wave interpretation of the Schrodinger matter-wave-function of wave-mechanics and quantum-mechanics.

On the other hand, in the AETHRO-KINEMATIC alternative, the explanation of the phenomenon is based merely on the kinematically logical reaction of the isotropic medium to the local disturbance caused by the motion of a moving particle. Thus, it follows from the established density difference between the isotropic medium and the dynamically organized particle structure, that a greater mass, and/or a greater speed of motion, will produce a greater disturbance in the medium.

Recalling the Huygens Principle of the propagation of periodical pulses and their momentum distri-

bution, (Ch-13) it can also be seen that, due to the transverse pressure of the Huygens Wavelets, even a disturbance, caused by uniform motion, must separate from the moving body upon reaching a certain energy density. (App.III) This limit is represented by  $h$ , thus the frequency of separation and the production of periodical pulses are naturally directly proportional to the momentum of the particle.

So far, this theory does not render an explanation for the existence and calculation of the second maxima and minima and the corresponding curve which is usually shown in text books describing the thought experiments of single slit electron diffraction theory. Thus, looking back from the present stage of science, without an in depth research, it is quite impossible to separate the real experimental facts from the mere speculations, based only on thought experiments.

In the case of the photon diffraction theory, it is obvious, that the existence of the second maxima cannot be based on the particle characteristics and must be calculated by Young's constructive and destructive wave-interference method. Still, modern physics is forcing the absurd argument of the double slit interference gedanken-experiment, even with in-

dividual photons, and claims that by a small mathematical switch the experimental curves can be predicted from Young's the wave-interference.

The present alternative hypothesis leaves the question of the second maxima of electron diffraction open, with the hint that if it is really needed, then, as shown on [Figure 16-21](#), the theory of the diffraction channels, produced by the real pilot waves in the Aether can be further developed.

## THE ULTIMATE UNIVERSAL CONSTANT

So far *quantum-aethro-kinematics* presented a humanly perceivable concept to fill Planck's empirically forced constant of discontinuity,  $h$  in the form of the minimum quantity of excess energy density of a *single pulse* of electromagnetic radiation.

The same concept seems to be valid in the alternative AETHRO-KINEMATIC solutions of Einstein's theory of the photoelectric effect, and of the Doppler interpretation of Compton's collision-scattering effect. With these, the bi-linguistic photon theory has been rendered superfluous.

Seemingly, all kinetic energy exchange between radiation and matter are executed through the multiples of the quantity  $h$ , and the total energy density

delivered by a train of radiation pulses is  $E_d = h\nu / V$ , where  $\nu$  is the frequency of radiation.

It will be shown below that an even more general meaning can be attached to Planck's constant as the expression of one of the fundamental characteristics of the ideal gas of Aether. Dimensional analysis shows that  $h = \text{energy} \times \text{time}$ .

$$\begin{aligned} Et &= kg \times m/s^2 \times m \times s \\ &= \frac{kg \times m/s^2 \times m^3 \times s}{m^2} \end{aligned}$$

Since  $1/s$  is the dimension of frequency,

$$\begin{aligned} h\nu &= kg \times m/s^2 \times m \times s \times 1/s \\ &= kg \times m/s^2 \times m \\ &= \frac{kg \times m/s^2 \times m^3}{m^2} \quad (16.38). \end{aligned}$$

Now, according to Hook's law, the change in the volume of an elastic medium is proportional to the pressure applied to it, meaning that  $\text{stress}/\text{strain} = \text{constant}$ . This ratio is called, in Young's term, the *Modulus of Elasticity*, or simply the *Bulk Modulus*.

$\text{Stress} = F/A$ , where  $F$  stands for force and  $A$  for unit area, which equals to the *force of pressure*,  $P$ .  $\text{Strain} = -\Delta V/V$ , where  $\Delta V$  represents the resulting change in the initial volume,  $V$ .

Thus, the Bulk Modulus,  $K$  can be expressed by

$$K = \frac{\Delta P}{-\Delta V/V} = \frac{\Delta PV}{\Delta V},$$

where the minus sign indicates that the volume decreases upon application of a given stress.

Dimensionally,  $-\Delta V/V$  represents no units, thus  $K = \Delta P$  has the dimensions of pressure ( $F/A$ ).

Therefore

$$K = \frac{F}{A} = \frac{\text{Newton}}{m^2} = \frac{kg \times m/s^2}{m^2} \quad (16.39).$$

Now, compare  $K$  in Eq. 16.39 with Eq. 16.38 and see that

$$h\nu = Km^3 = KV,$$

where  $m^3$  is the dimension of volume, and  $kg \cdot m/s^2$  is energy. Thus, the *Bulk Modulus*,  $K$  has the dimension of energy density.

$$K = \frac{h\nu}{V} \quad (16.40).$$

Here  $\nu$  is the frequency and  $V$  is the volume.

Taking the unit of time as *the time interval of the formation of a single pulse*, and taking the unit of volume as *the volume filled by the excess energy density of one pulse*, then

$$h = K \quad (16.41).$$

Consequently, Planck's universal constant represents nothing less than the Modulus of Elasticity of the all-pervading Aether.

## ENERGY AND ANTI-ENERGY OUT OF NOTHING ?!

In the second half of the century there was a gradual change in the attitude of theorists in the attempts to incorporate the classical continuum with quantum discreteness. A tendency appeared to accept that quantum mechanics represents a whole new intellectual structure, within which some kind of 'understanding' exists how these two incompatible conceptual systems could cohere. Based on this conviction Planck's quantum, the principles of comple-

mentarity, correspondence and uncertainty and probability wave-function invaded all microscopic departments of science. A searching for elementarity developed particle physics, and through the Big Band hypothesis, the quantum expanded into astrophysics, cosmology and cosmogony. In fact, high-powered scientific circles advocate a firm conviction, that quantum mechanics is on the verge of developing the 'Theory of Everything', or the 'World Equation', a kind of a 'Super Unified Field Theory' that will unite all laws of Nature into a single statement that reveals the inevitability of everything that was, is and is to come in the physical world.

Evidently, this subject is way out of the scope of this study, however, the general direction of the mathematical evolution and its conceptual reverberation in the minds of physicists create an interesting last note for this chapter.

Consider then the following quote from the valued work of Peter Covency & Roger Highfield: *The Arrow of Time*, 1990 [140].

"Schrodinger himself had realized from the start the limitations of his own equation (wave-function) - it did not satisfy the requirements of Einstein's spe-

cial relativity (specifically, it was not Lorentz invariant) and as a result it could not account for the finer details of atomic spectra.

"Dr. Maurice Dirac attacked this shortcoming and in 1928 had written down a relativistic equation...the mathematical properties of which lead him to propose the existence of the positron, a unit of '*antimatter*'. The positron has the same mass as an electron but is of opposite electric charge; (and spins) a collision between the two results in their mutual annihilation, together with the production of a burst of radiation. An experiment by Carl Anderson in 1932 confirmed the existence of the positron and therefore the reality of antimatter, a discovery that radically altered the conceptual foundations of elementary particle physics. From then on, it was recognized that matter is not immutable but could be created and destroyed at will.

"On the basis of the mathematical description provided by Dirac, the positron has been interpreted as its antiparticle - an electron - moving backwards in time.

"An intricate relationship exists between matter, antimatter, spatial symmetry and the two direction

of time. It appears in the remarkable *CTP theorem*, which is a consequence of the mathematical form of the microscopic laws of physics. Its name arises because symmetry is tested by the combined sequence of three abstract operations:

"*C* = charge conjugation, by means of which matter is converted into antimatter. (Opposite sign)

"*P* = parity inversion, which converts spatial coordinates into their mirror images.

"*T* = time reversal, which reverses the direction of time.

"The CTP contends that the laws of physics predict equal but opposite events in a kind of 'generalized mirror image' world. Thus, symmetry in the guise of the CPT theorem can be used to make deductions about physics. (For different reasons most of these theories were found inadequate and later reappeared in a more sophisticated approach as string, superstring, super-symmetry, super-parity and super-gravity theories.)

"Heisenberg's uncertainty principle has consequences for the measurement of time. There is a limitation to the accuracy with which we can measure energy within a given interval of time.

“A precise measurement of an atom's energy in a particular quantum state can only be performed at the expense of considerable uncertainty over the time it spends in that state. In classical physics, energy was neither created nor destroyed but rigorously conserved, merely being converted from one form to another. However, over short time intervals *the conservation of energy* is undermined by Heisenberg's uncertainty principle. The link between energy and time in Heisenberg's principle says that the shorter the interval of time considered, the more uncertainty there will be in the energy. This allows the law of energy conservation to be suspended over very short time intervals; owing to random quantum fluctuations, *energy may be 'borrowed' at no cost from nowhere at all*. Such event occur even in vacuum in which, classically speaking, there is simply 'nothing' present. Quantum theory thus gives us a quite different view of what a vacuum is. Because of the uncertainty principle, it is in fact seething with activity.

"Dirac is largely responsible this modern picture of a vacuum. He recognized that Maxwell's electromagnetic field must be described in quantum terms if it

is to explain correctly the way matter absorbs and emits photons. In his extension of Maxwell's mathematical model, he pictured the electromagnetic field as a collection of a vast number of oscillators, each of whose energy levels was quantized, just like the energy levels of an electron in the atom. But now, by virtue of the uncertainty principle, each oscillator can never have less than a fixed minimum energy - *the zero point energy* - with the result that even a vacuum is always seething with virtual activity: - there are endless fluctuations in energy of the field at all points within space. Fluctuations of sufficient energy enable matter-antimatter pairs of particles, such as electrons and positrons, to be momentarily formed - the more energy borrowed, the more transient the particle pairs will be. These vacuum quantum field fluctuations have considerable physical significance. For example, the constant creation and annihilation of photons provides the trigger whereby atoms swollen with energy can spontaneously emit radiation as light. *In fact the vacuum fluctuation also resurrect in a certain sense the nebulous aether which Einstein eliminated as excess baggage in 1905.*"

...Or did he ?!

## **CHAPTER SEVENTEEN**

### **THE LAST SIX DECADES**

#### **CONCEPTUAL DEVELOPMENT IN A NUTSHELL**

The previous chapter was mainly involved with the introduction of an alternative explanation for the origin of Planck's fundamental quantum discontinuity as the minimum measurable kinetic energy density in the ideal gas of the Aether. It has been

attempted to discuss all involved physical concepts within a minimum interference of the underlying complex philosophical foundations of quantum mechanics. For the sake of concentration and clarity, the discussion also tended to minimize the involvement with the unceasing dissatisfaction of scientific minds during the last six decades with the orthodox Copenhagen interpretation of the final mathematical formalism of quantum mechanics. To attempt to deal with the conceptual development of quantum mechanics during the years between 1930 and 1990, a highly condensed history of the conceptual development of the quantum theory is needed:

1. Planck's solution of the discrepancies of classical predictions for the energy distribution of black-body radiation is that radiation energy is produced by electromagnetic oscillators in a discontinuous manner; each giving off a minimum value of energy, called *quantum*, ( $h$ ). With this, electromagnetic oscillators are quantized.

2. Einstein, - in order to explain the high velocities of energetic photo-electrons, - extends Planck's quantization of the oscillators, to radiation itself by hypothesizing that the quantized



energy electromagnetic waves in some cases can be concentrated at a single point in space, behaving as a particle and its total kinetic energy can be transferred to a mass particle, like an electron. The energy of the *photon* equals the frequency of the electromagnetic wave times the Planck's constant, that is,  $E=hv$ .

3. Compton's effect experimentally proves the particle-like properties of Einstein's photon by showing classical type collisions of them with electrons according to the laws of conservation of energy and momentum. Thus, the wave-particle duality of light is scientifically established.

4. Bohr initiates the solar model of the hydrogen atom in which a single electron revolves about the single proton nucleus on different possible orbits. By applying the Planck's quantum to the angular momentum of the orbiting electron, Bohr finds the explanation for the empirically found regularities, like the Balmer-Lyman-Paschen series in the spectrum of the hydrogen atom. In order to save the stability of the atom, in contradiction with the electromagnetic theory, he assumes that the electron only radiates ener-

gy when it jumps from one quantum level of energy to another.

5. De Broglie, just by symmetrical reasoning, stipulates that, if light can have wave and particle attributes, then particles may have similar duality, having wave attributes. Taking from Compton's collision hypothesis and his momentum and wavelength relation of the photons, de Broglie suggests a theory of pilot waves which are associated with all particles. He assumes, that the wavelength of these pilot waves is equal to Planck's constant divided by the momentum of the particle. Further more, de Broglie extends this theory to the solar model of Bohr's hydrogen atom by assuming that the waves associated with the electrons can replace Bohr's quantum jumps by forming standing wave orbits which are only stable if the circumference of the orbit is exactly divisible by the electron's wavelength.

6. Davisson and Germer experimentally proves the existence of the wave nature of mass-particles by producing wave-like diffraction effects of electrons in quantitative agreement with the de Broglie prediction.

7. Schrodinger follows the direction of de Broglie's model and develops Wave-mechanics. Taking the well known classical equation of wave motion, correlating it with Young's mathematics for light-interference and substituting the particle's momentum by de Broglie's relation of matter wavelength, he discovers the quantum *wave-function*. This formalism applied to the new theory of the hydrogen atom, explains a great deal of the quantized structure of the atom and mathematically predicts the electron diffraction phenomenon. Initially Schrodinger interprets the wave-function as the representation of a vibration in an electromagnetic field and believes that the underlying physical reality is strictly of undulatory nature. He viewed an atomic electron not as a particle but as a collection of wave disturbances in an electromagnetic field with the wave-functions representing the evolution of the interference amplitudes of the waves.

8. Heisenberg, unlike Schrodinger, does not search for an underlying physical reality, but merely looks for a mathematical algorithm through which connections can be made between

physical quantities that would fit the known experimental facts. This tendency of his investigation leads to Matrix Mechanics.

9. Pauli shows that matrix mechanics can also predict the hydrogen atom's emission spectrum. Schrodinger demonstrates that wave-mechanics and matrix-mechanics are mathematically equivalent. The question at this point is which formalism is philosophically superior.

10. According to Max Born neither of them are acceptable. Matrix-mechanics is merely a mathematical machine without conceptual content. Wave mechanics is unable to explain how a wave-like electron can be removed from its atomic orbit and produce a discrete trajectory in an ionization chamber. Thus, Born concludes that the square of the amplitude of Schrodinger's wave-function merely represents the *probability density* of finding a given quantum particle in a given region. According to this interpretation, the evolution of the wave-functions represents nothing physical but merely the evolution of our state of knowledge about the classical attributes of a given quantum system.

11. Pondering the particle-wave duality in the electron-diffraction experiment, Heisenberg finds that the directional change in the velocity of the particle is inversely related to the size of the slit through which it passes. The smaller the slit, the greater the deviation in the trajectory from Newtonian mechanics. Applying de Broglie's wavelength-momentum formula he discovers that the more precise the measurement of the position of the electron (that is, as the size of the slit approaches zero), the more uncertain the direction of its motion becomes. Thus, a precise measurement of the position and the momentum of a classical particle cannot be established simultaneously. Similarly, the more sharply we can measure the time of the passage of a quantum particle through the slit, the more uncertain will be its energy, and vice versa. This statement is called the *uncertainty principle* which is again related to Planck's constant.

12. Heisenberg and Bohr disagree on the fundamental philosophical character of quantum-mechanics. Heisenberg believes that the theory merely provides a mathematical scheme that

predicts everything that can be observed and tells the limitations on what is *measurable*. According to Bohr the fundamental problem of theoretical physics is the wave-particle duality and all the rest, – including the uncertainty principle, – are mere mathematical consequences of the attempt of using two diametrically opposed classical concepts to describe something that is fundamentally non-classical. Thus, quantum theory limits not what is measurable but what is *knowable*.

13. It takes Pauli's intervention, to find mutual ground for the different views of Heisenberg and Bohr. The cooperation of these three theorists finally results in the so-called Copenhagen Interpretation of quantum-mechanics, which coordinates Bohr's complementarity solution for the wave-particle duality with Heisenberg's uncertainty principle, and Born's probabilistic interpretation of Schrodinger's wave-function. The Copenhagen interpretation provides the fundamental postulates of quantum mechanics and its mathematical structure and formalism that results from them.

14. The most controversial constituent of this interpretation is Bohr's concept of *Complementarity*. According to Bohr the paradox of quantum mechanics is that it attempts to describe quantum phenomena in terms of idealized classical concepts, like those of waves and particles. Complementarity requires the acceptance that we can never 'know' quantum concepts. A quantum particle is neither a wave nor a particle. They are simply beyond human experience and merely elements of *empirical reality*. Hence, a quantum system is but a substitution of the appropriate classical concepts, the empirical reality of which depends on what attribute of the quantum phenomena is observed by the specifically designed instruments. For Bohr, although the wave picture and the particle picture are mutually exclusive, quantum mechanics is a successful interpolation of the controversial classical descriptions in a single all-encompassing mathematical formalism.

Thus, the resulting description gives either the wave or the particle attributes of the quantum system but never both of them simultane-

ously. Thus, the successful predictions prove that the classical concepts of waves and particles are not contradictory but complementary to each other. Similarly, as Heisenberg's uncertainty principle states, the measurement of different particle attributes, like those of position and momentum are also exclusionary. To determine these quantities requires two different kinds of apparatus, thus, although they cannot be measured simultaneously, nevertheless, they are also *complementary*.

15. The Copenhagen interpretation essentially states that quantum mechanics renders a complete description of *empirical reality*, but with that *we have reached the limit of what we can know about Nature*. Any attempt to introduce a new mechanical concept to describe an underlying *physical reality*, independent of our measuring, inevitably returns to the idealized classical concepts that summarize the fullest extent of our knowledge: *waves and particles*.

16. By Bohr's *Correspondence Principle* this interpretation also sets the boundary between classical and quantum physics. It is assumed

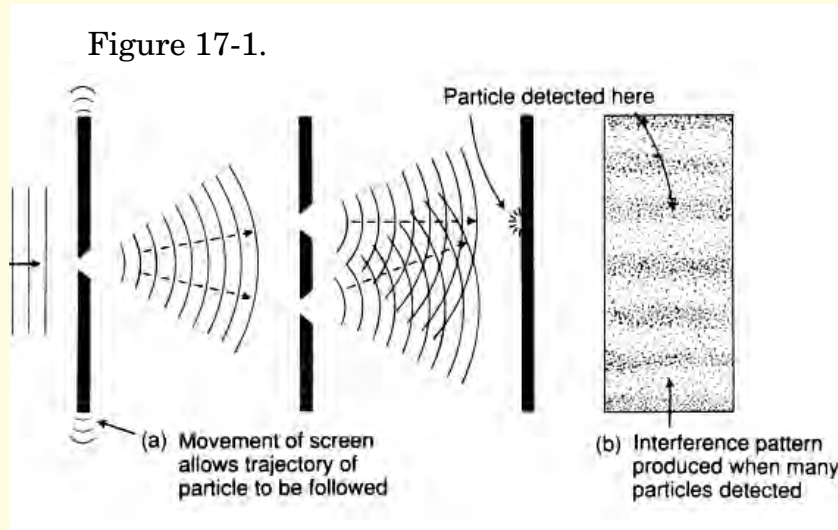
that a theory of quantum mechanics, based on de Broglie's matter-wave formula includes ordinary particle mechanics as a limiting case. Just as relativistic mechanics contains Newtonian mechanics in the limit of velocities compared to which the velocity of light may be regarded as infinitely large;  $c \rightarrow \infty$ , quantum mechanics is reduced to classical mechanics when the de Broglie wavelength of the particle approaches zero;  $\lambda \rightarrow 0$ .

17. Extended by Dirac's theory of electron spin and Pauli's exclusion principle the mathematical formalism of quantum mechanics provides a reliable method of computation of atomic spectral frequencies and intensities, of cross-sections for scattering of electrons by atomic systems, of chemical bonds and many other microscopic properties of solids.

18. Nevertheless, Bohr's complementarity, as a solution for the fundamental problem of the wave-particle duality creates serious dilemmas and disturbing vagueness in theoretical physics. Right from the inception, there exists a philosophical controversy between classical epistemological principles and those of quantum mechan-

ics about *physical reality*. The Copenhagen postulates lead to the denial of causality, determinism and even that of physical reality itself. In the purely mathematical switching between particle and wave attributes both classically clear concepts of particle and wave become elusive and the problem of their physical relation invokes metaphysical speculations instead of mechanical considerations. Thus, scientists who contributed much to the conceptual and mathematical development of quantum mechanics, like Einstein, Schrodinger and others, have launched persistent attacks against the alleged consistency and completeness of the Copenhagen interpretation.

19. Einstein believes in causality and determinism. He directly challenges Bohr's positivist philosophy which only accepts *empirical reality* and insists on not attempting to understand the physical world as independent from our observations. Einstein's opinion is that the success of quantum mechanics lies in its statistical nature and the squares of the wave functions merely represent the statistical probabilities obtained by averaging over a great number of *real* particles.



The obvious analogy is with Boltzman's statistical mechanics which predicts macroscopic physical quantities such as gas pressure and thermodynamic functions, using microscopic, molecular and atomic statistics. The probabilities predicted here are derived from the behavior of an ensemble of real particles which exist in pre-determined states and obey the laws of deterministic classical mechanics. – Einstein designs a gedanken experiment to show in principle an alternative description of the wave-like interference behav-

ior of electrons in a double slit experiment. The Copenhagen complementarity principle states that we can either demonstrate the particle or the wave behavior of a quantum object but never both simultaneously. Einstein argues as follows: suppose that the transfer of momentum between the particle and the first screen is carefully measured and observed (Figure 17-1/a). A particle hitting the screen will be deflected and its trajectory beyond the screen will be determined by the conservation of momentum.

From this and from the final position of the particle on the detector screen we can infer which one of the two slits the particle passed through the middle screen. Hence, it is possible to determine the whole trajectory of the particle through the apparatus. When, however, we record a large number of particles on the detector screen, one after the other, due to their random collisions with the slits, we will find the total double-slit interference pattern. Thus, Einstein concludes, that it is possible to demonstrate both the particle-like trajectory and the wave-like interference of a quantum object simultaneously and by the same apparatus. Hence, the principle of complementarity is proven to be wrong.

20. Bohr's simply refuses this argument by showing that Einstein's assumption of controlling the transfer of momentum between the particle and the screen must imply a factor of uncertainty. If we measure the change in the momentum of the screen with arbitrary precision, then an infinite uncertainty in the position of the screen must result. Why? - According to Bohr, in order to observe the change in the position of the screen, it should be sufficiently illuminated and the scattering of the photons from the screen represents an uncontrollable momentum transfer. Thus, Einstein's hypothesis is in contradiction with the uncertainty principle and with the experimental facts.

21. Einstein, Podolsky and Rosen (EPR) then attack the alleged completeness of quantum mechanics by the following argument: Imagine that two particles interact and separate from each other but some of their physical attributes, like their momenta and positions, remain correlated. With the aid of the laws of conservation of energy and momentum any later measurement of the position or momentum of one of the pair will render the knowledge of the same attribute

of the other particle. Suppose, that these are quantum particles, going through a diffraction experiment, and quantum mechanics applies.

According to the uncertainty principle the measurement of the position or the momentum of the particles requires two different devices which cannot be used simultaneously. However, when one of the particle is measured by striking on the screen, the wavefunction collapses and both quantum particles, *A* and *B* must regain their local physical reality.

It follows that measuring, say, the position of *A*, means that the position of *B* also becomes a local physical reality. Hence, EPR argue that, while the particles are in flight, we can still have a choice between the two devices. Waiting till the very last moment with this decision it becomes obvious that there must be an instantaneous communication between the two particles for *B* to regain the local reality of the same attribute as that of *A*'s. – EPR do not believe this is possible nor that it is necessary. They insist that the classical attributes of position and momentum exist continuously and separately all along the

path of the real particles and should be defined continuously and independently. Since, there is nothing in the wave function that describes the evolution of these quantities, *quantum mechanics must be incomplete*.

22. Bohr's answer to these EPR paradoxes is essentially a repetition of the philosophical argument of complementarity and its application to those special cases. He states that due to the mathematical structure of quantum mechanics, the wavefunction cannot be separated for the two quantum particles because it describes their probability density by the square of the amplitude of the interference between their superpositions. The concept of separation in this case is totally meaningless and in mathematical language it is expressed by the *non-factorability* of the wavefunction.

23. Schrodinger offends quantum mechanics from another direction and strikes right to the heart of the measurement problem, invoked by the Copenhagen interpretation. His famous argument is called the '*Cat Paradox*', a complex scheme of events through which the classical and

quantum mechanical worlds interact. -- A live cat is placed inside a chamber together with a Geiger tube containing some radio-active substance of known half life. If an atom disintegrates, the Geiger counter triggers a switch that releases a lethal gas which kills the cat. Within an hour there is a probability of  $\frac{1}{2}$  that an atom would disintegrate. The purpose of this scheme is to show the vagueness of quantum mechanics when it comes to the definition of the boundary between classical and quantum worlds.

According to quantum mechanics, prior to actual measurement the atoms of the substance are in the *superposition* of being intact, or disintegrated. They stay in this suspended reality until one atom disintegrate and measured by the counter. At this instant the *atomic* wavefunction collapses. The probability of disintegration collapse to unity for that atom and zero for all others. For predicting any further event, a new wavefunction must be established. -- But what about the Geiger counter, or the switch, or the gas, or the cat itself? -- Schrodinger brings up the fact that classical entities, inanimate or living,



are also made of quantum systems which can only be described by the quantum mechanical wavefunction and therefore all the constituents of the measuring apparatus should be in superposition between their two probabilities of yes or no. Uncovering this ambiguity indefinitely widens the boundary between the two worlds and gives no hint where and when should be the final collapse of the wavefunction. If it happens at the Geiger counter then a new wave function must be applied to the electronic switch that releases the gas, and so on all the way through the quantum systems of the brain cells of the cat. No matter how many wave functions collapse, there will always be another superposition that requires a new wavefunction. Thus Schrodinger's paradox demonstrates that *the Copenhagen interpretation leads quantum mechanical measurements into a hopeless infinite regression.*

24. In essence the Copenhagenian answer to this argument is that since we have no other means of predicting the behavior of the quantum world but through the probability density described by the wave function, we *must* resist the

temptation to ask ourselves what possible physical state a particle or a cat actually is prior to a measurement. Such a question leads nowhere, thus it is totally meaningless.

25. Under the title of "*Wigner's friend*" the scheme develops even further in the same direction by adding a human observer to the list of constituents of the measuring apparatus. This extension of the Copenhagen superposition over the human consciousness results in wild speculations about the relation between the observer and the observed.

26. As obvious as the success of the mathematical formalism is, most physicist who care to understand what they are doing, cannot accept that the Copenhagen interpretation is liable for that success. Among other reasons, the dissatisfaction comes from the fact that, through the development of quantum mechanics Schrodinger's well-defined, classically founded deterministic wave function is re-interpreted as some unrealistic statistical probability wave, with no better justification than the ignorant rhetorical question: *What else could it mean?!* – Thus, beneath the Copenhagen power structure a hesitant

search begins for an alternative humanly conceivable interpretation.

27. It is characteristic to the dominantly mathematical thinking of the century that this search, which is supposed to uncover some, so far unknown part of physical reality, is named as the search for "*hidden variables*". -- Accordingly, the search consists of mainly mathematical exercises to derive in principle whether or not, such hidden variables added to the wave function could somehow reinstate classical causality and local reality, while still reproduce exactly the quantum mathematical predictions.

28. Soon, Von Neumann's so-called "*impossibility proof*" appears, in the form of a sophisticated mathematical derivation, proving that, if there were such variables added to the quantum mechanical formalism, they would allow us to measure simultaneously the position and momentum of a quantum particle, which conflicts with the uncertainty principle and the experimental facts. Thus, for the next two decades scientists take this proof as a victorious reinforcement of the Copenhagen dogma.

29. In spite of the paralyzed state of theoretical physics, due to von Neumann's authority, in 1951

David Bohm reopens the EPR debate. -- Most probably, as an attempt to relieve the argument from the clinch of the uncertainty principle, instead of the position-momentum correlation, Bohm considers the correlation of the spin orientations of two atoms disassociated from of a hydrogen molecule. If the total electron spin angular momentum in the molecule was initially zero then the atoms will move away in opposite directions with opposite spin orientations (say *up* and *down*). Hence, the correlated atoms and their spin orientations ( $\frac{1}{2}$ ) are elements of independent local physical realities and measurable without invoking the uncertainty principle.

Figure 17-2. (a) shows how in Bohm's thought-experiment the conservation of the angular momentum of a hydrogen molecule leads to the opposite spin orientation of the disassociated atoms. Part (b) shows a setup of two parallel oriented Stern-Gerlach magnet that separates the oppositely spinning atoms into up or down positions on the detector screens at both sides. The source, at the center produces pairs of randomly oriented atoms, but if one of the pair points up the other invariably points down. In quantum mechanics the pair of correlated atoms must be

described by a single (or singlet) wavefunction and their spin orientations are in non-separable superposition until the moment of measurement, when both orientations become empirical reality.

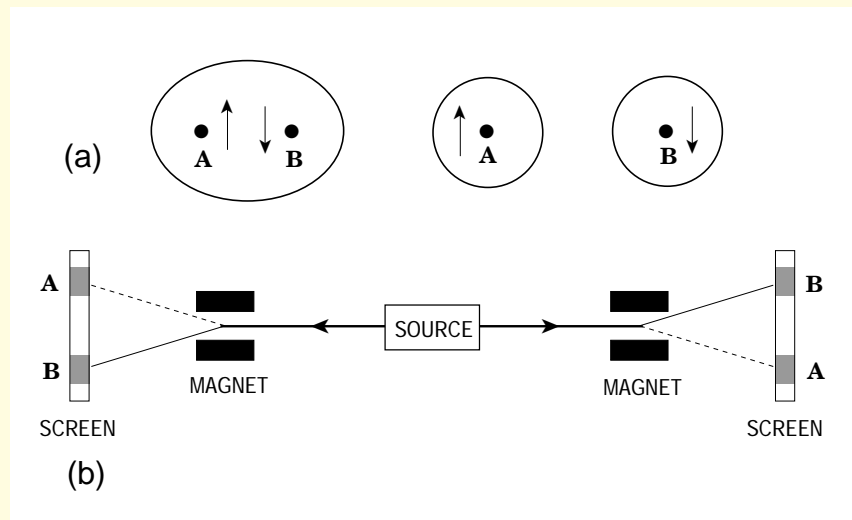


Figure 17-2.

Before that it is meaningless to speculate the states of the atoms. However, EPRB (Bohm) argue that by measuring the spin orientation of A (up) along the laboratory  $z$  axis by the left magnet makes the orientation of B (down) at the right magnet immediately predictable. Bohm extends the argu-

ment by asking, what if we choose to measure another component of the spin of A, say, along the  $x$  axis?!

Classical physics demands that all component of the opposite spins are pre-determined and correlated, thus a measurement on A would also make the  $x$  component of B become local reality. But the quantum mechanical wavefunction can only specify one spin component for each atom. *Thus, either the wavefunction is incomplete or the EPR definition of physical reality is wrong.*

30. After several discussions with Einstein, Bohm comes to the conclusion that both Bohr and von Neumann were wrong. In 1952 he publishes a completely developed alternative to the Copenhagen interpretation of quantum mechanics based on a hidden variable theory, very similar to de Broglie's pilot wave theory which was rejected by the Copenhagenists and eventually even de Broglie, himself abandoned it 25 years earlier. As Bohm states in this work, he was not aware of de Broglie's theory, nevertheless, he states that in his version all past objections are answered by developing the initial idea to its logical conclusions. Bohm calls his work; *The theory of quantum potentials.*

31. Bohm's courageous work seems to awaken the conscience of the scientific community, revitalizes the EPRB debate and triggers a re-evaluation of von Neumann's theory. -- John S. Bell in 1964 indeed finds a definite inconsistency in the mathematics of the "impossibility proof", which at least legitimatizes Bohm's reopening of the hidden variable question. But Bell also shows, that classical statistical probabilities, based on local reality, cannot reproduce *exactly* the quantum mechanical probabilities and predictions. *Bell's theorem of inequality* states that no *locally real* hidden variable interpretation of the experimental facts can fully replace the Copenhagen interpretation.

32. Jumping ahead some, here are a few free quotes from books and articles written and published *four decades later*:

Paradigms Lost by John L. Casti, 1989 [463].

"Bohm began to develop de Broglie's earlier idea into a mathematically consistent interpretation of quantum theory involving only ordinary objects. Originally, de Broglie's pilot wave theory was rejected by the Copenhagenists in view of the associated insurmountable mathematical dif-

ficulties. However, Bohm showed how to overcome the alleged difficulties. He regards a quantum object as a particle with an associated pilot wave that in effect tells it how to move. In this picture, every quantum object is a real particle possessing definite attributes at all times. Associated with each such *real* particle there exists a pilot-wave-field which is also *real* but *undetectable other than through its effects on the particle*. This wave-field in Bohm's theory is termed as *quantum potentials*, and serves the function of '*reading*' the environment and reporting back to the particle. The particle then acts in accordance with the provided information. As a result, a quantum object is not composed of a single "*thing*", either particle *or* wave, but both *a real particle and a real wave-field*. Thus, objective reality and local causality is restored, as there is no longer the ongoing schizophrenia (complementarity) between the mutually exclusive wave and particle attributes. At all times the quantum object possesses both attributes and at all times the particle side has all the usual classic attributes. (position, momentum). Bohm's genius was

to show how this scheme works mathematically by an extension of Schrodinger's wave function, containing not only the evolution of the pilot-wave-potentials but also the continuous evolution of the position coordinates of the associated classical particles."

From an article by David Z. Albert, published in the May 1994 issue of Scientific American:

"Although Bohm's new interpretation of quantum mechanics has existed in the scientific literature for more than forty years, it has until quite recently been mostly ignored.

Throughout that period the thinking about such matters has been dominated by the standard dogma, usually referred to as the Copenhagen interpretation. But it is now emerging that those conclusion were settled somewhat hastily. As a matter of fact, Bohm's interpretation is a radically different, fully worked-out theory that accounts for all known behaviors of subatomic particles. In this theory, chance plays no role at all, and every material object invariably does occupy some given space at all times. Moreover, this theory takes the form of a single set of basic physical laws that apply in exactly the same

way to every physical object that exists. Bohm's theory accounts for all the unfathomable looking behaviors of quantum particles as well as the standard mathematical formalism of quantum mechanics does, but it is free of any of the metaphysical perplexities associated with the Copenhagen interpretation of superposition and measurement."

"In 1982 Bell recasts Bohm's original theory into a both mathematically and conceptually very simple and compelling form. With this Bohm's theory in its entirety consists of three basic elements. The first is a deterministic law, the Schrodinger's wave equation, that describes how the wave functions, or the quantum potentials of physical systems, evolve over time. The second element is a deterministic law of the resulting motions of the particles, represented by the actual coordinate values of the components of motion including the effects of the standard quantum-mechanical probability current. The third element is a statistical rule analogous to one used in classical statistical mechanics. It stipulates precisely how one goes about '*averaging over*' one's inevitable ignorance of the detailed exact states of a physical system. As a result, during the evolution of the wavefunction, at

any time, the probabilities of the positions can be calculated. As this information about the position becomes available during a measurement, it is used to "update" the probabilities through a mathematical procedure, called *straightforward conditionalization* which renders the orthodox collapse of the wavefunction unnecessary. This is all there is to Bohm's theory. Everything else derives strictly from these three basic elements."

"Bohm's theory is the only serious proposal in competition with the Copenhagen interpretation. It reinstates causality and determinism, does not require the concept of superposition of quantum particles, not even on the microscopic level and avoids the infinite regress of the entangled quantum measurements and other perplexities of the standard dogma."

33. Nevertheless, Bohm's theory is not totally free from transgressions. There are three major problems with the theory from the stand point of common physical sense.

a) In order to restore classical objective reality the theory assumes the existence of a wave phenomenon which is physically unobservable other than its effects on the classical mechanics of microscopic par-

ticles. To most working physicists and experimentalists unobservability equals to non-existence.

b) To reproduce exactly the quantum mechanical predictions, this theory must approach the EPR problem of correlation through the exact mathematical formalism of quantum mechanics, by a singlet wavefunction, which is non-factorable. Therefore, it is in contradiction with Einstein's requirement of separability. Hence, like standard quantum mechanics, Bohm's theory is also explicitly *non-local*. This means that it has to face the existence of an instantaneous or superluminal communication between correlated particles measured at distant places.

c) Being simple and clear, Bohm runs into problems that the vague philosophy of the Copenhagen interpretation never had to face. If Bohm's quantum potentials successfully restore objective reality, then it also invokes the physical reality of an information transmission faster than light. With this and with the unobservable pilot wave phenomena the theory not only finalizes the unavoidable separation between the classical and quantum worlds, but it also reinforces the mutual exclusion between the worlds of special relativity and quantum theory.

36. Bohm's theory has a built in explanation for this problem. "The reason why no contradiction with relativity arise in spite of the instantaneous transmission of momentum between particles is that no signal can be carried in this way. For such a transmission of momentum could constitute a signal only if there were some practical means of determining precisely what the second particle would have done if the first particle had not been observed; and as we have seen, this information cannot be obtained as long as the present form of the quantum theory is valid." (Bohm: Suggested interpretation of the quantum theory in terms of "hidden" variables. – Physical Review, 85, 1952 [166]).

34. In the wake of this novel theoretical result, the half a century old EPR debate now takes a 180° turn. For the still reigning Copenhagen administration Bohm's dilemma suggests that if non-local quantum mechanical correlation can somehow be proven experimentally, it would not only cancel Bohm's new reality but the logical inconsistency of the whole EPR argument would forever justify the postulates of the Copenhagen interpretation.

Hence, it becomes the interest of the orthodox group to show that there is not only a correlation between quantum particles in the EPR style, but even beyond that, in terms of Bohm's non-locality which require some "spooky" superluminal communication. For this reason, an ambitious search develops to find experimental proofs of the necessity of an anti-relativistic superluminal signal which discards the whole EPRB argument.

35. The main stream of the resulting experiments conveniently extends Bohm's spin-correlation idea to the elementary light particles of photons. Quantum mechanics assigns two possible components of spin to an individual photon which is assumed to be equivalent of the left or right circular polarization of light waves. The spin property of the photon is essentially a mathematical convenience and comes with the warning that it is not to be primitively interpreted as if a little shiny sphere was literally spinning on its axis. It is also stated, that the law of the conservation of angular momentum is valid in the case of spinning photons. When a *doubly excited* calcium atom, with zero angular momentum, returns to its ground state it emits two oppositely

spinning photons, also representing zero angular momentum. Very low intensity emission makes it possible that *a pair of single photons* emitted in opposite directions in a cascade of rapid succession. Pairs of such photons are oppositely correlated, being left and right circularly polarized.

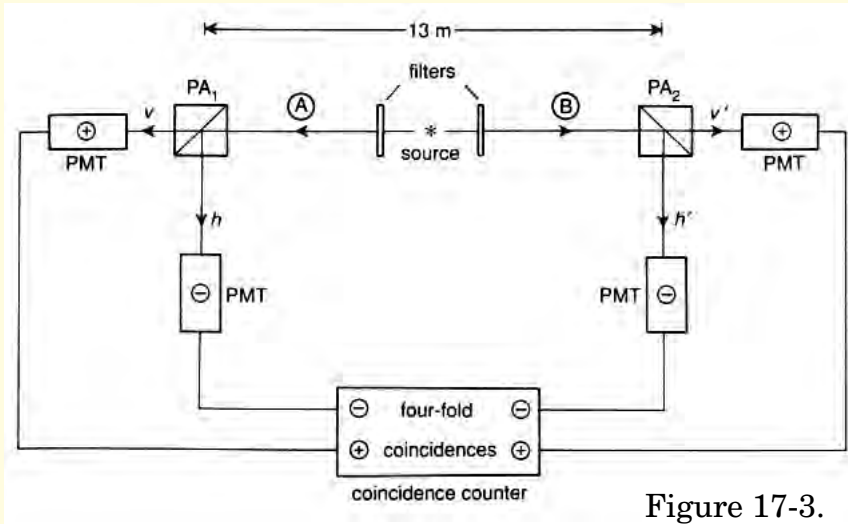


Figure 17-3.

The most famous of correlated photon-spin experiment is designed and executed by Alain Aspect and associates. Figure 17-3 illustrates the basic theory and construction of all Aspect-type experiments. Two oppositely polarized photons are emitted from a gas

of calcium atoms excited by high-powered lasers of different wavelengths. The resulting emission of photon pairs in opposite directions are passing through monochromatic filters which isolate the green photons on the left (A) and the blue photons on the right (B). The calcite analyzer cubes in each side (PA<sub>1</sub> and PA<sub>2</sub>) are placed 13 m apart. They *transmit* vertically polarized photons and *reflect* horizontally polarized ones. As a result, there are four separated beams of photons, two on each side, emerging independently and enter into four photomultipliers which then send electronic impulses to the four-fold coincidence counters at the bottom center.

The detection of a transmitted photon gives a '+' result and that of a reflected photon gives a '-' result. Each calcite-cube analyzer with the related photomultipliers are mounted on independent axes on which they can be rotated, thereby altering their relative orientations. By this set up the polarization angle of one individual photon of the pair can be separately altered. Further more, the coincidence counter is set to look for the arrival of photons A and B within a 20 nanosecond *time window*. Hence, any signal 'informing' B about the fate of A must travel



13 meter in 20 nano second which requires a greater speed than that of light.

36. It is always noted in the descriptions of these experiments that they are far from ideal and in practice there are a number of physical limitations that reduce the conclusiveness of the coincidence counting. To mention some; real *polarization analyzers* do not transmit and reflect all the photons they suppose to, but they often leak both ways. Also this leakage may depends on their different orientation relative to the laboratory frame. *Photomultipliers* are quite inefficient in producing signals from only the small number of photons that is actually generated, thus making it hard to realize single photon measurements. Further more, because of *the limited size* of all these devices, they cannot 'gather' all the arriving photons and, of course, with different results for the two sides, which could break up the sequence of the pairs. These and other inefficiencies limit the success of the coincidence detection of the photon pairs and some can even be detected incorrectly. The experimenters' way out of this impasse is through mathematical generalization and averaging over the different inefficiencies, Also to account for this dampening

effect on the correlation, physicists derived a slightly modified form of the quantum mechanical prediction, taking into account that not all photons are caught by the detection system.

Nevertheless, this quite esoteric experiment, involving sophisticated apparatus and complicated statistical analysis with a chain of basic and auxiliary assumptions, the total results seem to show that the corrected quantum mechanical predictions are overwhelmingly justified by the experimental data.

37. Some stubborn proponents of local reality, causality and determinism still try to find loopholes in the theory of the Aspect experiments. – They argue that, since the change in the relative orientation of the polarizers are set before the photon pairs are emitted, they believe, there is a possibility that the photons were somehow informed about the way the apparatus was set up while they were produced. If so, it is possible that the photons were created and correlated with just the right "local hidden variables" by which they can reproduce even the adjusted new quantum mechanical predictions.

To close this loophole, Aspect and colleagues extend the original apparatus with two acousto-optical

switching device, one on each side. These switches operate randomly on the photons in flight alternating their paths through analyzers with different orientations. It follows that there is no way for any photon to "know" in advance and communicate its physical attribute to its twin before the instant of the collapse of the wavefunction.

This addition, of course, also contributes somewhat in the inefficiency of the apparatus, but again the experimenters mathematically overcome the difficulties and the final statistical experimental data convince them, that quantum mechanical predictions of non-local correlation still prevail. If EPRB insist on local reality and causality, it must face the unavoidable necessity of superluminal communication between distant particles.

38. According to the orthodox Copenhagenists, the Aspect experiments are merely a roundabout demonstration of Bohr's Complementarity Principle. The problem still is the limitation of what is knowable through the classical duality of waves and particles. These concepts are only applicable to quantum entities when specifically designed devices used to measure either one or the other characteristics, but

never both together. Thus, EPRB either give up underlying reality, as the Copenhagen interpretation does, or live with the counter-intuitive, anti-causal "spooky action at a distance" involving anti-relativistic superluminal communication.

39. In 1979 in his Einstein Centennial Address J.A.Wheeler suggests an important further extension of Aspect's experiments. After Einstein's death, there was no hope that some kind of ingenious Unified Field Theory will relieve theoretical physics from the vagueness of the Bohr Copenhagenism. Nevertheless, Wheeler believes that during the half a century that passed since the inception of the EPR debate, science and technology finally reached the level where the metaphysics of quantum mechanics can be proven experimentally right or wrong.

Wheeler proposes a simple method for the experimental verification of Bohr's principles of wave-particle duality and complementarity. The same experiment can also lead to a conclusion whether or not non-locality and super-luminal communication is an unavoidable constituent of empirical reality. The idea is to construct a single apparatus ([Fig. 17-4](#)) that can manifest both the particle and the wave attributes of

a quantum entity and able to switch between them in a time frame which guaranties that the predicted quantum mechanical correlation cannot be achieved any other way but by super-luminal communication.

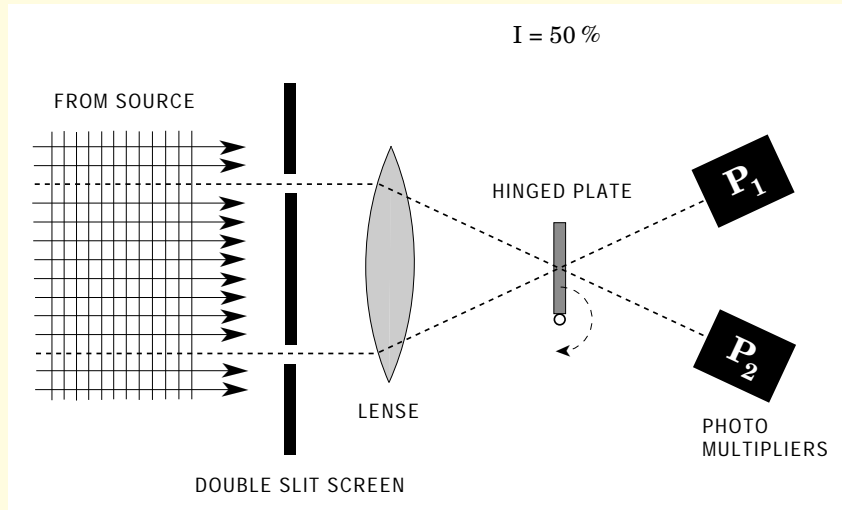


Figure 17-4.

As it can be found in J. A. Wheeler's Quantum Theory and Measurement. III.13. Wickes [457]:

"In a traditional optical double slit interference experiment, photons from a distant source are incident upon a screen containing two small apertures. With a lens behind the screen an image of the source

is formed on, for example, a photographic plate situated in the focal plane of the lens. The size and shape of the image depend upon the apertures, but the image will be crossed by interference fringes of angular frequency  $\lambda/D$ , where  $D$  is the separation of the apertures and  $\lambda$  is the wavelength of the light. Such an experiment isolates the wave character of the incident radiation: the interference fringes can be best understood by describing the energy contained in the radiation as passing through both apertures, even if the intensity is reduced so that usually only one photon at a time enters the system."

"If the photographic plate is replaced by a pair of photomultipliers situated so that each one receives light from only one of the apertures, then the experiment emphasizes the particle nature of light. We might imagine that the photographic plate is hinged to swing rapidly into and out of the photon paths: if the plate intercepts the beams, an interference patterns is recorded, one grain at a time; if the plate is swung out, photons passing through and individual apertures detected. If for example, one of the apertures is covered, there is no effect on the count rate observed with the photomultiplier associated with

the other aperture. This effect implies that each photon passes through one aperture or the other, never both."

"This reasoning suggests that the configuration of the apparatus, and hence, the choice of an experimenter, determines whether the photons exhibit particle-like or wave-like behavior. Acceptance of this apparent paradox is central to the Copenhagen interpretation of quantum mechanics. Bohr moreover asserts that the outcome of a double-slit experiment will not change even if the apparatus is changed after the photon is already in flight."

Of course, this was still a gedanken experiment and its simplicity, like the flipping in and out of the photographic plate with the speed of light, was not feasible technologically.

40. A group of scientist Wickes, Alley and Jacobowitz (WAJ) set out to design an apparatus based on Wheeler's theory using the most modern electronic devices. They call the proposed apparatus, the "Delayed Choice Interferometer". In general, the device creates a phenomenon which is exactly analogous with Young's double slit experiment, but capable to demonstrate both the interference phenome-

non of light waves and the localized particle position-recording of individual photons.

Figure 17-5 (a) illustrates the schematics of the Delayed Choice Interferometer. For clarity, let us view the theory and the construction of the device first solely in terms of the electromagnetic wave theory of light.

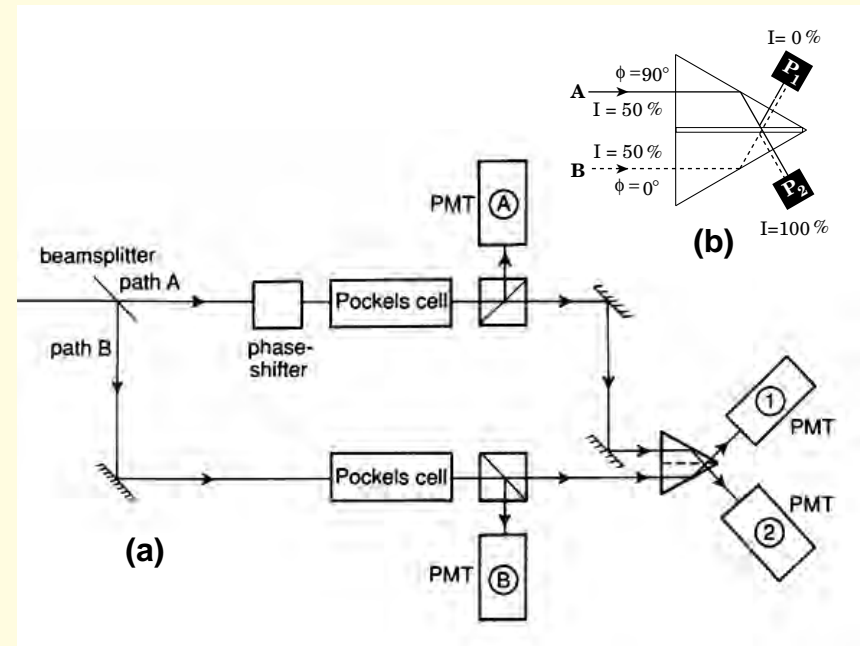


Figure 17-5.

A pulse (short wave-train) of linearly polarized light-waves, generated by a laser, which splits on a half-silvered mirror and proceeds on two separate paths of propagation,  $A$  and  $B$ . Three fully reflecting mirrors bring the separated beams back into coincidence inside of a triangular Koster Prism. Neglecting all other details for now, consider the fact that if the rejoining *half-intensity waves* were exactly in phase, then the resulting *constructive interference* (peak coincides with peak) reproduces the total initial intensity. Waves arriving at  $180^\circ$  out of phase (peak coincides with trough), produce *destructive interference* and records zero intensity.

Next consider, a phase-shifter (PS), inserted on the upper path, shifts beam  $A$   $90^\circ$  out of phase compared to beam  $B$ . The triangular prism itself also acts as a beam-splitter, passing and reflecting each half of the rejoined beams and lead them into the two *photomultipliers*, (1) and (2). Further more, the prism is also a phase-shifter and adds another  $90^\circ$  out of phase to the *reflected* half of both beams. It is important to consult with the details of illustration (b) and clarify that the reflected and therefore phase-shifted part of beam  $A$  (solid line) is united with the

*transmitted* part of beam  $B$  (broken line) and together enter into *photomultiplier* (1), . Since  $A$  is shifted twice, it is  $180^\circ$  out of phase relative to  $B$ , thus they destructively interfere and record zero intensity. On the other hand, the Koster prism transmits the initially phase-shifted  $A$  beam and reflects and phase-shifts the  $B$  beam and reunites them in *photomultiplier* (2). Since both beams are  $90^\circ$  shifted their interference is constructive, thus record the total initial intensity. Thus, final result produced by the wave attributes of the quantum particle is that only *photomultiplier* (2) shows the arrival of light.

The next addition to the apparatus is the so-called Pockels Cell which is capable of rotating a vertically polarized light into a horizontally polarized one. Another device is the calcite crystal which transmits the vertically and reflects the horizontally polarized light. Pockels Cells are inserted in both path conjointly with calcite crystals. Thus, if one is turned on it rotates the polarization angle and the crystal reflects the beam out of the path into the *photomultipliers* ( $A$ ) or ( $B$ ). With this setup, each beam,  $A$  and  $B$  can be individually deflected out of their initial paths.

Still considering strictly light-waves, it follows, that with both Pockels Cells off, the original interference result is unchanged. Either one of the Pockels Cells turned on would cause the deflection of either *A* or *B* and let only the other beam go through the Koster Prism. This beam will be split and guided into photomultiplier (1) or (2), measuring  $\frac{1}{4}$  each of the initial intensity.

Evidently, there is no mystery about the results of this part of the experiment based strictly on the classical wave theory. The only requirement for the consistent interference results is that the distance of the two paths must be exactly equal, or differing by an integral multiple of the wavelength, so the two beams arrive to the point of interference at exactly the same phases. All results of this part of the experiment, including the wave phenomenon of polarization agrees with the classical wave-theory and Maxwell's equations.

Consider now the second part of the description of the delayed choice apparatus which is concerned with the production, guidance and recording of the strictly particle attributes of a single photon within a specific time frame. In this respect there are some

basic theoretical differences between the initial Aspect-type experiments and this latest one. As the original report of WAJ, (Wheeler [457-8]) explains:

"The delayed-choice experiment looks at the behavior of single photons with a choice of trajectories to a single recombination in space-time (non-relativistic) rather than at pairs of photons at distant points. Any interpretation of the results of this experiment will depend, of course, on whether it is sensible to speak of the *position* of individual photons, especially as regards to the extrapolation backwards in time from the detection of photomultiplier pulses."

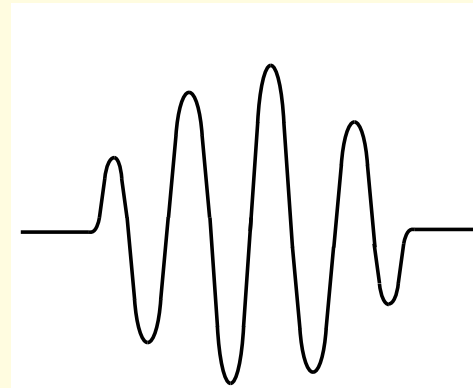


Figure 17-6.

In the delayed choice experiment both the position and spatial extension of the photon, as a particle, are important thus, the quantum concept of a so-called *wave-packet* comes into play. Figure 17-6. is the usual illustration of this concept.

As WAJ describes: "a laser light source emits pulses with a time duration of 100 ps corresponding to a wave packet with spatial extension of 3 cm."

(Divided by a wavelength, say, 500 Å (0.00000001 cm) seems to be a rather lengthy train of peak-and-troughs, an and immense number of phases, rather than an infinitesimal point particle.)

"In the proposed system, the detection of '*particles*' and '*waves*' is accomplished by *photomultipliers* in which detection events can be localized in time."

Considering now the strictly particle attributes of the quantum entity, let's follow the description of the delayed choice experiment in accordance with the above mentioned novelties:

Recall, that the polarized *light-waves* were split by the first beam-splitter and then the two beams follow paths *A* and *B*. What happen to the *indivisible photon* at the beam-splitter? Will it go one way, or the other, or both? Will it go through at all?

As Baggott in 'The meaning of Quantum Theory' (Photons have it both ways) describes:

"Performing the experiment with the laser light intensity reduced, so that only one photon passed

through the apparatus at a time, resulted in the expected detection of the photons only by photomultiplier (2). In this arrangement, the photon behaved as though it had passed along both paths simultaneously, interfering with itself inside the prism, in exact analogy with the double slit experiment." (Constructive or destructive interference).

"Thus with only one photon in the apparatus switching on either Pockels cells was equivalent to asking which path through the apparatus the photon had taken. This is analogous to asking which slit the photon goes through in the double slit experiment. The choice between measuring a single photon's 'wave-like' properties (passing along both paths) or 'particle-like' properties (passing along one path only) was therefore made by switching on one of the Pockels cells."

"The great advantage of this arrangement was that this switching could be done within about 9 nano seconds (one billionth). The lengths of the paths *A* and *B* were each about 4.3 m, which a photon moving with the speed of light can cover in about 14.5 ns. Thus, the choice of measuring device could be made *after* the photon had interacted with the beam-splitter."

"Of course, according to the Copenhagen interpretation, the wavefunction of the photon develops along both paths. If one of the Pockels cells is switched on, the detection of the photon directed out of either path collapses the wavefunction instantaneously, and we infer that the photon was localized in one or the other of the two paths."

Hence, – based on the assumptions that the limiting intensity and an ideally short (3 cm) pulse of *light-wave-packet* corresponds to the quantum particle attributes of a single photon, and that the use of the photomultiplier, recording both the positions of the self-interfering photon particle and the constructively interfering light waves -- WAJ concludes: "the configuration of the apparatus, and hence, the choice of the experimenter determines whether the photons exhibit particle-like or wave-like behavior".

"Acceptance of this paradox is central to the Copenhagen interpretation of quantum mechanics."

Thus, a further metaphysical conclusion follows, that even empirical reality depends on whether or not an observer watching the path of the photon. If watched, it manifests the position of a particle, if not it shows the interference phenomenon of waves.

According to the Copenhagen debaters the positive results of the delayed choice experiments create insuperable difficulties for the followers of Einstein even nowadays.

But of course, the 'hidden variable'-ists vehemently refuse this claim. They are rather willing to *dispose* the central quantum mechanical concept of *Einstein's photon altogether* and return to the classical and locally real electromagnetic wave-fields, supplemented by the random fluctuations in the so-called *zero-point field*, or those in the so-called *seething vacuum*. (Look up T.W. Marshall, Foundations of Physics, [22, 363] 1992)

Meanwhile, generation after generation are still being educated in the spirit of the '*standard*' *Copenhagen interpretation* and learn very little else.

With this lack of competition, the search for the experimental verification of the reigning ideology goes on and so does the philosophical lamentation between positivists and realists. - Having just a few more years to go to complete a whole century of this modern physics, one can ask the not very impatient rhetorical question: Are we really going anywhere?!



## AN AETHRO-KINEMATIC INTERPRETATION

The ultimate goal of this study is to render a coarse sketch of kinematical understanding for all known natural phenomena, based on the ideal gas model of the Aether. This also means the complete unification of classical, relativistic, and quantum mechanical physics, from Galilean inertia to Copenhagenian superluminality. Stating it in an other way; this theory suggests that -- as gas-pressure and other macroscopic phenomena can be explained by atomic and molecular statistical mechanics -- all events that we can predict, but are unable to comprehend through classical and modern physics, we should be able to contrive and explain from the conceptual view of a presently not yet existing *STATISTICAL AETHRO-KINEMATICS*.

The foregoing sixteen chapters were written with this general intention and the last one (with Appendix III) attempted to uncover the general kinematic origin of the quantum phenomenon of discontinuance of radiation energy. -- Hopefully, it has been done with some initial success of opening sacred doors for further research. Now, besides generality, -- just to put a foot in some of those doors - it must be shown

here that the last six decades of scientific evolution has been totally ship-wrecked on a dangerously stubborn dogmatism. This dogma is reigning by vague metaphysical lamentations and ultra-sophisticated mathematical argumentations over the results of theoretically complex and technologically extreme experimental jugglery.

Moreover, all this is happening in spite of the fact, that most of the real perplexities of the dogmatic Copenhagen interpretation of quantum mechanical formalism has already been solved and explained away more than four decades ago by the continuously neglected de Broglie-Bohm theory. We have quoted some very convincing recent expert analyzes about the justification and criticism of this theory. Nevertheless, there are some remaining uncleared problems in the Bohm re-interpretation of quantum mechanics which serve as excuses for the orthodox school to postpone any serious reflection.

The fundamental problem with any re-interpretation of the quantum facts lies in the undeniable success of the mathematical formalism of quantum mechanics in predicting the probabilities of experimental results.

Thus, the basic condition of any conceptual re-interpretation is, not to affect the quantum mathematical structure to any extent that would disturb the already proven power of prediction.

The greatest merit of Bohm's work is the successful combination of the de Broglie pilot-wave concept with the deterministic Schrodinger wave-equation and with the classical trajectory concept, without affecting the general formalism of the quantum mechanical mathematics. However, by reproducing exactly the quantum mechanical predictions, Bohm's theory inherited one of its fundamental problems which is called *non-locality*, or the specific prediction that correlated particles are *not Einstein-separable*.

Mathematically this means no less than that two correlated quantum particles must be described by a single (singlet) wave-function which, in turn, guarantees that they remain correlated and in communication until one of them is measured.

It further follows, that the correlation between the two particles at any arbitrary distance apart requires an instantaneous and therefore *superluminal communication* at the instant of measurement. This conclusion is totally at variance not only with

common sense but with the postulates of the theory of special relativity as well.

According to the Copenhagen school another problem with Bohm's theory is that the de Broglie's pilot waves are based on an ad hoc hypothesis which offers no experimental verification.

Originally, Bohm's interpretation reinstated local reality, determinism and causality by reintroducing the real and continuous existence of classical particles and their trajectories by assuming that their non-Newtonian mechanical behavior results from the mechanical effects of a *real* de Broglie wave-field, similar to those of the classical electromagnetic field. However, because of the superluminal communication requirement, the mathematical formalism forced Bohm to face the choice between opposing relativity or giving up the realism of the wave-field.

As Bell addresses these problems in his collection of lectures: 'Speakable and Unspeaking in Quantum Mechanics', 1987.

"Could it be that this strange non-locality is a peculiarity of the de Broglie-Bohm construction, and could be removed by a more clever construction? *I think not*. It now seems that the non-locality is

deeply rooted in quantum mechanics itself and will persist in any completion. Could it be that in the context of relativistic quantum theory,  $c$  would be the limiting velocity and the strange long-range effects would propagate only subluminally? *Not so!* The aspects of quantum mechanics demanding non-locality also remain in relativistic quantum mechanics.”

More from Bell, On the EPR Paradox, Physics. I. [195-200] :

“Then for at least one quantum mechanical state, the ‘*singlet*’ state in the combined subspaces, the statistical predictions of quantum mechanics are incompatible with separable predetermination. -- In a theory in which parameters are added to quantum mechanics to determine the results of individual measurements, without changing the statistical predictions, there must be a mechanism whereby the setting of the measuring device can influence the reading of another instrument, however remote.

“Moreover, the signal involved must propagate instantaneously, so that such theory could not be Lorentz invariant.”

Back to Aether:

The missing link in these logical argumentations of Einstein, Bohr and de Broglie, Bohm, Bell, and in general, modern theoretical physics, is represented by the complete absence of a medium within which microscopic reality exists and which may render the kinematical causality and reasoning which is certainly not derivable from the totally characterless empty space.

The following section of AETHRO-KINEMATICS is an attempt to find some kinematical guidance out of this philosophical labyrinth. Thus, the first step is to re-iterate the general kinematic characteristics of the supermundane isotropic, homogeneous medium.

The all-pervading Aether, like the hypothetical ideal gas itself, exists in eight fundamental kinematic states:

1. *Free Aether.* The state of total isotropic randomness, where the motion of the individual Aethrons obey Newton’s mechanics and described in details in the atomic kinetic theory of gases.

2. *Aether flow.* The state of global translational motion, where because of some local density fluctuation, each Aethron of a given volume of Aether is able to move a greater distance in a given direction than

in any other direction. This results in the continuous drifting of the Aethrons in the same direction, superimposed on their initial random oscillations. Such mass translation, or fluid flow of the Aether toward a low pressure area ceases when the average isotropic density is re-established.

3. *Vortex.* A state of circulation, or rotational translational motion which can develop around a persisting low density locality, like a sink, or because of a torque produced at the boundary between two linear flows of different speeds. The later tendency of local rotations is called fluid-dynamic *vorticity*.

4. *Turbulence.* A state of motion in which several of the above states are mixed together.

5. *The Donut-vortex.* As illustrated in [Figure 11-1](#), this state is a complex three-dimensional flow pattern of drifting Aethrons which evolves from specific circumstances under the constant isotropic pressure of the free Aether. It is kinematically plausible that, under non-extreme conditions, this flow pattern could be permanently bounded by the isotropic pressure and that its internal density is greater (Bernoulli's theorem) than that of the surrounding free Aether. This *unit of mass* can have its own transla-

tional motion relative to the isotropy of the Aether and therefore possess its own inertia and momentum. A donut-vortex also has an intake and an output of Aether and therefore their interconnectability can represent the natural evolution of complex systems, or conglomerates of elementary mass particles, which we call *macroscopic matter*.

6. *Force-fields.* Various complex flow-patterns of the drifting Aethrons, produced by the dynamic connections between sinks and sources within and around the interacting and conglomerated particles of matter.

7. *Wave-motion.* A tendency of re-establishing the equilibrium of the isotropic density of the medium. Any locally produced density fluctuation in the isotropic free Aether dissipates in an expanding spherical shell. When the nature of the local disturbance is periodical, the dissipation is also discontinuous. This is the kinematics of periodical dissipation of excess density in the form of compression or rarefaction pulses, called wave-trains or wave-motion. It is important to differentiate between the concept of *translational motion* of a given mass of Aether and that of wave-motion where only local density fluctua-

tions are conveyed through the body of the motionless medium. The waves of density variations are propagated through the motionless medium by the constant speed,  $c$  which reflects the specific elastic character of the Aether and proportional to the average speed and collision free path of the Aethrons.

8. A subdivision of wave-motion should be noted; depending on the method of producing the local density fluctuations, there are two fundamental type of waves in Aether :

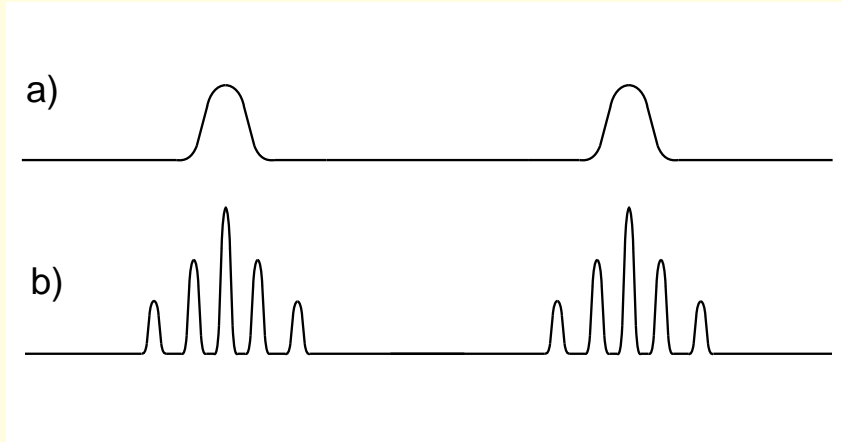


Figure 17-7.

a) As it has been described in Chapter Sixteen and detailed in Appendix III, due to the Aether's

resistance (Lorentz formula), a certain density fluctuation is generated by the simple, uniform motion of a particle relative to the medium. This is called a *particle-wave* with the clear understanding that it is a wave made by a uniformly moving particle in the Aether. A macroscopic analogy is the bow-wave produced by a ship. (Figure 17-7.a)

b) Electromagnetic radiation is produced by microscopic oscillation of elementary particles or by the oscillation of the electromagnetic field. Oscillators represent accelerating and decelerating motions, thus the impulse exerted by them on the medium varies with time. According to the kinematic analysis of the origin of the particle-waves (bow-waves), – as presented in App.III. – the time interval between the accumulation of two individual pulses is proportional to the relative speed of motion of the body and the separation of the pulse happens when the medium suffers a certain extent of compression.

From these it follows, that during the forward motion of the oscillator a group of sub-pulses are produced with decreasing distances from each other while the oscillator accelerates, and increasing distances when it decelerates (Figure 17-7.b).

Thus, a group of sub-pulses are created by the varying forward velocity of the oscillator until it comes to a stop and starts moving backwards. During this backward period the group propagates away from the oscillator with the speed of light. The distance, that the group reaches before the oscillator turns in the forward direction again, is the wavelength of radiation. The total picture of this complex radiation pulse is similar, but not identical to the common illustration of a wave-packet.

It is important to note here that the above description of the eight characteristic states of motion of the Aether should neither be considered as precise nor as complete, but rather as a rough sketch which should be refined and completed through an immense research of the detailed kinematics of the ideal gas. Nevertheless, it still represents a lot more than the total kinematic ignorance that is admitted by assuming that space is void.

With regards to the general problems of the Copenhagen interpretation of the quantum facts and the mathematical requirement of a superluminal communication, there are three main groups of arguments, represented by three different experimental

methods to prove or disprove the orthodox theory.

I. The EPR Gedanken experiment-argument is based on the interaction and separation of elementary particles to simulate the behavior of electrons in a diffraction or a double-slit experiment. The non-dispersive correlation between these particles is based on the law of conservation of *linear momentum*.

II, The EPRB version created by Bohm, is based on the spin orientation correlation of atoms, that is, on the law of conservation of *angular momentum*. The predicted final position measurement, or the detection of the spin-orientation is produced by the Stern-Gerlach magnet.

III. In all Aspect-type and other Delayed Choice experiments the spin-orientation correlation is extended to the photons. The conservation of angular momentum in this case is represented by the preservation of the polarization transmission angle of the quantum particle. The predicted final position measurements are produced by the calcite crystal which transmits vertically polarized photons and deflects horizontally polarized photons.

According to this present interpretation Aether pervades all space. Elementary particles are perma-

nent flow-systems formed under the isotropic pressure of the medium. When these ‘mass particles’ are made to move relative to the Aether, they experience fluid resistance, to which they react and produce compression ‘particle-waves’. Thus, the kinetic behavior of the particles during these experiments more or less depends on the interactions between the particles and the medium.

The above described eight basic kinematical states of the Aether offers the following guidelines for those interactions:

In the special case when a single particle somehow gained momentum in the past and now moves uniformly relative to the free Aether, it suffers no other effects but a linear deceleration in the direction of motion. Its own particle-waves continually dissipate with the speed of light and therefore they do not alter the direction of the particle’s motion. The resistance of the medium is proportional to the ratio between the speed of motion and the speed of propagation of light (Lorentz Transformation).

When two or more particles move in the same direction, initially on Newtonian trajectories in the free Aether, they only suffer a feeble dispersion effect

due to the transverse pressure produced by their own particle waves and their reflections from one another. This force is proportional to their momenta and inversely proportional to the square of distance between them.

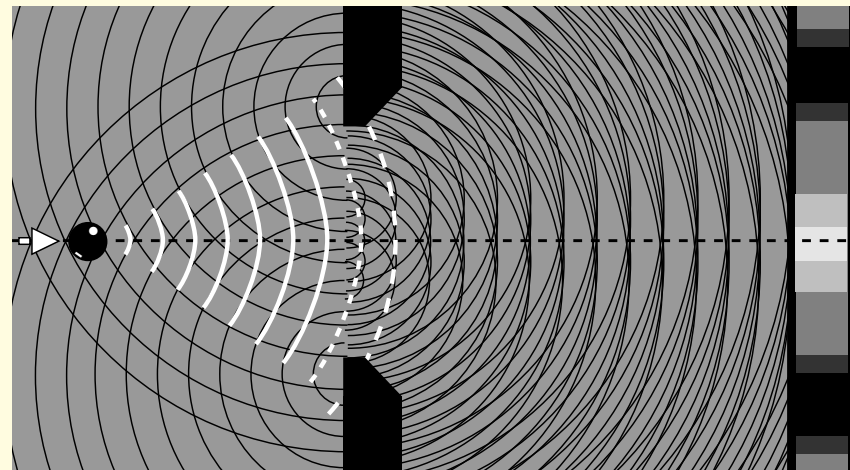


Figure 17-8.

There is a case when one or more small mass-particles move relative to the Aether which is enclosed in a solid macroscopic environment, that is, capable of reflecting the waves produced by the particles. Figure 17-8 illustrates the experimental setup which describes the electron diffraction theory and in some sophisticated way it is also used for the deriva-

tion of Heisenberg position-momentum uncertainty principle. A more complicated version of this basic idea is the electron double-slit experiment.

Now, as it has been described in details by Appendix III, when one or more small mass-particles move along relative to the Aether in an environment which reflects the particle-waves, there will be a general alteration of the initial Newtonian trajectories by the wave-field. For this reason the final position measurements of the particles will display statistical wave-phenomenal patterns.

If the particle-source and the reflecting environment are in an exactly symmetrical setting, then the probability of the final position measurements can be predicted by the quantum mechanical wave-function based on the de Broglie wave-length of the particle. The symmetry is needed because, for the sake of prediction the Newtonian trajectories must be altered evenly throughout the whole experimental field.

A clarifying note is due here about the frequently mentioned predictive power of the quantum mechanical mathematics, that generates so much of the compromise with the unbearable metaphysics of the Copenhagen interpretation.

The fact is, however, that the total success of this formalism is weighed by lumping together atomic spectral analysis with that of the predictions of particle diffraction and interference phenomena. This produces a slanted picture.

The major part of the predictive power is created by the de Broglie-Schrodinger wave-mechanics of atomic and molecular structure. The substitution of Bohr's quantum-jump orbits by Schrodinger's theory of selective standing-wave orbits, based on de Broglie's electron wavelength, was the one that scored success after success. Where it failed, 'subtle but mathematically logical modification made it even more powerful' (Ch-16). This typical evolution of mathematical formalism has been lumped together with Bohr's Principle of Complementarity and formed quantum mechanics. Thus, Bell's consideration of the power of the quantum mechanical singlet wavefunction is not at all justifiable.

(I.) In the Aethro-kinematic interpretation, the de Broglie pilot-waves are real particle-waves (bow-waves) in the Aether and this phenomenon does not require any other detection, as part of physical reality, but the experimental fact of the electron diffrac-



tion itself, which proves that the reflections of the waves from the environment *can and does alter* the Newtonian trajectories.

After all, the acceptance of *all action at a distance forces*, as part of physical reality, is always based on the detectible alterations they cause in the trajectories predicted by the Newtonian laws of motion. Think about gravity, magnetism, or electricity.

*It also follows, that the EPR thought experiment, that assumes a non-dispersive correlation between two interactive and separated elementary particles, is an absurd proposition.*

Consider, that after interaction and separation, both particles continuously create their own waves which are propagated in the enclosed Aether and are reflected back by the environment and from one another. Both particles and their Newtonian trajectories are under the continuous influence of the changing transverse and reflected pressures of their own interfering waves. The complex kinematics of this situation totally out-rules the classical conservation of linear momentum of the individual particles and certainly cancels the possibility of non-dispersive EPR correlation and Einstein separability.

As for the quantum mechanical singlet wavefunction requirement of non-locality, note here, that according to this interpretation, at any instant, all waves that fill the Aether in the experimental environment and all changes in their interference patterns are propagated with the speed of light in advance of the particle's motion and therefore locally and instantaneously affect the trajectories of the particles, *wherever they are*. The evolution of the trajectories remains correlated by the *symmetrical* wave-fields at all times and at the instant of measurement the positions of the particles are determined by their history (Bohm) that is, the continuous chain of local realities of their interactions with the medium at each point. -- *Hence, although the quantum mechanical predictions and their non-locality are totally reproduced, -- aside of the natural light-speed propagation of the particle-waves -- superluminal communication between the particles or between distant devices are not at all necessary*

But Bell states that this strange non-locality and superluminality are deeply rooted even in the relativistic version of quantum mechanics. So, where are they coming from ?

As they remark in most contemporary text books, it is ironic that Einstein spent the second half of his life fighting against the counter intuitive vagueness of the quantum theory which was initiated by his own photon hypothesis.

Somewhat less obvious is how much he strengthened the positivist school by replacing the classical reality of the electromagnetic Aether-frame with the anti-common-sense philosophical postulates of special relativity. Also it is quite evident that Einstein's vague Relativistic Correspondence Principle;  $c \rightarrow \infty$ , (§16) has paved the way for the acceptance of its exact conceptual and mathematical copy: the Quantum Mechanical Correspondence Principle, stating;  $\lambda \rightarrow 0$ , that is, classical mechanics is a special case of quantum mechanics and applicable only when the de Broglie wavelength of the particle approaches zero.

Obviously, one of the problems here is that the de Broglie wavelength of the electron does approach zero, but is also *definitely not zero*.

Although it possesses classical mass and momentum, the electron is still small enough to be sensitive to the feeble quantum effects of the Bohm-de Broglie-Aether-particle-waves and therefore becomes disper-

sive with regards to the classical conservation of its momentum.

*It follows, that the Quantum Correspondence Principle is neither conceptually nor mathematically adequate to map out the boundary and the borderline details between classical mechanics and quantum mechanics.*

(II.) Bohm's version of the EPR gedanken experiment shows a different shortcoming of the Quantum Correspondence Principle. In this case Einstein's linear momentum correlation is replaced by the conservation of angular momentum. Bohm's correlated atoms are produced with opposite spin orientations which are detectable by a Stern-Gerlach magnet. This instrument is specifically designed, based on the classical theory of magnetism and on the quantization rules of particle spin. The strong gradient in the magnetic field of the magnet separates the atoms of opposite spin-orientations into two sharply defined groups on the detector screen. This result is then interpreted as the position measurement of quantum particles, which therefore justifies the application of the quantum mechanical formalism of the *singlet wavefunction*.

As Bell remarks: “...many measurements reduce to measurement of position. For example, to measure the spin component,  $\sigma$ , the particle is allowed to pass through a Stern-Gerlach magnet and we see whether it is deflected up or down, i.e., we observe position in subsequent time. – The result of a ‘spin measurement’ for example, depends in a very complicated way on the initial position of the particle,  $\lambda$  and on the strength and geometry of the magnetic field. The result of the measurement does not actually tell us about some property previously possessed by the system, but about something which has come into being in the combination of system and apparatus.”

Now, from the point of view of the electromagnetic theory of magnetism, and its application to this macroscopic measuring device, it can be seen that the *analogy* between the EPR correlation of linear momentum and the EPRB correlation of angular momentum, is far from being justifiable. While the electron diffraction was produced in an environment totally free from macroscopic forces and the alterations of the trajectories were solely due to the feeble de Broglie wave-phenomenon, the detections of the spin-orientation of EPRB clearly depend on the

*strength and geometry of the Stern-Gerlach magnetic force field.*

Hence, if nothing else is wrong with the analogy, it certainly neglects the great difference between the magnitudes of the two allegedly ‘analogous’ forces. This misconception, however, brings up the questions of whether or not the de Broglie particle waves should still be a guiding factor in EPRB beyond and above the much stronger macroscopic magnetic field. Moreover, in general, whether or not it is still justifiable to apply the quantum mechanical singlet wavefunction to this experiment?

From the above described kinematical characteristics of the Aether, it can be seen, that there is a whole order of magnitude difference between *the force of the magnetic flow-pattern, which actually carries the atoms through the Stern-Gerlach magnet*, and the feeble, microcosmic force of the de Broglie compression waves produced by the moving particles. Obviously, the magnetic force is the macrocosmic cause of the alteration of the Newtonian trajectories and the resulting position measurements.

*Hence, the conditions should be described exclusively by the classical electromagnetic theory and not*

by the microscopic probability densities of the quantum mechanical wavefunction.

Therefore, it may be suggested, that *the Quantum Correspondence Principle should be further refined by a definite restriction of the applicability of quantum mechanical formalism only to the specific cases where there are no stronger forces acting but those of the de Broglie-Bohm-Aether particle-waves.*

(III.) Finally, consider the presently leading edge of the experimental development: the WAJ 'Delayed Choice Experiment'.

As experts believe, this version -- more than the similar tendencies of the Aspect-type experiments, - strikes directly into the heart of the matter, one of the foundation stones of the Copenhagen Interpretation: *the fundamental problem of wave-particle duality.* This version of EPRB promises an experimental display of Bohr's Principle of Complementarity, that is: *Wave or particle, but never both !*

Moreover, this version also promises to provide the experimental justification for the inevitable necessity of a superluminal communication between the distant photons or the measuring devices. In this experiment Bohr's wave-particle duality is demon-

strated by the spin-orientation-correlation of the photons, as it has been described by §40 in the language and logic of the Copenhagen interpretation of quantum mechanics.

(Before challenging the conclusions drawn from this experiment, let us recall that Chapter Sixteen introduces an alternate explanation for the problems of the photo-electric effect. This alternative renders a solution to the kinetic energy problems of the ejected photo-electrons without invoking the corpuscular theory of light and the ambiguous concept of the photon. Thus it also avoids all the headaches of the last six decades caused by the wave-particle duality and Bohr's complementarity. Nevertheless, with regards to the uncovering of the hidden ambiguities of the Delayed Choice Interferometer, the use of the Aethro-kinematic rejection of the photon hypothesis is unnecessary.)

The Aethro-kinematic challenge of the theory and conclusions of the Delayed Choice Interferometer is simple and straight forward. As it has been pointed out earlier, without applying quantum mechanics, each and every phase of this experiment is clearly and unambiguously explainable by the electromag-

netic theory and predictable by Maxwell's equations, as different facets of the typically classical wave-phenomenon. This includes not only the wave-like attributes, but the allegedly particle-like attributes as well. Thus, the necessity of the application of quantum mechanical formalism and the singlet wavefunction to predict the probabilities of position measurements are based on artificially complicated and internally inconsistent assumptions and therefore totally unjustified.

For substantiating the above statement, consider the following arguments:

In a very general way the theory of the Delayed Choice Interferometer introduces a shift in the basic concepts of the wave-particle duality of the Complementarity Principle. Here, the waves and particles are no longer Bohr's 'two diametrically opposed classical concepts' but rather inherent parts of a quantum entity, something that is 'fundamentally non-classical and therefore un-knowable.' -- According to WAJ group the experiment produces single photons, possessing both wave-like and particle-like attributes, which can be detected and measured by different specifically designed measuring devices.

In Wheeler's initial suggestion, the special device for measuring wave-like attributes, or interference fringes, was a photographic plate placed in the focal point where the paths of two individual photons crossed. The particle attributes were measured by hinging out the plate and let the photons continue into two photo-multipliers, recording the photon's final positions.

Incorporating the theory of this experiment with Bohr's Complementarity and with Bell's latest analysis of the quantum mechanical position measurements, WAJ declare to achieve the same result *with a single photon* in the apparatus, where its wave-like or particle-like attributes are produced by different devices, placed along separate routes and detected or measured by four independent identical photomultipliers.

Recalling the detailed description of the different devices along the different paths of the photon, it can be seen that the manifestation of the particle-like attributes of the photon is achieved explicitly by the Pockels cells which "*upon application of a high voltage*, produce a 90° rotation of the plane polarization of the photon' (WAJ).

This means, that the Newtonian conservation of the angular momentum, that is, the spin-orientation of the photon was altered by a macroscopic electric force. This rotation is the cause for the deflection of the polarized photon from its original path, a result of which it ends up in the side-track photomultipliers (A) or (B) where its final position is recorded.

Evidently, this case is exactly analogous to the interaction of Bohm's atoms with the macroscopic Stern Gerlach magnet. In other words, the major roll of the Pockels cells in the WAJ is identical to the roll of the Stern-Gerlach magnets in EPRB.

Hence, the conclusion for the particle-like attributes of the WAJ experiment is the same as for the EPRB argument: *The Quantum Correspondence Principle must include a definite restriction of the applicability of quantum mechanical formalism exclusively to those cases where there are no stronger forces in action but that of the de Broglie-Bohm particle-waves of the Aether.*

It should also be noted here, that photomultipliers are based on the photon theory of the photo-electric effect. As a result, there is a general scientific impression that the ejection of the *initial single elec-*

*tron* produced by the transmission of the kinetic energy of a single photon particle. Then the ejected single electron is amplified by photomultiplier, thus it must records exclusively particle-like attributes. -- This misconception, however, must have been cleared away in the Delayed Choice experiment, since it uses identical photomultipliers to record the wave-like attributes of photon interference as well.

The rest of the scenario is utterly simple. The wave-like attributes of the individual photon, and the resulting interference phenomenon is certainly beyond classical logic since the photon is, by definition, indivisible and consequently not re-unitable with itself. Admittedly it is not even explainable by quantum logic.

It is just one of those things that are not categorizable as 'knowable' by Bohr's philosophical postulates. Hence, right from the first step of the photon, as it is entering the beam-splitter, Bohr's rigid denial of reality must be applied, so nobody should dare to inquire what is happening and where, until the constructive and destructive interference measurements are already executed by the multi-talented photomultipliers (1) and (2).

This conceptual cascade is described by different phrases:

Some theoreticians use the enlightening words that the 'photon behaved as though it had passed along both paths simultaneously, interfering with itself in the Koster prism'. – These authors totally neglect the further complication, that the Koster prism contains a second beam-splitter, which then is supposed to chop up each of the already chopped up indivisible photon into four parts and one pair must interfere destructively, the other constructively in order to produce the wave-like behavior predicted by quantum mechanics.

Some others are bothered even less with these wavy details. They simply and literally covered the whole experimental ground by the singlet wavefunction, stating that whichever route the single photon takes, the wavefunction simultaneously develops through the other, 'empty' path and then reunites with the photon in the prism in quantum interference. Nevertheless, - beside its Bohrian perplexity, - there is another problem with this 'explanation'. If the particle-like attributes do not justify the application of the singlet wavefunction, then nothing else

remains to explain interference but the classical wave theory, which can be most easily reinstated. We simply admit that even a short laser pulse is still 3 cm long, consisting of an immense number of phases that makes it indistinguishable from a wave train that is, of course, divisible and re-unitable in interference.

For the *very low intensity* which allegedly separates the nature of waves from that of photons, recall that the photon hypothesis also established, that the intensity of the light does not alter the kinetic energy of the ejected photo-electron. Thus, the photo-multiplier would still work by a short, low intensity wave-train.

Moreover, not only is every phase of the wave-like attribute of the quantum entity explainable by the classical wave theory, but it is also easily understandable why the quantum mechanical formalism produces the same results, as the classical electromagnetic theory.

Remember, that the de Broglie pilot-wave wavelength of the elementary particles was derived from the relativistic mass-energy formula and that the momentum of the massless photon was taken as

merely kinetic energy. From this it follows, that the de Broglie wavelength of the photon particle is equivalent with the wavelength of the initial classical light-waves. Thus replacing the electromagnetic waves by photons and then applying de Broglie's wavelength formula to this quantum particle, we end up exactly where we started from; with the original wavelength or frequency of the electromagnetic waves. Thus, in the case of the photon, or light-particle, the application of the quantum mathematical formalism, that is, Schrodinger's singlet wavefunction and Young's theorem, is simply a total reversal of the starting procedure; this time going backwards from the quantum photon hypothesis to the electromagnetic wave theory of light.

But with one obscured addition, – which is really the essence of the whole procedure, – the *implanted singlet wavefunction*, which then mathematically enforces an unavoidable correlation between the interactive and separated particles and consequently enforces the requirement of the inconceivable superluminal communication. This is where the hopeless conceptual confusion of the Copenhagen interpretations comes from.

These, and a number of previously discussed conclusions demand another restriction of Bohr's Correspondence Principle:

*The application of the quantum mechanical mathematical formalism, especially the 'singlet wavefunction' should only be allowed to a physical state if there was no classically proven theory which can predict the same final experimental results.*

This restriction achieves two most important adjustments:

By a simple change of the roles, *Quantum Mechanics becomes the limiting case of the more general Classical Mechanics* and the monstrous singlet wavefunction is finally caged in, where it belongs, exclusively applicable to the diffraction and interference phenomena of elementary particles, when moving in the Aether, which is enclosed in a reflecting environment. More importantly, with this restriction, the infamous superluminality problem will quit haunting common sense and be filed away into the scrapheap of the other modern metaphysical speculations.

Through somewhat deeper analysis it can be found that the inadequacy of both Correspondence Principles originate from the initial mathematical



over-simplification of the meaning of the Lorentz Transformation. The fundamental misconception is that the effect of the '*relativistic mass-increase*' only comes into existence when the velocity of a material particle approaches the speed of light. According to the Aethro-kinematical interpretation both phenomena of the relativistic mass-increase and the quantum mechanical de Broglie matter-waves are merely physically detected demonstrations of the existence of the all-pervading ideal gas medium and its kinematical resistance against any motion of any material particle relative to the absolute frame of reference of the Aether.

This is the real and humanly comprehensible meaning of the re-interpretation of quantum mechanics and more generally the re-interpretation of the Lorentz Transformation for all physics, which thereby renders a complete unification of the three separately discovered classical-mechanics, relativistic mechanics and quantum-mechanics into the whole of *AETHRO-KINEMATICS*.

## **CHAPTER EIGHTEEN**

### **THE BIG BANG AND THE KINEMATICS OF DISPERSION**

The theory of AETHRO-KINEMATICS and its conceptual content, described in the foregoing seventeen chapters, totally determines the only acceptable cosmological hypothesis: *The Rotating Universe*.

From the limited earthly point of view, our Universe seems to be an unceasing chain of rotational gravitational systems of materialized units floating in Aetherial vortices, each of which is enclosed in one

of a larger order of magnitude. Each and all of them exist in the long term equilibrium of Universal Gravitation, balanced by Universal Rotation.

As far as observations can reach out in space or time, we can only 'see' systems quite autonomous of each other. The only feeble thread of causality between the smallest and largest observable is the kinematical inheritance of Kepler's differential rotation, the fundamental characteristic of all gravitational rotational systems. This all-pervading kinematical tendency of creation of matter exists throughout space and time, at any imaginable number of order of magnitudes, from the infra-microcosmic rotation of the elementary donut-vortex to the ultra-macrocosmic whirling of the meta-galactic super-clusters of super-clusters of clusters of galaxies.

The question of whether this inheritance starts or stops somewhere in space or time is out of the reach of human inquiry, since it is equally impossible to imagine both a finite or an infinite Universe or a beginning or an end of time. But a Rotating Universe being in equilibrium and in kinematical contact with all its parts, does not require an answer to these metaphysical problems.

Nevertheless, like in all other departments, modern science also managed to create a bold innovation in Cosmology with its astonishing theory of the Big Bang Universe, which is completely at variance with AETHRO-KINEMATICS, thus, it must be addressed and re-interpreted as will follow.

The main pattern in the evolution of Cosmology is a step by step degradation of the Earth's position and importance relative to the Universe as a whole.

Within the last three centuries, the Earth's position has been devaluated from being the very center of the World to being an insignificant planet of an insignificant average star, called Sun, which is wandering on an insignificant orbit in an insignificant galaxy. The position of the Milky Way, as we call our Galaxy, cannot even be described, due to the billions of such systems scattered isotropically in space within our observational limits.

To point out a particular grain of sand among all the beaches of all the continents would be a comparatively easy task compared to finding the Earth within the observable Universe.

Thus, it is understandable that, after believing and burning one another for the childish fantasies of

Geocentric, Heliocentric and Galactocentric universes, cosmologists finally took the oath, that never ever again would they fall for a similar fairy tale.

This full pledge of modern times is embodied in the '*Perfect*' *Cosmological Principle*, which states that; *anywhere in Space and Time all galactic observers must view the same kind of grand scale picture, regardless to their particular position in the Universe.*

In other words, from here on no hypothesis will be acceptable, which assigns any special significance to the position of the Earth, the Sun, the Milky Way, or any other particular point or system in space, anywhere in the Universe, or at any time.

To detect any motion outside of our solar system, astronomers must patiently watch even the nearest stars for decades and the recording of any motion of even the closest galaxies is totally beyond the human time-scale. Our direct observation of the skies is basically two dimensional and non-stereoscopic. Beyond the motion of the Planets and the Sun and the motions of a small number of nearby stars relative to the background of fixed stars, our direct methods are completely useless.

Consider a typical neighborhood example of cosmic Time and Space: The Sun is orbiting about the center of the Milky Way with the tremendous velocity of 150 kilometers per second. Still it takes 200 million years to complete a single revolution in the Galaxy. While the Earth lived through some four billion orbits, the same time, the Sun became merely 20 galactic years old.

The same general picture of isotropy, combined with the accepted Newtonian concept of the infinite universe, presented some serious contradictions between the laws of physics and the observational facts of Astronomy. In the early eighteenth century, H. Olbers discovered a cosmic paradox, which has been puzzling scientists ever since. It starts with the innocent question: *Why is the sky dark at night?*

The common answer, that the Sun shines on the other hemisphere of the Earth, is not satisfactory, because there are myriads of stars, greater than the Sun, and shining on us from every direction of the night sky. Maybe they are simply too far from us and their lights are too dim?!

No, their distances turned out to be totally indifferent. Olbers' paradox presented an undeniable con-

tradiction between the laws of Physics and the observations of Astronomy.

Physics states that the amount of light energy falls on a unit area of a surface per second is diminishing inversely proportional to the square of the distance from the source. By the same geometric logic, however, another fact of astronomy, the isotropic distribution of galaxies, means that each consecutive spherical shell of space contains more and more galaxies, which increase is directly proportional to the square of the distance from the observer. If the Universe is infinite, as it should be to agree with the theory of gravitation, then at every point of the sky there should be a star no matter how far it is. Thus, mathematics shows that what is lost in energy through the distance is exactly gained back in the density of the sources.

It follows, that in the case of an infinite isotropic Universe, every point of the sky should glow with the intensity of the sun and any observer at any point of the cosmos would be surrounded by a sphere of sources radiating  $5000^{\circ}\text{C}$  of heat from all direction. Obviously, these predictions do not agree with the existing observations.

If the Universe was finite, either in space or in time, Olbers' paradox would be solved, but Newton's gravitation would have pulled all matter of the cosmos into the center of mass. Another problem with the finite Universe is, that observations reveal a complete isotropy of the sky and show no trace of density difference in any direction, that would suggest a center or a border.

Nevertheless, in the twentieth century, the ambitious human mind succeeded in producing the most exciting cosmological theory; the Expanding Universe, which, among other problems, also solved the paradox of Olbers. The most popular version of this hypothesis even attempts to explain the origin, the age and the mechanism of the Universe by the *Theory of the Big Bang*.

As it will be seen, however, in spite of the promise of the perfect cosmological oath, the new scenario still managed to salvage some special privileges for the human species in the Cosmos. This complex story evolved from three basic ingredients of indirect astronomical measurements:

a) Through spectroscopic analysis of the light of astronomical objects, scientists came to the conclu-

sion that, the chemical composition of matter is the same everywhere in the Universe.

b) Based on this uniformity and on the rule that the apparent luminosity of a star is inversely proportional to the square of its distance, astronomers found an indirect measuring method for great distances. If the distance of a recognizable type of star in our neighborhood is established, and its *intrinsic luminosity* is measured, then from the *apparent luminosity* of the same type of star, its distance can be calculated anywhere in the Universe.

c) Part of the general uniformity of the chemical spectra of cosmic sources is, that the spectrum of white light is not totally continuous but certain colors are missing at specific wavelengths. This gives a universally recognizable pattern in the spectra of the light received from all parts of the universe.

Based on these characteristics astronomers have found that compared to the spectrum of a laboratory source, the light of most stars were shifted toward either the blue or the red end.

This phenomenon has been satisfactorily explained as the result of the well known *Doppler effect* of light, a strictly wave-phenomenon, which was dis-

cussed in details in [Chapter Fourteen](#) and illustrated on [Figure 14-11](#).

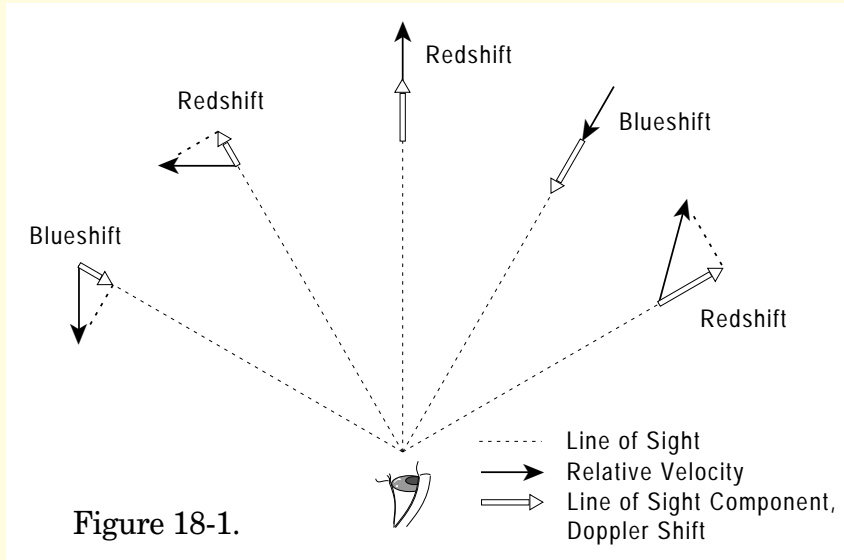


Figure 18-1 illustrates the character of the Doppler phenomenon when an astronomical source moves in different directions relative to the earthly observer. In our two dimensional view of the Universe, there is no way to tell in which direction a star really moves. The only information the Doppler effect can give us is the direct, *line of sight component of the velocity of the star*.

The technical possibility to measure these effects is given by Spectroscopy which is based on some fundamental wave-characteristics of light; namely the optical phenomena of *refraction and dispersion*.

It is an empirical fact that the speed of propagation of light decreases in proportion with the density of the transparent medium. Light is retarded when passing from air to glass. When the angle of incidence of a light beam is oblique to the boundary between the two media, its direction changes. This deviation from the rectilinear propagation is the phenomenon of refraction.

It is also the nature of light waves, that while all colors propagate with the same speed in vacuum, the speed of propagation of different colors or the different frequencies of light, is different in the same transparent medium. Higher the frequency, greater the retardation, that is, lower the speed and greater the deviation from the straight line. Since the extent of refraction depends on the speed of propagation, blue light is refracted more than the lower frequency red light. The deviation of the different colors between these two extremes are proportional to each frequency. Thus, as shown below, a beam of white

light is dispersed into its components when passing through a prism.

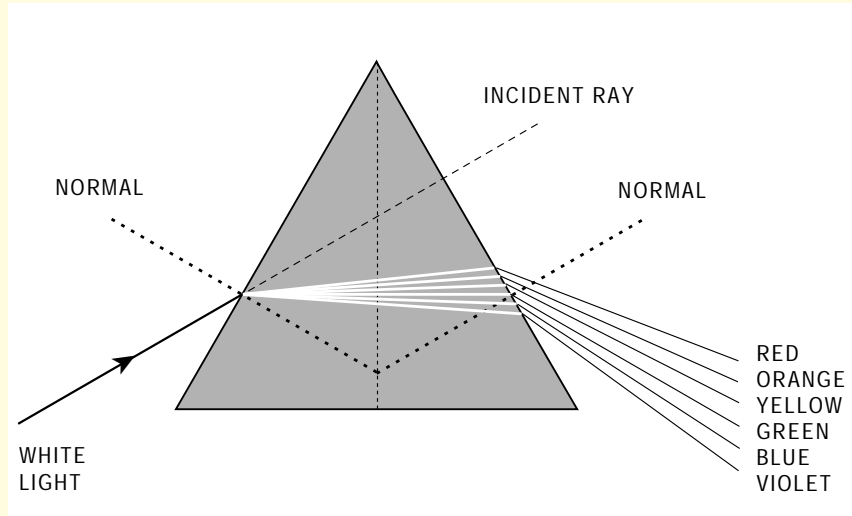


Figure 18-2

In case of the Doppler effects of star-light, it has been established that each frequency of an approaching light source shifts a given percentage toward the higher frequency blue, and that of a receding source shifts toward the lower frequency red. These shifts were measured by comparison with the un-shifted positions of the two most recognizable absorption lines in the spectrum of a laboratory source.

From the magnitude of the shift, scientists were able to calculate the *line-of-sight velocity* of a moving star. This interpretation of the spectral shift gave the first indirect indication of the motions and velocities of astronomical objects. The new possibility caused a great upheaval in cosmological research and in the first decades of the century a major part of observational time was spent on the measurements of Doppler velocities.

Through these measurements, it has been found that the spectrum of the great majority of stars are shifted one way or another, showing their random velocities relative to the earth.

In 1925, during this already routine research, V.M. Slipher made a discovery, which led to an astounding extension of the size of the Physical Universe toward inconceivable measures. He found from the line of sight velocities of certain 'nebulae', then thought to be within our own galaxy, that they are receding from us at phenomenal velocities up to 1,800 km/sec.

Soon it was discovered, that these nebulae and the great majority of the *naked-eye-stars* were, in fact, distant galaxies, galactic clusters and galactic

super-clusters. It was also established, that the observable universe contains star systems, like our Milky Way by the billions, spreading in random isotropy in all directions, without indication of a density difference in any direction showing a center, or a boundary of the Cosmos.

In 1929 Edwin P. Hubble reported his discovery that the spectrum of the light of the great majority of galaxies are shifted toward the red end. As he wrote:

"Galactic spectra are peculiar in that the lines are not in the usual places, as found in nearby light sources. The displacements, called Redshifts increase on the average with the apparent faintness of the Galaxy. Since the apparent faintness measures distances, it follows, that redshifts increase with distance.

"Detailed investigation shows that the relation is linear. Small microscopic shifts either to the red or to the blue have long been known in the spectra of astronomical bodies. These displacement are confidently interpreted as a result of motion in the line of sight radial velocities of recession or approach. The same interpretation applied to the redshift in galactic spectra led to the term, *velocity distance relation*

between redshift and apparent faintness. On this assumption the galaxies are supposed to be rushing away from our region of space with velocities that increase directly with distance. A completely satisfactory interpretation of the redshift is a question of great importance, for the velocity-distance relation is a property of the observable region as a whole. The only other property that is known is the uniform distribution of the galaxies.

"Now, the observable region is our sample of the Universe. If the sample is fair, its observed characteristics will determine the physical nature of the Universe as a whole. The conclusion, in a sense, summarizes the results of empirical investigations and offers a promising point of departure for the realm of speculation." (E.Hubble, A Relation Between Distance and Radial Velocity, Proc.Nat.Ac.Sci, #15, 1929)

Indeed, the modest words of this report proved to be the seed for a gigantic plant of speculation. The Doppler Interpretation of the galactic redshift, which is expressed in the law of velocity-distance relation, became the catalyst that turned the apparent eternal fixity of the world into a violently dynamic picture of the so-called *Expanding Universe*.



Hence, the contemporary scenery of Modern Cosmology is, that everything is rushing away from us and the further they are the faster their recession. This picture is also isotropic, that is, the same in every direction.

The direct and sensible conclusion from all these would be, that we are again in the very center of this explosion. But according to the Cosmological Principle any other observer at any point of the Universe must see the same general picture. Therefore, only one possible conclusion left, that everything is rushing away from every other thing.

How could this be possible?

Someone came up with an ingenious analogy: If the whole Universe was a raisin-bread baking in the oven, the raisins were the galaxies and we were sitting on any one of them, then due to the expansion of the dough all raisins would seem to recede from us and from one another with velocities proportional to their distances. So, if we could only see a part of the bread, we would stare into an expanding system with no particular center.

In the routine calculation, based on any spectral shift of  $\Delta\lambda$ , of any particular wavelength  $\lambda$ , the veloci-

ty,  $v$  was to be found by the relation of  $c(\Delta\lambda/\lambda) = v$ , where  $c$  is the velocity of light. Eventually this method led to recession velocities of 76,000 km/sec. Hubble's law of redshift established the velocity-distance relation,  $v = Hr$ , where  $r$  represented the distance of the source and  $H$  was the so-called *Hubble constant*.

This empirical formula showed that according to the Doppler Interpretation of the Redshift, for every million light year distance, the galaxies are dashing away from each other with an additional 55 km/sec. (Figure 18-3.)

Beyond a certain distance the apparent luminosity becomes clearly unmeasurable, however the redshift measurements were still reliable. Thus, in the evolution of this interpretation, the Law of Redshift itself has become the unique yardstick and the speedometer in the immense space of the amazing Expanding Universe.

As a result, and with the appearance of the radio telescopes in the 1950's, near to the observational limit, the recession velocities of the galaxies were established at the astonishing rate of over 100,000 km/sec; more than one third of the speed of light.

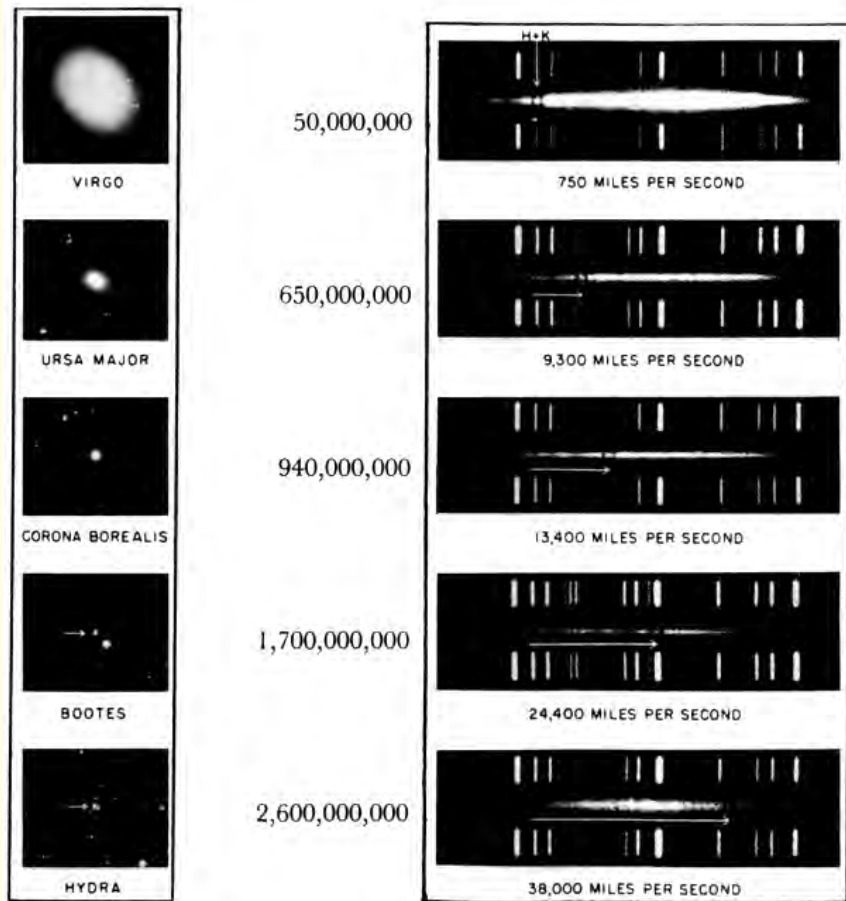


Figure 18-3

It is a natural consequence of this general picture of expansion in every direction, that once upon a time all the individual systems of the material Universe must have been close together. It followed, that from the reciprocal of Hubble's Constant scientist were able to calculate, that some eight to twenty billion years ago the distance between the galaxies must have been zero.

Hence, the fast rewind of this hypothetical cosmic video tape reveals a picture of a fiery ball of all matter of the Universe in an extremely condensed state, a kind of *Primeval Atomic Egg*, which either by fusion or fission, or by some unknown triggering mechanism, has exploded into our present Universe indeed with an astonishing *Big Bang*.

It should be noted here, that the lower time limit of this retroactive prediction has been carefully adjusted to fit between the Hubble velocity constant and the astrophysical and geological findings about the approximate age of the sun and planets. Evidently, the Universe cannot be younger than the good old Earth. Setting a safe upper age limit for the Universe was even more delicate. Looking into space is also looking into the past and as we penetrate

immense distances, we should find a younger and younger Universe, but so far, in the distance of five billion light years, no trace of a beginning has been found. The dozen, or so, billion years of tolerance comes from the understandable uncertainties, due to the indirect measurements of the tremendous distances and velocities.

Hence, although the Earth and even our Milky Way has lost their central positions by Copernicus and by the Cosmological Principle, with the theory of the Big Bang, we have still regained some of our Universal Importance, that is, being in the lucky position on the cosmological scale to be able to discover the time of the birth and maybe even the death of our Universe. If not in space, at least, we have an enviable position in the flow time.

As for Olbers' paradox, the theories of the Expanding Universe claims a double solution:

"As E.R. Harrison has emphasized, in conventional (Euclidian) cosmologies, there are logically two independent ways out of this dilemma; the expansion of the universe and a finite age of the universe. In Big Bang theories cosmological expansion and a finite age go hand in hand. Expansion helps, because the

cosmological redshift prevents distant stars from making the simple Euclidian contribution to the night-sky brightness. A finite age of the universe also helps, because the light from very distant stars simply does not have time to get here even if we were to ignore the redshift." (F.H. Shu, *The Physical Universe* [384])

To avoid all the delicately detailed arguments among rival Big Bang theories about the plausible state of the Universe in the first twenty seconds of creation or the last couple of billion years at the other end of time, and to escape the decision making whether the Cosmos is expanding forever or it is a cyclic one, oscillating between explosion and implosion, it is preferable to push the fast forward on the cosmological VCR and stop at the quote from the *Encyclopedia Britannica* of 1979:

"Although the fact of an Expanding Universe is now accepted by the majority of scientists associated with this class of problems (Cosmology), there are a few who prefer to believe in a stationary universe and consider the observed redshift not as a result of recession of the galaxies, but rather as a consequence of some unknown property of light quanta to lose a

part of their energy in traveling over long distances. However, none of the proponents of this point of view were able to formulate any reasonable and consistent theory for such energy depletion of light quanta beyond an anthropomorphic analogy of *getting tired after a long voyage*."

Consider also the quote presented below from William Bonnor, *The Mystery of the Expanding Universe*, 1964 [54]:

"One reason for believing that the red shift is a Doppler Effect is the negative one that nobody has ever proposed a convincing alternative explanation. It has been suggested, that the reddening might be due to scattering of light by intergalactic dust.

"However, this explanation will not work, because the scattering would blur the images of the distant galaxies to such an extent that we should not see them as points of light.

"Other suggestions, for example that light changes its wavelength in some mysterious way on its journey through intergalactic space, do not count as explanations since they have no theoretical basis, and lead to no predictions which could be used to verify them.

"The fact is that the Doppler effect is the only possible scientific explanation of the red shift at present. The Doppler law states that a given recession velocity causes a *fixed percentage change of the wavelength*, and the same for all wavelengths. This means that if the velocity (of the source) is one-tenth of the speed of light, then a wavelength of 1,000 Å increased by 10 percent, that is by 100 Å, one of 2,000 Å is increased by 200 Å, and so on. Thus the shift is not a bodily one -- the whole spectrum is not shifted to red by the same amount of, say 100 Å. Nor does the shift affect only certain wavelengths -- it affects the whole spectrum of electromagnetic waves. *The red shift of the galaxies follows precisely the percentage Doppler law.*"

In fact, chronologically the Doppler effect interpretation of the local redshifts and blueshifts came first and the discovery of the distant extra galactic nebulae came later. Since it was the only means of measuring any motion of distant astronomical objects, it became common practice to assume that all Doppler shifts represent radial velocities. The astonishment came from Slipher's and Hubble's observations that there is a galactic redshifts in every direc-

tion and that in general the *calculated magnitude of the receding velocities are in linear relation with the distances.*

Consider now the following quote from Richard Berendzen (and co-authors), *Man Discovers the Galaxies*, [206],1976:

"Hubble, himself, felt that the Doppler interpretation of redshift was not completely obvious and insisted on using the wording 'apparent velocities' to indicate this. 'The term *apparent velocity* may be used in carefully considered statements and the adjective always implied where it is omitted in general usage. Because the telescopic resources are not yet exhausted, judgement may be suspended until it is known from observations whether or not redshifts do actually represent motion'

"The arguments about the real nature of the observed redshifts, however, have never been settled. Nor have the arguments been quieted over which of the newer cosmological models (if any) is an accurate picture of the universe."

Nevertheless, this initial scientific cautiousness did not stop the grand scale cosmological speculations which has flourished for over five decades.

Scientist, writer, Eric J. Lerner gives an essential summation for the evolution of the mainstream twentieth century cosmology in his book; *The Big Bang Never Happened* (published by Random House in 1992) :

"The Big Bang arose initially as an explanation for the Hubble expansion -- the relation of the redshifts and distances of the galaxies. The observations of the past several years have put that theory into grave doubt, contradicting all its predictions as well as its basic assumptions. One would think that these developments would reopen a debate over the correct explanation of the Hubble expansion. However...For a decade now the accumulating contradictions have met not with a reexamination of basic assumptions but by boilerplate hypotheses. Just as the medieval astronomers added epicycle after epicycle to Ptolemy's spheres in order to match his geocentric theories with observed planetary movement, so today cosmologists add dark matter to cosmic strings to inflation, papering over the yawning crevices in their theory." [53-54]

"The test of a scientific theory is the correspondence of predictions and observation and the Big Bang has

flunked. It predicts that there should be no objects in the universe older than twenty billion years and larger than 150 million light-years across. There are. It predicts that the universe on such a large scale should be smooth and homogeneous. The universe isn't. The theory predicts that, to produce the galaxies we see around us from the tiny fluctuations evident in the microwave background, there must be a hundred times as much dark matter as visible matter. There's no evidence that there's any dark matter at all. And if there is no dark matter, the theory predicts, no galaxies will form. Yet, there they are, scattered across the sky. We live in one." [39-40]

## REDSHIFT IN THE PRISM

AETHRO-KINEMATICS takes the common sense approach for an alternate interpretation, starting from the acceptable observational facts used by the 'Tired Light Theory' of the Red-shift.

The simple statement of this simple theory is based on the direct application of the inverse square law, derived from the geometrical principles and from the empirical facts of the distribution and depletion of light energy.

Astronomical distances are measured by the comparison between *intrinsic and apparent luminosities* of the sources. By applying the inverse square law of the distribution energy, from the difference between these two magnitudes, the distance of the source can be calculated. In other words, the energy arrives to the earthly observer from a cosmic source is inversely proportional to the square of its distance. It has been also established in physics, that the energy carried by wave-motion is proportional to the square of the amplitude of the waves. It follows, that *the amplitude of light must be in linear relation with the distance of the source.* And so is the redshift.

Founded on these physical principles, based on observational facts, the Tired Light Theory suggests that the galactic redshift maybe connected with the *depletion of the amplitude of light* traveling through immense cosmical distances. Nevertheless, no hint was given about the nature of this connection.

Aside of its undeniable logical simplicity, this hypothesis would also readily explain both Olbers' Paradox and our apparent center position in the Universe, based on the simple fact, that *wherever we are, that point is certainly the center of our own limit-*

*ed observational territory.* – If one stands on the highest peak and observes that, due to the hazy air, the color of the surrounding mountain ranges are fading in proportion with their distances, one will find that the effect is equal in all direction, that is, centered on oneself. For Olbers' sake, one will also find that beyond a certain distance, the color of the ranges fades totally into the color of the haze.

According to the proponents of the Big Bang, however, the Tired Light Hypothesis was lacking the theoretical and physical proof, that the loss of the energy of the galactic light is physically responsible for *the percentage decrease in each individual frequency*, as it is accounted for by the Doppler Interpretation.

In the following an attempt will be made to show that the galactic redshift is neither produced by the scattering of the light, nor by some mysterious changes in the wavelengths or frequencies through the great distances, but neither was it produced by the Doppler expansion of the Universe. The shifting of the spectrum toward the red is simply happens at the very end of the long journey, in the prism of the spectrograph as a result of the quantitative change

in the kinematics of refraction during its interaction between the depleted light energy and the refractive power of the transparent matter.

The key to this alternative explanation of Hubble's redshift is to achieve a better understanding about the kinematic nature of the phenomena of refraction and dispersion.

As it has been described in Chapter Fourteen and illustrated on Figure 18-4 (reproduced 14-21), the phenomena of refraction and dispersion are neither the sole property of the refractive power of the media, nor that of the frequency of the compression pulses of light, but it is due to the interaction between the two, that is, between the pressure delivered by the pulses and the density of the crystalline channels of the transparent medium.

The denser the transparent medium and the more pressure is forced through the crystalline channels, the greater the retardation in the speed of propagation. It follows, that *the total excess pressure delivered per unit time*, that is, the frequency of the periodical pulses, is also a factor in the resulting retardation of the light. Consequently, the higher frequency light is retarded more, deviated more, and

have a higher index of refraction than the lower frequency light. This is then the kinematic explanation of the phenomena of refraction and dispersion.

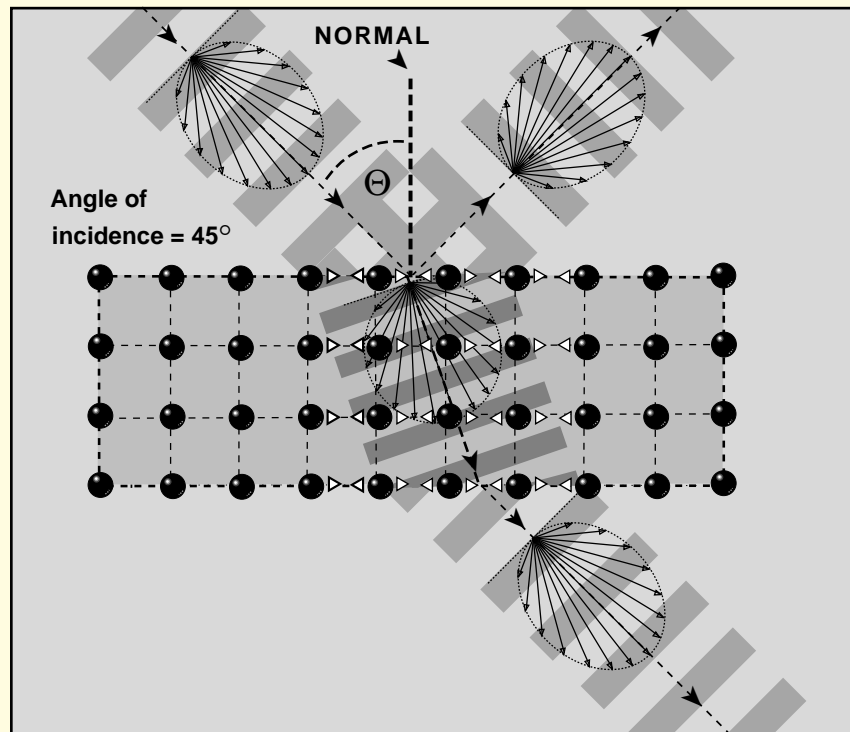


Figure 18-4

The importance of this theory of dispersion in the alternate explanation of the cosmological redshifts

calls for a reinforcement of the idea by the well known theorem of hydrodynamics.

First let us point out again that, according to the kinematic theory of wave-motion, the excess pressure, or momentum density carried by the periodical compression pulses only acts in the forward and transverse directions. (momentum amplitude, [Fig. 14-11/13](#)). There is no excess backward pressure in the direction of the source. Considering this, a beam of light, propagated in the isotropic Aether from a source to a receiver is delivering a given amount of forward momentum per unit area per unit time.

With respect to the pressure exerted on the receiver, the beam can be taken as equivalent with the dynamic pressure of a fluid in motion, exerting force on a plane perpendicular to the direction of the flow. The periodicity of the pulses can be neglected since the frequency is an expression for the delivery of momentum per unit time, i.e., momentum density.

When this point is accepted, two fundamental theorems of hydrodynamics become applicable. The *Equation of Continuity* is valid in this case, stating that as a light beam 'flows' through a transparent medium, the excess momentum that enters the inter-



nal Aether must be the same that leaves. Thus, in passing through from air to glass and to air again, the total momentum of the pulses per unit time is conserved both in speed and direction.

More importantly, Bernoulli's Theorem of the relationship between the static pressure and the dynamic (flow) pressure developed in an ideal fluid in motion can also be applied to this case:

$$p + \frac{1}{2} r v^2 = \text{constant} \quad (17.1),$$

where  $p$  denotes the static pressure,  $r$  is the mass density and  $v$  is the velocity of the fluid. Essentially, this expression is also a statement of the principle of conservation of energy, applied to fluids in motion, and derivable from Newton's mechanics.

Recall the experiment with a gas-burner described and illustrated in Chapter Eleven, Figure 11-4, where the constriction of the pipe demonstrates that as the flow velocity of the fluid (dynamic pressure) increases, the static pressure decreases.

In the case of the refraction of a light beam a reciprocal situation arises. The law is that the sum of the static and dynamic pressures is a constant. As the compression pulses enter in the crystalline chan-

nels of the glass and due to the transverse components the internal static pressure of the Aether increases, the dynamic pressure, that is, the velocity of the propagation, must be reduced.

Since the delivered pressure is proportional to the frequency, the beam of higher frequencies must be retarded and deviated more than that of the lower frequencies. This is the hydrodynamics of the refraction and dispersion of light.

Recall now, that the concept of the '*wave amplitude*' originates from the maximum displacement of the particles in the mechanical wave-motion on a taut string. By the derivation of the wave-equation, the same concept has been applied to the longitudinal waves of sound, where the concept of the amplitude expresses the peak of the pressure amplitude of the compression layers. Similarly, the wave equation has been found applicable in the theory of the electromagnetic waves of light, where the amplitude expresses the maximum transverse magnitude of the vectors of the electric and magnetic fields.

Consequently, it can be stated that in all wave propagations the concept of amplitude marks the magnitude of the peak energy density created by a

single oscillator and/or carried away by a single pulse. The concept of intensity, on the other hand, marks the total energy created by a great number of oscillators and superimposed on one another in the medium.

Mathematically, the intensity is proportional to the square of the amplitude, and since the intensity is inversely proportional to the square of the distance, the amplitude of the energy density of the individual pulses must be in linear relation with the distance of the source.

To put it into the form of a postulate:

*Refraction and dispersion are results of the interaction between the energy of light and the crystalline structure of the transparent media. The magnitude of the deviation from the normal is proportional to the density of matter, to the frequency of light, and to the energy amplitude delivered by the pulses.*

*Thus, the astronomical redshift, which is the decrease in the deviation of light in the prism, is a result of the global decrease in the specific index of refraction for all frequencies, proportional to the depletion of the amplitude of light, and consequently in linear relation with the distance of the source.*

At this point, several questions should be asked and answered.

*Does this theory predicts a percentage shift for the different wavelengths or frequencies, as the Doppler interpretation predicts in agreement with the experimental facts ?*

Definitely. On the one hand, the Doppler percentage law states that the magnitude of the shift of any wavelength, relative to its original position in the laboratory spectrum, is proportional to a percentage calculated by the division of the speed of source by the speed of light.

On the other hand, the specific index of refraction of any wavelength in a given transparent medium is found by the division of the speed of light in air (or vacuum) by the speed of light of the given frequency in the given transparent medium. Since the speed of light in the medium is inversely proportional to the energy of light ( $\text{pulse} \times \text{frequency}$ , or  $h \times \nu$ ), so is the resulting deviation.

It then follows, that the division of the index by the speed of light also gives a *percentage deviation for each frequency* relative to its laboratory position in the spectrum.

In principle, if a prism of given index of refraction is replaced by one 5% less dense glass (smaller index), it would result a shift toward the red end, a percentage shift in the position of all wavelengths relative to their positions given by the first prism. Based on the above hypothesis, it can be seen, that a proportional depletion in the amplitude of the energy density of light in the same prism will demonstrate an identical percentage law, being indistinguishable from that of the Doppler redshift.

*How was this simple solution obscured through more than a half of a century ?*

There are several psychological and scientific reasons for the historical rejection of the Tired Light Theory. The most general one lies in the nature and methods of the human brain, which almost without exemption first directs thinking toward the most complex solution and from there struggles toward simplicity. This goes together with the instinctive attraction of the human mind toward the most mysterious, global and final solutions.

Remember, that the concept of the galactic redshift and the velocity-distance relation was initiated by Astronomy. The discovery of the galactic universe

came in the midst of the most exciting novel possibility of Astronomy to measure the velocities of the stars by the Doppler Effect. Thus, the first natural question was not about the origin of the redshift, but: how can they all move so fast away from us? Before any cautious astronomer, like Hubble, or philosopher-physicist, like Einstein would seriously search for an explanation based on physical principles, the frontiers of cosmological innovators were ready to speculate on a variety of the most exciting scenarios.

Just as all other 'bold leaps' of modern physics, these cosmological speculations enforced the already established direction of modern science toward the denial of common sense and their pessimistic sensationalism was favored by the anti-materialistic ideology of the troubled ruling classes.

So the sensible, simple and boring idea of the Tired Light, without any serious analysis, was swept under the abstract rugs of modern science together with all other tired attempts to save classical common sense.

An important mathematical factor that helped obscuring the obvious is the scientific convention, used in optical theory, that "*the amplitude of light*

*waves is always to be regarded as infinitesimal.*" (C.G. Darwin, Nature [17]), – which creates no ambiguity in the short distances of laboratory experiment. The same is not true, however, when light travels millions of years.

The astronomical obscurity came from the phenomenon of the Doppler shift. Because of the various line of sight components of the motions of nearby stars and galaxies, most astronomical spectra have shown either blue or red shifts. Therefore, even if there was a deliberate search for a measurable sign of amplitude depletion, it would have been impossible to distinguish the amplitude-redshift among the overwhelming positive and negative Doppler effects. However, since the relative local motions of the galaxies become less significant with greater distances, the amplitude redshift in the spectra of the sources millions of light-years away, finally became a major factor in the measurements. Nevertheless, by the time the amplitude depletion finally showed up in the cosmic redshifts, Einstein's boldly postulated photon theory, as a quantitative explanation for the photoelectric effect, was unanimously accepted and extended confusion through the whole of science.

Now, the wave-particle-photon is described as a wave phenomenon during its creation by the oscillator and again when it produces the refraction and spectrum. However, during its propagation through empty space, became a full pledged particle, carrying the total inherited energy concentrated in time and space, in the Galilean sense of inertia, undiminished till eternity and infinity. The intensity of light translates to photon density which diminishes with the square of the distance.

What about the amplitude?

No wonder, by the time of the inception of the Tired Light hypothesis, nobody dared to think that the linearly diminishing amplitude (*??of the photon??*) could have anything to do with anything. This possibility was already deeply buried under the bilingual labyrinth of the duality of light.

Another deep conceptual maze has been formed through the method of analyzing the spectral shift of extremely distant sources by exposures extended to great number of hours and days. This technic of accumulating and multiplying the energy of faint sources has also created the illusion that the redshift is independent from the energy of the light.

Nevertheless, the essential difference is that, while the photographic plate can chemically accumulate the apparent intensity of an unobservably faint cluster during long exposures, the process of retardation and deviation of the same light in the prism is determined by the instantaneous pressure amplitude of the compression pulses.

*How about the possible correlation of the present theory with the conclusions derived from Quantum Kinematics?*

In Chapter Sixteen, discussing Black-body radiation, Photo-electric and Compton effects, it has been assumed that the kinematical equivalent of the Planck's constant,  $h$  might express the magnitude of a limiting energy density, produced by an electromagnetic oscillator and carried by the individual compression pulses in the elastic Aether. In later discussions this assumption has evolved into the more universal concept of  $h$ , being not only the natural limit of compressed energy, but an expression for the *bulk modulus* of the all-pervading medium.

Now, after the present discussion, a distinction should be made between the two seemingly equivalent concepts of the maximum energy density of a

pulse, and that of the bulk modulus of elasticity. While the two seemed to be identical in quality and quantity in the laboratory experiments, their necessary differentiation became clear in astronomical phenomena.

Planck's constant of discontinuity,  $h$  does represent both concepts in the laboratory, because the compressed energy of a single pulse is quantitatively equivalent with both of the stress caused by the motion of the oscillator and the strain produced by that in the elastic medium.

Hence, in these cases the ratio of stress and strain, or the bulk modulus is unity. The energy carried away by the pulse equals the energy given off by the oscillator. The amplitude of the pulse is proportional to the amplitude of the oscillator. Evidently however, this equality becomes invalid at any significant distance from the source, since in propagation the amplitude of the pulse energy is depleting in linear proportion with the distance.

Thus, if  $h$  represents the universal cosmic constant of the bulk modulus of the Aether, some other sign must be assigned for the diminishing energy amplitude of an electromagnetic pulse.

It is evident from all of the above, that AETHRO-KINEMATICS has no need for the theories of the Expanding Universe, or the Big Bang hypothesis to describe the physical cause of the observational facts of Hubble's cosmic redshifts.

In the Cosmology of the all-pervading ideal gas model, Rotational Gravitation of AETHRO-KINEMATICS takes care of the threat of the gravitational collapse of the Universe, -- finite or infinite.

In the seemingly endless chain of rotating orders of magnitude, as it has been established in Kepler's harmonious formula of the sink-vortex, the single, all pervading thread of causality is that of *the universal differential rotation* of the next higher order. The centripetal force of gravitation and the centrifugal force of inertia are parallel aspects of the eternal equilibrium created by the continuous evolution of Aether toward the ever increasing complexities and condensation of Energy, Matter and Life.

In this hierarchy the question of infinity is purely metaphysical in nature and indifferent from the stand points of Epistemology and Science. Hence, in any single link of this endless chain the unified laws of physics and cosmology, they our mind is able to

conceive, are valid, and all other human endeavor can exist in complete harmony with Nature.

This unique link, our observationally limited Universe, – at least at the present level of science, – can be assumed to be independent and non-contingent on any others.

Thus, AETHRO-KINEMATIC cosmology is liberated from the metaphysical perplexities of infinite time and space and that of the initial cause.

*"Miserable mind, you get your information from  
your senses, and do you try to overthrow them ?*

*The overthrow will be your downfall."*

— Democritus: Atomism. Sixth century B.C.

## **EPILOGUE**

### THE 'UNDERSTANDING' OF NATURE

#### COMMON SENSE

The primary intention of this study was not to criticize or try to disprove the theories of Modern Physics, but to offer alternative explanations for those perplexing problems of Classical Physics, which lead to the seemingly inevitable acceptance of the modern anti-common-sense and counter-intuitive mathematical theories.

Since modern mathematical theories are based on the manufacturing of formulas and formalisms to match and predict the observational facts and experimental curves, any alternative conceptual description and explanation of an experimental fact must reproduce the same data as predicted by the presently used mathematical formulas and formalisms. Thus, the possible acceptance of any alternative conceptual theory must reproduce the results predicted by the reigning mathematical theories.

The '*alternate explanation*' is merely a phrase of extreme politeness, because for the perplexing phenomena of modern physics, humanly conceivable conceptual explanations. simply do not exist.

As much as it was possible, I have stuck to this non-argumentative approach all the way through, mainly because I believe that once common sense and classical logic were invalidated, no more tools or methods remained to challenge the validity of any bizarre hypotheses. In fact, once we turned to sculpturing mathematical formalism to fit the experimental curve and boldly and simply discarded logic and common sense then even the weirdest interpretations of the 'facts' became unchallengeable.

My firm conviction is, that only one kind of logic or reasoning or intuitive feeling of reality and causality exists; the one that we have inherited all through the billions of years of the evolution of living things.

Once a single fundamental assumption or postulate has been accepted contradictory to these naturally evolved selectors of real and unreal, – scientific reasoning has been traded for metaphysics, or – which is even worse – for mathematical dogmatism.

Nonetheless, there are grave inherent weaknesses in any kind of argumentation against these modern mathematical theories and their verbal translation into metaphysical postulates.

Both Relativity and Quantum Mechanics have silently but explicitly postulated that certain experimental facts, like the Michelson Null-result or the discontinuity of Planck's Black-body radiation, and with them a whole new world of physical phenomena, *could not be and would not ever be explained* through common sense or by the laws and logic of classical physics.

Note, that without the unconditional surrender to this assumption as a scientific fact, none of the modern postulates could even be stated or accepted.

Thus – by restricting the validity of classical physics to a certain part of reality, the macroscopic order of magnitude, – relativity and quantum theory not only slammed the door on the history of classical physics, but also froze it from any further evolution or any retroactive correction of its existing theories.

Of course, as all modern innovators agree, when it comes to the measurement of an experimental fact, physics must resort to the *classical language*. For what else can we measure but the classical quantities of mass, distance, velocity and time, etc.,...But the rest of classical physics; theories, methods, common sense, logic and causality are gone forever. We don't want them and we don't need them!

This is the real first postulate of modern physics.

Unfortunately, without a valid alternative explanation of the experimental facts based on common sense and classical logic, modern mathematical philosophers can postulate whatever they want to and be as inconsistent as they are.

The sad fact is that those incomprehensible metaphysical postulates of relativity and quantum mechanics are the only existing 'conceptual' linkages



between the experimental facts and the undeniably successful modern mathematical formalisms.

One asks innocently: How could the mathematics work if the philosophy that created it is so faulty?

Someone can state that it happened the other way around; the mathematics came first by chiseling equations to fit the experimental facts. The philosophical postulates are merely retroactive attempts to fit or unfit the old common sense concepts to the artificial, deconceptualized mathematical formalism.

But Relativist and Copenhagenist philosophers wonder what are these mysteriously unclear concepts of common sense and the understanding of nature? And what is so sacred about them? According to some, they are mere fashionable prejudices against new, revolutionary ideas.

Just a few centuries ago common sense told us that the earth was flat. Now it tells us that the Michelson result should not be Null and Planck's radiation should not be discontinuous, – Now we 'know' that the earth is round! Common sense?!

Well, – here, at the end of this sketchy description of the ideal gas model of a universal Aether medium that might help to understand Nature, – I

am offering an attempt to clarify these concepts of common-sense and understanding and what is so sacred about them for the regular, open minded, intelligent, – though mathematically seriously underdeveloped humans – who are interested in the workings of the world and in the meaning of reality.

I'm trying to make a very long story very short:

Some three and a half billion years ago in a pond, somewhere on the surface of the sizzling Earth, a kind of complicated atomic conglomerate, protein and amino acid molecules or something like that, got accidentally encapsulated by a film of clay molecules.

This accident created a temporary boundary between the *inside world* and the *outside world*, just like a soap film creates a boundary between the air molecules inside and those outside of a soap bubble.

Like accidents that have happened a few quadrillion times in millions of ponds for hundreds of millions of years and some of these bubbles accidentally hit the evolutionary jackpot, having just the right thickness of the clay film to reach a feeble equilibrium between internal and external pressure. These bubbles became the encapsulated *units of life*.

A billion or so years later this life-unit-bubble reached the complex organism of an Amoeba which achieved the miraculous method of self-locomotion by internally changing the shape of its own bubble. By adjusting the internal pressure locally, it created bumps and lumps on its 'body' in different directions. With this it managed to move relative to the external world and soon found the sensitive position and depth in the pond where shadow and light and heat gave just the optimum mixture of energy for its survival. Thus, it had to, and became able to, 'paddle' itself up and down, back and forth and sideways as its constantly changing environment dictated.

In my mind, this microscopic 'blob' of life had already recognized a wealth of information about the external world and reality.

One might oppose the usage of the concept of 'recognition' but it can hardly be denied that the Amoeba must have reacted to the facts of life that both itself and its environment were existing in three dimensional space with ups and downs and sideways. Also, it must have sensed the received mixture of heat and light as a changing effect which is somehow connected to its own locomotion. With this

it also reacted to the flow of time, that is, to the fact that events at a given place are happening in some kind of definite sequence. Thus, the Amoeba lives, acts, reacts and survives in a reality of *three dimensional space, one directional sequence of time and some definite causality* between its motion and the temperature; one is the cause, the other is the effect.

These 'recognitions' were the fundamental pre-conditions of its survival and therefore the Amoebial philosophy has never ever changed in the course of evolution but was constantly reinforced through the increasing complexity of the conglomerations and specializations of the interacting life-bubbles.

A couple of billions of years later, – few millions before us, – somewhere in the Rain-forrest, a monkey of some kind, in its daily food-collecting routine, took a leisurely jump from one tree to the other. The distance between the selected branches was thirty two and a quarter feet, the elevation difference between them was roughly eleven and half feet down. The monkey weighed 220.3 kilograms, pulling toward the ground and there was also a 44.7 km wind, blowing through the forrest in a direction  $72.55^\circ$  angle with the *anticipated* trajectory of the jump.

Well, – this particular monkey has missed that particular branch by an inch-and-an-eight and grabbed the next lower one to the left. Nevertheless, somewhere in it's awesome data bank *the whole experimental environment with initial and final conditions, the experimental result and a matching conclusion with all its immense complexity has been recorded for future references.*

“Maybe, the left big toe should have applied an extra repulsive force on the starting branch, something like 2.12 kg.m/sec at 5.052° in the North-eastward direction against the wind, maybe some of it upward, against gravity. – Hm!...Nobody is perfect.”

The reasons, why the experimental result and the conclusion were not recorded in this manner, were that this life unit had not yet learned to think with words or conceptualize its experiences, did not know vector addition and had neither a compass nor a pocket calculator on hand.

Nevertheless, in any other respects this monkey must have been aware of most everything that Newton axiomatically organized in his Three Laws of Motion some hundred millions of years later.

Evidently, the procedure of life is nearly equivalent to practicing experimental physics and accumulating conclusions constantly correcting the theories of anticipation of experimental results. All this on an instinctive level. This is the immensely deep source, origin, evolution and meaning of **common sense**.

If **instinct** is the storage of un-conceptualized physical experiments with the attached results and conclusions drawn from them, then **common sense** is the conceptualized and verbalized translation of the three billion years of evolutionary practice of life.. – Can we have any more sacred inheritance?!

Now, just a few seconds of evolution ago, Newton succeeded in simplifying, generalizing and axiomatizing the essence of the physical behavior of all animate and inanimate objects in the three dimensional immovable space and in the absolute flow of time. This wonder became possible through the evolution of the nervous system during the last fifty thousand years, between the invention of the first axe and Galileo's innovation of the first telescope.

Newton of course, possessed the whole data bank, everything that had happened and had been accu-

mulated from the Amoeba on. Plus whatever else was added to that during this latest evolution of the nervous system of the life-bubble.

Newton used all available innovations; words, concepts, language, intuition, abstraction...you name it...! He used the whole accumulated written knowledge of several civilizations about geometry, algebra and mathematics and jacked it up to his own level.

He Used measuring devices of space and time, Cartesian coordinate systems, all astronomical data. He mastered all products of the sophisticated complexity of the brain at that stage of the homo sapiens.

But above all, with his concepts of *push* and *pull* taken from the living muscle forces of locomotion, he drew a line straight through the three and a half billion years of evolution of common sense in the exact direction tangential to the progression from the amoeba to the monkey to the human philosopher:

Length, time, motion, mass, force, acceleration – measurable quantities and their mathematically expressible relations. – Obviously, classical physics and classical logic was founded on this kind of common sense, thus it is humanly comprehensible.

## UNDERSTANDING

At this point, however, we must make a distinction between the meaning of common sense and the concept of Understanding Nature. For this is the historical point where these concepts are getting muddied and confusing, creating the stronghold of modern anti-common-sense, anti-reality argumentations.

For Newton proceeded further. He introduced an abstraction based on those simplest common sense concepts of push and pull and hypothesized an attractive force between all masses in nature, similar to the force between two human pulled by an elastic rope toward each other. – He called it Universal Gravitation and showed that this hypothesis can tie together earthly and celestial mechanics of the falling apple and the revolving moon.

There is nothing in this generalized abstraction of muscle force that would oppose common sense. The jumping monkey does not have to know that not only the Earth attracts him but he attracts the Earth too. He only had to anticipate the total force and his common sense did that. Not knowing the rest of the story doesn't make his common sense wrong. It is merely the case of insufficient information.

Think now for a second about the ignorance of the 'Flat Earth' argument.

But how about the force of gravitation? For the last four centuries nobody could understand what it is and how it works. – Maybe the act of abstraction is the one that separates common sense from understanding?! But if that 'abstraction' is the cause of confusion, being something uniquely and totally different than the rest of the biological evolution, then just think about the kitten who pretends that the cotton ball that he slaps around is a lively mouse which desperately tries to escape from his claws. Or think of the monkey who recognizes that the other monkey behind the impenetrable shiny plate is repeatedly making the same movements as he does, therefore it must be a 'mirror image' of himself. – These abstractions maybe ranked equal or higher in complexity than that about the gravitational force.

Nevertheless, this is the point where common sense and understanding separate from each other. For gravitation is based on the common sense of the Amoeba, the Monkey and the Homo Sapiens, but we still cannot say that we understand what it is and how it works. Why?

Because, in all the three billion years of daily life sensory perception only recorded the basic rule of mechanistic reality that motion can only be caused by the motion of something else. Newton's *action at a distance force* that creates motion without bodily touch or some kind of transmitting medium, had no resonance in our data bank. Think about the rolling rock transferring its motion to another, or of the invisible wind that moves everything in its way; monkeys, branches, falling leaves and dust.

Although his contemporary mechanistic philosophers severely criticized him for not giving an understandable model of how his gravitational force works, it was no real problem for Newton. For he was convinced that there must be some kind of medium, maybe Huygens' Aether, that conveys this force. Still he also recognized the fact that there was *insufficient information* about this substance for speculating about its mechanics that might explain gravity.

Newton clearly and explicitly declared his conviction that 'no man who has a competent faculty for thinking can believe in the action at a distance force of gravity through vacuum without the mediation of something else.' – Although he refused to hypothe-

size and claimed that the theory of gravitation merely provides an instrument for mathematical prediction, till the end of his life, never relinquished the hope that the dynamics of the Aether or something similar *will* explain away the mystery of gravity.

This is the right place to note, that three hundred some years later Einstein was just as clear and explicit, but in the opposite direction. He declared that the problems with the measurements of the speed of light *will never be solved* by classical common sense, therefore the Aether, together with Newton's absolute space and time must be discarded.

According to Einstein, the mechanical models, – that helped classical physics to understand the abstractions into the worlds beyond sensory perception, – were merely temporary scaffolding to build the theory and must be removed, after the mathematical description was found, *for avoiding confusion*. This attack was aimed against the Faraday-Maxwell electromagnetic theory which was invented, designed and mathematically described, explicitly based on the existence of the luminiferous Aether medium.

Newton kept an open mind ! Einstein succeeded in closing everybody's mind ! – It is just this simple.

If **common sense** is the conceptualized instinct that was condensed into the brain through the whole of evolution, then **understanding** is the correlation and corroboration between those necessary **abstractions** beyond the sensory experiences and our awesome data bank of common sense.

The comprehension of abstract hypotheses about phenomena beyond the range of sensory perception is an act of dismantling the complexity of the event to its smallest separable constituent events which were already experienced and familiar within our sensory perception and thus some simple mechanical principles and concepts are applicable. Or from the other end, understanding of an abstract hypothesis is a procedure of building a conceptual bridge between abstraction and common sense. As classical physics has practiced for three centuries by building common-sensible, understandable mechanical models.

Think about the atomistic kinetic theory of gases which was based on the childish 'scaffolding' of the billiard-ball-atom and brought to us the understanding of gas pressure, temperature and entropy, etc. by the simplest possible common sensory experiences of the motion and collision of the childhood marbles.

## PREDICTIVITY

This concept and word must have been invented to represent the major, maybe even the only merit of modern mathematical physics. The necessity of this innovation will become clear when considering the product of the last few nano-seconds of evolution:

A member of the latest stage of the homo sapiens evolved within the last couple of thousand years, a mere evolutionary baby, called the mathematician, can exhibit the following procedure:

He can set up a scientific observation station on a beach where the ocean and the land meet. He can equip the station with a meter-rod, a clock, a calendar and a couple of thousand rolls of graph-paper and he can start meticulously recording the exact time of the periodic rise and fall of the sea-level relative to the shore.

Pursuing this for some years, he can set up a two dimensional Cartesian coordinate system – using rectangular lines, with the  $x$  coordinate on the horizontal line, representing time and the  $y$  coordinate on the vertical line, representing the position of the waterline. – By this method he will be able to organize the accumulated data and plotting them in the

form of a graph. Thereby he produced an *experimental curve* which represents a pictorial information about the periodic rise and fall of the water-line.

Some meticulous study of this graph brings him to the discovery that the observational curve is approximately periodical on a daily basis.

The next step brings out his real forte’.

An experimental curve represents a complex relationship between two quantities where one is the function of the other. If the position of the water on the shore is  $y$  and it is changing with time  $x$ , then  $y$  is the function of  $x$ . Thus the relation between these two quantities represented by the observational curve can be described by a mathematical equation.

The simplest example of this is the case when the water level is uniformly rising with the flow of time. Let’s say, one meter rise during one hour, thus the quantities of  $y$  and  $x$  increase evenly. In this case the plotting points will be the same distance from both rectangular axes and the connecting line-graph will be a straight  $45^\circ$  diagonal between the lines.

There are an infinite number of other possible relations between the two quantities, resulting in infinitely complex curves, but if there is any kind of

repetition in their relation, there is a good chance that it can be expressed by mathematical equations.

Aside from the obvious daily periods of rise and fall he found the first total repetition of the curve connected to the year, but on a closer analysis he discovered that the daily movement of the water level was not the same in every twenty four hours but its maximums and minimums slowly changed and repeated itself in every 28 days. There were also some changes in the curve which were somehow related to the different seasons, ...and so on...

Fortunately, these periodical changes of the changes themselves can also be plotted producing another graph with another curve which can also be expressed in a mathematical equation. In case of uniform changes we can insert a *constant* into the equation. If the changes are non-uniform, we simply add a sub-equation. Thus, it is merely a matter of mathematical ingenuity and perseverance to produce a complex equation which, when it's plotted, reproduces the original observational curve. – Once this wondrous mathematical formula is chiselled to perfection it will describe a phenomenon of Nature, the Ocean Tides, without the slightest knowledge about

the roundness or the rotation of the Earth, or the existence of the Sun, or the orbiting moon, or Newton's Universal Gravitation, or utilizing anything that the former evolution accumulated. Furthermore, it requires neither common sense nor understanding. This is the wonder of **predictivity**.

Now comes the *mathematician philosopher* who not only comprehends the sophisticated and elegant mathematical formalism but is also able to explain in the laymen's classical language, why these wondrous interpolation of curves and equations should work.

Of course, an infinite number of different stories, can be constructed to fit between the observational facts and human imagination. Let us pick only three:

One could be the mythical Monster hypothesis according to which an extraterrestrial invisible relative of the Loch-Ness monster is living in the Ocean and is breathing in and out trillions of liters of air while it is swimming through a complicated yearly route between the continents. It has a menstrual period of 28 days which heavily effects its breathing. This hypothesis has slight contradictions which however can be worked out by introducing a few family members of different sizes and various habits.



The next interpretation can be the classical one mentioned above. The story of the solar system with a Sun and an orbiting Earth which mutually pull one another and then a Moon with its 28 days period of orbits around the earth which pulls both the Sun and the Earth and all three of them pull the ocean...etc.

The most modern version, a mathematical theory is way beyond the comprehension of an average life-bubble. Nevertheless, the philosopher proponents of this explanation come to help with a humanly conceivable interpretation of the quantum mechanical formalism which aims directly to the point:

Light has a dual nature; sometimes waves, sometimes particles. Matter also has a dual nature; sometimes particles, sometimes waves. The extra intrigue of this quadruplet of wave-particles and particle-waves is that no two of these quantum entities can ever be measured at the same time. Now, this maybe a paradox but not a contradiction and easily relieved by the simple concept of complementarity which can be expressed by Schrodinger's wavefunction together with Heisenberg uncertainty principle. Nevertheless, since we do not know whether we measure a wave-particle or a particle-wave until we measure it and

they cannot be both at the same time, we must deny that they existed before the actual measurement. In fact, for this reason, we might as well deny all of reality outside of the instance of measurement. Incidentally, there is a slight problem with the measurements too, because according to predicted probability waves, two quantum entities are able to communicate with each other by superluminal signals which is an absolute no-no for both relativity and quantum mechanics. – Hm!...Nobody is perfect!

So, which one makes more sense? – What sense ?

In the very last fraction of the very last nano-second of evolution came the development of the mighty power of predictivity and the crunching monsters of super-computers. – Now, foretelling the future probabilities for a great variety of different things and their mysterious relationships – mathematicians begin to believe that it is only a matter of time when they will possess the ultimate equation, 'The Theory of Everything' predicting the next, and every next second of the whole Universe. – Then they might become the high priests of the religion of Predictivity – *foretelling everything and understanding nothing.*

This is where evolution stands right now.

## THE 'UNDERSTANDING' OF NATURE

requires the un-contradictory correlation of every bit of talent with which we are blessed by evolution: instinct, intuition, common sense, anticipation, logic, abstraction, understanding and yes, the powerful shorthand methods of mathematical predictivity.

The human mind is an evolutionary product of the sensory perception of macroscopic physical reality. The fundamental question is whether or not the world of different orders of magnitude above and below us could be understood by this mind? – The history of human philosophy and science itself is a phenomenon that shows at least an unrelinquishing faith in a positive answer to this question.

By assuming the possibility for the understanding of Nature, we also create a world of reality in all orders of magnitudes that is not dissimilar to our own macroscopic one.

It follows – as we have assumed and seemingly found – that matter is the same all through the Cosmos and our macroscopically found physics, chemistry and the conservation laws of matter and energy are valid at least within the observable Universe.

Doesn't it clearly follow from the macroscopic origin of this mind of ours, that the perplexing problems arising in the progress of this investigation must be solved within the capabilities of our understanding?!

We invented celestial mechanics to associate the orbit of the moon to the trajectory of a falling apple, tying a higher order of magnitude together with our laws of earthly mechanics. We did the same going lower in the orders, inventing billiard-ball-atoms to explain the macroscopic behavior of gases and mechanize the sensation of sound. We invented sub-atomic billiard-ball-electrons, and billiard-ball protons and neutrons forming billiard-ball nuclei. One more step down in the sub-atomic-particle order we are searching for billiard-ball gluons and quarks.

We might as well realize that we must live in a billiard ball universe to understand nature, because that is exactly the simplest and most basic mechanical format comprehensible to our mind.

That is, mass, motion and collision.

Nothing wrong with this. If we are to understand physical reality it must be made up of billiard balls of different orders of magnitude. Thus, we must find that fundamental order of magnitude from which,

based on Newton's simple laws of motion, we can design and build an all-pervading reality.

Exactly this was the original idea of the supermundane, luminiferous Aether which supports and transmits the waves of light through immense distances of space, just like sound is transmitted by the billiard-ball-atoms and molecules through the air from your mouth to my ear.

It was also believed that Aether transmits Faraday's and Maxwell's imperceptible electric and magnetic forces. Their lines and field of forces found directly analogous to the humanly already conceivable hydrodynamic phenomena of the relentless but sometimes correlated flows and circulations of the myriads of billiard-ball atoms of macroscopic fluids.

And the Aether was the one which also preserved Newton's hope that some day his macroscopic concepts of inertia and gravity will be no more mystery to our billiard-ball minds.

Through re-inventing the ideal gas model of the all-pervading Aether, AETHRO-KINEMATICS is the embryo of an emerging possibility that one day, by strenuous work and through immense growing

pains, we might succeed in unifying the natural philosophy of particle-physics, atom-physics, mechanics, electromagnetism, thermodynamics, quantum-mechanics, astronomy, cosmology...etc...under the simple common sense concepts and mathematics of the laws of Newton's mechanics.

Another day could come when, – as atoms proved to be non-ultimate, – we might find phenomena which will force us to conclude that Aethrons are still not the ultimate ones, but must have internal structure and made up from sub-Aethronal billiard balls.

Nevertheless, let us just deal with one order of magnitude at a time and see whether or not this theory of AETHRO-KINEMATICS gives us a better understanding of Nature.

Take it...or... leave it for the next generation.

## APPENDIX I.

### THE MATHEMATICS OF THE SINK-VORTEX

Kepler's third law renders a dynamic map for all rotational systems under the influence of a centripetal force which operates by the inverse square law. The law states, that

$$\frac{P^2}{R^3} = K \quad \text{or} \quad P^2 = KR^3 \quad (1)$$

*The square of the Period divided by the cube of the radius is a constant for each member of the whole rotating system.*

The period,  $P$  of the planet, that is the time required for the planet to go completely around the sun, is the circumference of its orbit,  $2\pi R$  divided by its velocity  $V$ ,

$$P = \frac{2\pi R}{V} \quad \text{or} \quad V = \frac{2\pi R}{P}$$

Combining equations (1) and (2)

$$V^2 = \frac{4\pi^2 R^2}{P^2} = \frac{4\pi^2 R^2}{KR^3} = \frac{4\pi^2}{KR} \quad \text{or} \quad V^2 \propto \frac{1}{R},$$

therefore according to Kepler's empirical formula:

$$V \propto \frac{1}{\sqrt{R}} \quad (2).$$

*The tangential velocity of any orbiting body in a gravitational system is inversely proportional to the square-root of the radius of the orbit.*

In the following we intend to prove the plausibility that the same result can be derived from the kinematics of the *Aethereal sink-vortex*.

In Chapter Seven it has been proposed that a *sink-vortex* produces a radial centripetal force, equi-

valent with Newton's gravitational force. Based on the Theory of the Evolution of Matter, introduced in Chapter Eleven, it was further proposed, that the *rate of consumption of Aether*, due to the evolution of matter, is proportional to *Newton's gravitational mass*. Thus, the identity between gravitation and the sink-vortex can be expressed by

$$F_{gravity} = G \frac{M}{R^2} \quad \text{or} \quad F_{sink} = K' \frac{Q}{R^2} \quad (3),$$

where  $G$  is the gravitational constant,  $K'$  is the sink-vortex constant and  $Q$  is the rate of consumption of mass, or the total number of Aethrons, ( $nm$ ) consumed by the sink, per unit time.

Nevertheless, Newton's theory of gravitation leaves the original cause of the tangential component of the planet's motion totally unknowable. AETHRO-KINEMATICS attempts to render a mathematical derivation of both the tangential and radial components of the forces acting in *Rotational Gravitation*.

Recall Figure 7-7 which shows (a) a circular vortex, (b) a linear sink, and (c) the combination of the two; a *sink vortex*.

It will be shown below, that the motion of a mass-

particle, placed into any point of the field of a sink-vortex (with zero velocity) will be affected by three *directional pressure differences*, i.e., fluid dynamical forces of different origin.

**1.** The *external pressure* of the isotropic medium,  $F_p$  that exerts a force all-through the evolution of a *circular vortex*, keeping the rotating fluid-particles, within a constant circular orbit. Hence, it is equivalent with Huygens' centripetal force.

**2.** The *tangential pressure, difference*,  $F_T$  of the *circulating fluid* in the direction of rotation will accelerate any mass-particle, placed in the flow with zero velocity. This force will act until the particle reaches the velocity of the orbiting fluid. Then the mass-particle will merely float and carried by the fluid and the pressure difference will cease to exist.

**3.** The *pressure of the radial flux*,  $F_R$  of the *linear sink* which is directly proportional to the rate of *consumption of the sink* and represents another radial or centripetal force which would accelerate a test-particle linearly toward the sink.

For the sake of mathematical clarity, the three components of the total force of the sink-vortex should be analyzed separately.

1. Consider first the origin and kinematics of the regular *circular vortex* of a great storm which is, theoretically (assuming a frictionless ideal gas), a permanent system in constant equilibrium under the isotropic pressure of the external medium. In a circular vortex the medium is rotating in closed rings, and each layer preserves its own matter. There is no exchange of mass between the surrounding medium and the rotating system. There is no mass or energy flux across the body of the vortex.

Two different factors should be recognized here:

a) In the theory of Aerodynamics a mass of air in rotary motion is said to be in a *permanent circulatory flow* if its velocities at various radii are of proper magnitude to induce *radial equilibrium* of the circulating mass. The requirements for this radial equilibrium consist in balancing *centrifugal forces against static pressures* as derived from Bernoulli's theorem:

$$P_S + \frac{1}{2} \rho V^2 = \text{Constant} \quad (4),$$

where  $P_S$  is the static pressure,  $\rho$  is the fluid's mass-density.

Differentiating Equ.(4)

$$dP_S + \rho V_C dV_C = 0,$$

where  $V_C$  is the circular velocity of the fluid particle. If  $V_C = 0$  then the external pressure,  $P_E$  is a constant. Therefore

$$P_E = P_S + \frac{1}{2} \rho V_C^2 \quad (5).$$

The force is equal with the pressure difference that is exerted by the medium at any two neighboring points along the radius:

$$F_P = \frac{dP_S}{dR} = - \frac{\rho V_C dV_C}{dR} \quad (6).$$

This is the force that keeps the fluid particles on the circular orbit, therefore it is equal to Huygens' centripetal force. Thus,

$$- \frac{\rho V_C dV_C}{dR} = \rho \frac{V_C^2}{R} \quad (7).$$

Cancel  $\rho$  and  $V$  on both sides of Equ.(7):

$$- \frac{dV_C}{V_C} + \frac{dR}{R} = 0 \quad (8).$$

Now, integral Equ. (8)

$$\ln V_C + \ln R = \ln V_C R = C \quad (\text{a constant}).$$

$$\text{and } V_C R = C' \quad (\text{another constant}).$$

It follows, that

$$V_C = \frac{C'}{R} \quad (9),$$

and substituting Equ.(9) into the pressure force;  $F_P = \rho V_C^2 / R$ , we have

$$F_P = \rho \frac{(C'/R)^2}{R} = \frac{\rho C'^2}{R^3} \propto \frac{1}{R^3} \quad (10).$$

This is the relation that results in the specification required by bernoulli's radial equilibrium, and also leads to the proportionality,  $V_C \propto 1/R$ ; the Newtonian formula for the velocities of the fluid particles in the circular vortex, based on which he discarded Descartes' solar-vortex theory.

b) If air is in circulation, based on Equ.(4), the velocity of the rotation at the center reaches a theoretical value of infinity. Since this is impossible, the center of the circulatory flow must be occupied by a small core which is, under the isotropic pressure of the radial winds, compressed to its limits and simply rotates as a solid object. The immediately surrounding layers are rotating with exceptionally high but not infinite velocities.

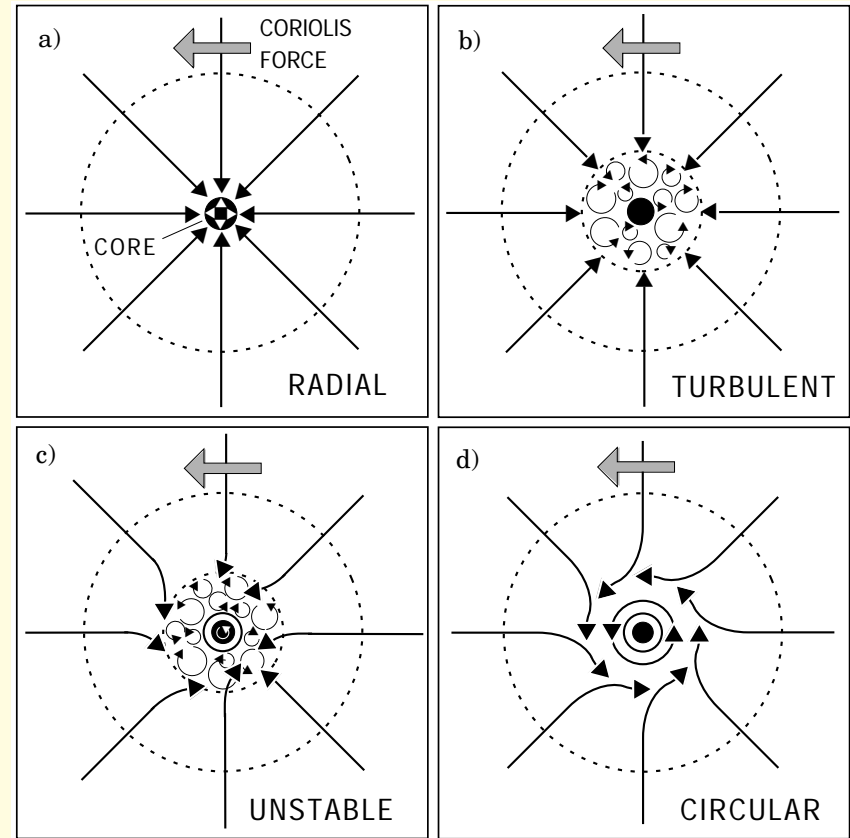


Figure AI-1

It follows, that the kinematic evolution of a circular vortex (Figure AI-1.a) starts at the center by the scattering of the linear radial streams into a tem-

porarily *turbulent* flow. This unstable state of the medium near the center (b-c), being under constant isotropic pressure, will eventually be forced to take up *the least volume of space, which can only be achieved by rotation.*

Once the rotation is established around the core, the radial streams bend around the already rotating layer (d) and under the constant isotropic pressure their linear momentum smoothly converts into the angular momentum of the circulation. This procedure repeats itself from layer to layer by kinematic friction and as the vortex grows, the rotational velocity decreases in agreement with bernoulli's formula.

The gradually changing ratio between the dynamic and static pressures establishes the radial equilibrium of the system. It follows, that both the mass and the energy density of the fluid in the rotating system, is greater than that of the average density of the external random medium. In other words, *the evolution of a circular vortex also represents a local condensation of mass and kinetic energy.*

The spatial extension of the vortex is limited by an outermost layer, representing a close to zero dynamic pressure (rotation) and a static pressure

equal to the pressure of the external medium. *At the boundary of the vortex the rotating system and the isotropic medium reaches a permanent static and dynamic equilibrium.*

Consider now, that the orbit of any fluid particle in a circular vortex is a permanent circle, therefore Huygens' law of centripetal acceleration,  $\mathbf{a} = mV_c^2/R$ , is applicable. Thus, the external pressure force,  $F_P$  that keeps each fluid particle on a constant circular orbit equals to Huygens' centripetal force:

$$F_P = \frac{mV^2}{R} \quad \text{or for a unit mass} \quad F_P = \frac{V^2}{R} .$$

2. It follows from the above, that the circulation of the fluid particles also represents a pressure difference, or a *force* in the direction of rotation. Thus, when a mass-particle, say a *donut-vortex* (CH.-9) with a greater density, is placed into the fluid at any point of the vortex field with zero velocity, it will experience an accelerating force acting tangential to the rotation. This force will be directly proportional to the square of the circular velocity of the fluid and inversely proportional to the square of the radius of the orbit. Thus, a tangential force;  $F_T \propto 1/R^2$ .



This is then the kinematic origin of the unknowable force, that is responsible for the unexplained initial tangential velocities of the planets or satellites or any secondary mass-particle revolving about a central mass in its Aetherial sink-vortex.

It should be noted, however, that the rotational pressure difference on the object ceases to exist, once the mass-particle moves with the same velocity as the fluid.

Nevertheless, considering the Aether medium, due to the higher density of the mass particle, than that of the fluid, the external pressure force, that keeps the *fluid particle* on a circular orbit is not sufficient enough to counteract the centrifugal tendencies of the *multi-unit mass-particle* that moves with the circular velocity of the fluid. Hence, in addition to the external pressure of the isotropic medium, a permanent orbit for the mass-particle requires a greater force than the one acts in the *circular vortex*.

3. This extra force is produced by a *linear sink*.

A linear sink in a fluid creates a local fluctuation in the isotropic density of the medium. From the law of propagation of local density disturbances in an elastic medium, it follows that at any point in the

plane, perpendicular to the plane of the sink, there will be a *difference in the pressure toward and away from the center*, the magnitude of which will be directly proportional to the consumption rate,  $Q/sec$  and inversely proportional to the cube of the radius from the sink;  $dP \propto 1/R^3$ .

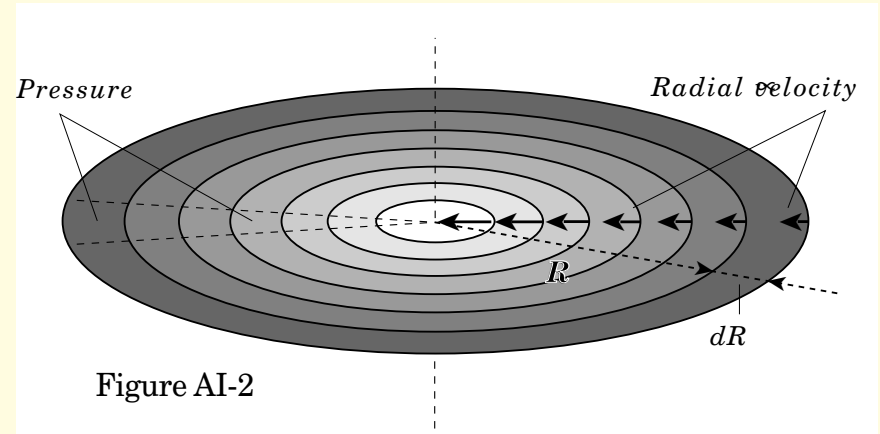


Figure AI-2

In the two dimensional diagram of Figure AI-2, the area,  $S$  of the outer most ring equals to  $S = 2\pi R \times dR$ . The mass, contained within this area will eventually be consumed by the sink.

Evidently, to reinstate the pressure and density equilibrium of the medium, there will be a radial drift,  $V_R$  of the fluid particles toward the sink.

Therefore, the total mass, or the total number of fluid particles, consumed by the sink per unit time is

$$2\pi R\rho dR = Qdt \quad (11).$$

Hence, the radial velocity of a fluid particle toward the sink is:

$$V_R = \frac{dR}{dt} = \frac{Q}{2\pi\rho R} \propto \frac{1}{R} \quad (12),$$

According to Bernoulli's Equ. (6) the radial pressure difference,  $P_R$  and therefore the radial force,  $F_R$  toward the sink, at any two neighboring point along the radius is

$$F_R = \frac{dP_S}{dR} = -\frac{\rho V_R dV_R}{dR} \quad (13).$$

Substituting  $V_R$  of Equ. (12) into above, we get

$$F_R = \frac{dP_S}{dR} = -\rho \times \frac{Q}{2\pi\rho R} \times \left(-\frac{Q}{2\pi\rho R^2}\right) \quad (14).$$

therefore the radial force of the linear sink is

$$F_R = \frac{Q^2}{4\pi^2\rho^2R^3} \quad \text{thus} \quad \propto \frac{1}{R^3} \quad (15).$$

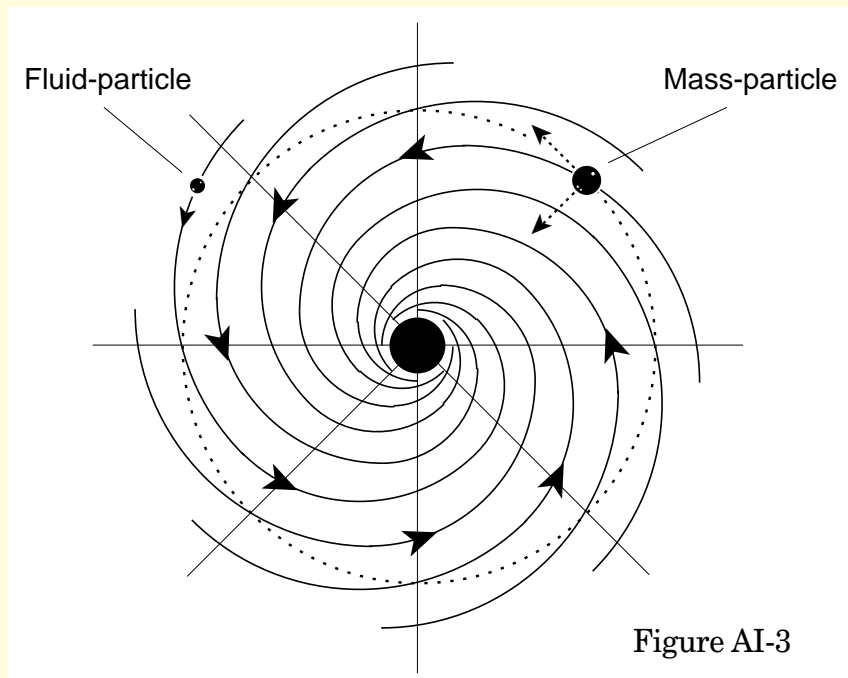
This kinematic system of the linear sink, also originates and evolves from the center outward, and bernoulli's hydraulic requirements apply. As the fluid particles start drifting toward the sink from all directions, the dynamic pressure of the streamlines increases and their static pressure decreases. Hence, this system also tends to condense the medium, but in this case along the radii. As Figure AI-2. illustrates, it leads to an inevitable conversion of the linear flow into rotation and condensation.

Consequently, the superposition of the two systems must be understood as the combined and simultaneous evolution of a sink and a vortex under the mutual influence of the two forces; the positive external pressure and the negative internal suction, the sum of which represents the *total centripetal force*:

$$F_P + F_R = F_C \quad (16).$$

Thus, when finally the two flow patterns; the rotational and radial flows are superimposed, forming a sink-vortex, all characteristics of both kinematic systems will reinforce each other. resulting in a denser and relatively faster rotating system. In other words, by bernoulli's concepts, due to the superposition, there will be a further decrease in the static

pressure, causing more condensation under the isotropic external pressure and an increase in the dynamic pressure of rotation, producing *higher circular velocities, related to the radius.*



Vector wise it can be seen on Figure AI-3 that the combination of a circular vortex and a linear sink produces special composite streamlines, called

*equiangular spirals* representing both the radial and the circular components of forces. The illustration also shows that the total forces act differently on the fluid-particles (spiral flow) and on the mass-particles (circular orbit).

With this the kinematics of the sink vortex presents a plausible conclusion, that there should be higher orbital velocities,  $V_S$  of a mass-particle, or a planet, in the spiraling stream of a sink-vortex, than that in the circular vortex. Thus,  $V_S > V_C \propto 1/R$ .

It has been found, that, the two forces,  $F_P$  and  $F_R$  are both inversely proportional to the cube of the radius, but, evidently their combined effect cannot be found by adding their proportionalities together.

Nevertheless, based on all the above, it is reasonable to assume that in the simultaneous, composite evolution of the circular vortex and the sink, during the procedure of the conversion of linear to rotational momentum, the radial equilibrium requires the two component forces to be equal. Thus, the magnitudes of the external pressure and that of the internal suction, may be assumed to have the simple relation:

$$F_P = F_R \quad (17).$$

Recalling, that the sum of the two forces, (Equ. 16) equal to Huygens' centripetal force, we can write

$$-\rho V_C \frac{dV_C}{dR} - \rho V_R \frac{dV_R}{dR} = \rho \frac{V^2}{R} \quad (18),$$

hence, based on the equality of the forces and related velocities, we can write

$$\begin{aligned} -2\rho V \frac{dV}{dR} &= \rho \frac{V^2}{R} \\ -2 \frac{dV}{dR} &= \frac{V}{R} \\ -2 \frac{dV}{V} &= \frac{dR}{R} \end{aligned}$$

Integral the above, we have

$$\begin{aligned} 2 \ln V + \ln R &= \text{Constant}_1 \\ \ln V + \frac{1}{2} \ln R &= \text{Constant}_2 \\ \ln V + \ln \sqrt{R} &= C \\ V \sqrt{R} &= C'. \end{aligned}$$

Therefore,

$$\begin{aligned} V &= C' / \sqrt{R} \quad \text{and} \\ V &\propto \frac{1}{\sqrt{R}} \quad (2), \end{aligned}$$

in accordance with Kepler's original formula.

From this result one can make a derivation backwards, as Newton did, and from Kepler's through Huygens' find, that the combination of the external pressure and the internal negative pressure of the sink, or the resulting *total* centripetal component of the force of the sink-vortex is inversely proportional to the square of the radius, as it is stated in the Law of Newton's Universal Gravitation and in the equivalent AETHRO-KINEMATIC Rotational Gravitation, expressed in Equation (3).

There is another method of derivation which leads from the sink vortex to Kepler, involving of the ratio of the mass density difference between the free Aether and its organized, condensed form in matter. This ratio can be applied to the different magnitudes of inertial tendencies of the two different states of the Aether and through that, determines the ratio

between the specific Huygens forces, that are necessary for their differing centripetal accelerations.

Another possible clue could occur from the above density ratio for a possible analysis of the kinematical origin of the elliptical shape of the orbits, as it has been hinted in Chapter Nine. Also the same ratio might render a kinematic reason for the existence of Bode's Law; i.e., the proportional distances between planets, and also for the great difference in size and mass between the inner and outer planets of the solar system. These problems, however, requires both conceptual and mathematical complexities which are beyond the scope of this study. With more sophisticated mathematics a further consideration should be possible: The interaction between two or more sink-vortices, those of the sun's and the planets'.

## SYNTROPY

In the mathematical treatment of thermodynamic processes there occurs very often a quantity, now associated with the probability of a given distribution of momentum among molecules and expressing the degree in which the energy of a system ceased to be available energy.

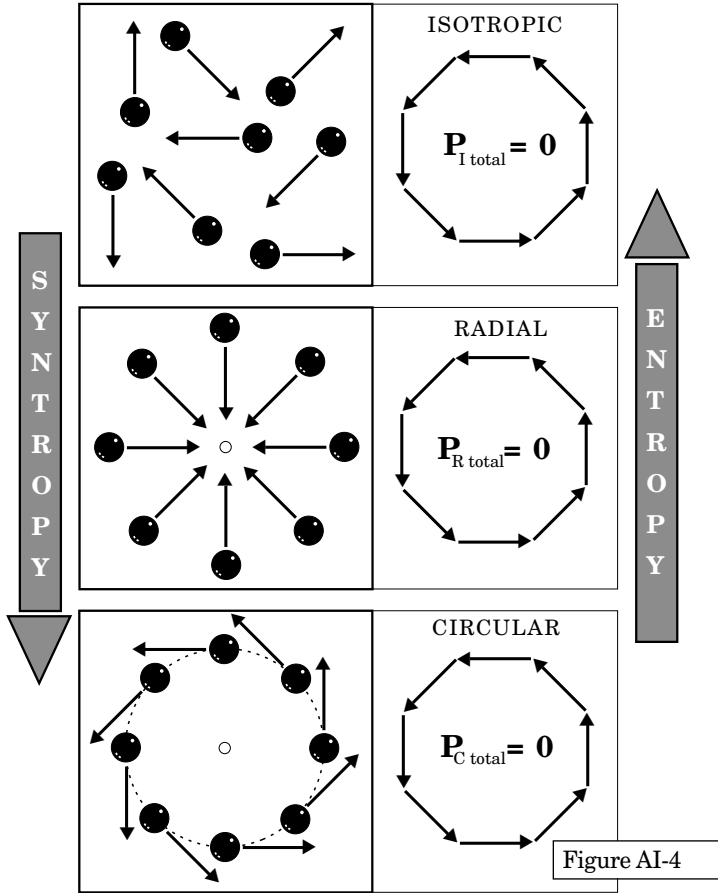
Application of the second law of thermodynamics leads to the conclusion that if any physical system is left alone to itself and allowed to distribute its energy in its own way it always does so in a manner such that this quantity, called '*entropy*' increases; while at the same time the available energy of the system diminishes. It also represent that part of the entropy of a substance, that is due to a disordered arrangement of the particles, as opposed to a similar but ordered arrangement.

This law applies to the universe as a whole, hence leads to the proposition that the entropy, the total disorganization and dissipation of the energy in the universe increases as time goes on.

'*Syntropy*', a concept, the exact opposite of entropy, is based on the existence of the Aether and the evolution of matter. The arrow of Syntropy is directed toward a dynamic organization and a condensation of kinetic energy out of the chaotic isotropy of the ideal gas of Aether.

In agreement with the law of the conservation of momentum any local fluctuation in the density of the medium produces radial drifts which by scattering converts into rotation.

The conservative conversion of momentum :  
ISOTROPIC  $\rightarrow$  RADIAL  $\rightarrow$  CIRCULAR



The resulting organized and condensed patterns of matter and its continuous evolution consumes more Aether and produces a global local density decrease and a rotational system of a higher order of magnitude. Rotational gravitation causes further condensation, increases elementary interactions and re-creates the random oscillation of Aether on a particle level. Through the resulting radiation of heat and other electromagnetic energies, matter continuously disperses its condensed kinetic energy.

*Thus, syntropy, the organization out of chaos is the primary tendency from which entropy can follow.*

As far as the universe as a whole is concerned, these tendencies exist simultaneously in opposite directions and their combined net result may not lead to a steady state universe. – There may exist an observable phenomenon of these opposite tendencies; leading to the gradual *evolution of Aether itself*; from the initial *isotropic aethron-randomness* toward a *discontinuous quantum-randomness*, due to the chaotic interference patterns of radiations from all directions at all frequencies, filling the allpervading Aether. This may be the source of the isotropic, *cosmic back-ground radiation?!*

## **APPENDIX II.**

### THE CYLINDRICAL SINK-VORTEX

Chapter Twelve proposes that the phenomena of the electron current in a *battery-circuit system* and the circular magnetic field around the current carrying conductor are both the effects of the circulation of Aether. According to this hypothesis the circulation of the Aether is produced by the chemical *decomposition* of matter at one of the poles of the battery and the chemical *composition* of more complex chemicals at the other pole and by the resulting pressure difference between sink and source, or -- as it is called presently, -- the potential difference between the two

poles or terminals of the battery. The tendency to equilibrate this pressure difference creates the circulation of the Aether through the external circuit.

In order to save time in explaining something that has been already established, consider a quote from Milne-Thompson, *Theoretical Hydrodyn.* [574]:

"19-24. Electrical Analogy. - There is an *exact correspondence* between the formulae concerning vortex motion and those concerning certain electromagnetic phenomena. In this analogy a vortex filament corresponds to an electric circuit, the strength of the vortex to the electric current, and the fluid velocity to the magnetic force. Thus the formula for induced velocity corresponds *exactly* to the formula of *Biot and Savart* for the magnetic effect of a current."

Newton refuted Descartes' vortex theory and left the tangential component of the force, that must act on the orbiting planets, unknowable. Ironically, three hundred years later the Faraday-Maxwell electromagnetic theory emphasized only the tangential component of the circular magnetic field and totally neglected the radial flux toward the conductor. Both fundamental hypotheses were based on the dynamics of the *circular vortex* and overlooked the potential

existence of the *sink-vortex*, which would be able to produce both tangential and radial components.

Due to this oversight the available hydrodynamic analogies were insufficient to physically connect the circular magnetic field to the motion of the electrons in the conductor. Instead, the theory had to accept the metaphysical and unexplainable '*action at a distance*' effects of the *charged particles in motion*.

There exists, however, the conceptually simple hydrodynamic analogy of the *water-battery* (Ch-12), with its perforated pipe-circuit which, through the kinematical concept of the cylindrical sink-vortex, may render a physically conceivable explanation for the combined phenomenon of electricity and magnetism.

Appendix I. gives a conceptual description of the kinematical origin and maintenance of the gravitational sink-vortex, the mathematical derivation of Kepler's Laws of planetary motion, and through that, Newton's inverse square law of gravitation.

Appendix II. attempts to do the same for the cylindrical sink-vortex, which forms within and around a battery and the current-carrying conductor. Nevertheless, before presenting the actual mathematical derivation, some similarities and dissimilarities bet-

ween the roles of the two different sink-vortices should be pointed out.

As for the similarities; under the constant pressure of the Aether, the kinematical origin of the two kind of vortices are conceptually and mathematically identical. In both cases the initial cause is the local density fluctuation and the consequential radial flow toward the low pressure center, which unavoidably leads to rotation. Both vortices build up layer by layer from the center outward.

The difference in this respect is that, on the one hand, gravity is a result of the very slow evolutionary composure of matter within a great amount of mass, the center of which is the center of the sink. On the other hand, the forced and fast chemical procedure in the battery produces both the composition and decomposition of matter at the two poles and thereby producing a rapid Aether circulation in the conductor. This, in turn, results in the consumption of the external Aether through a cylindrical sink-vortex around the wire. In other words, gravity is a *monopole* of potential difference, while the battery creates the circulation through a *dipole*. While gravity is represented by a constant consumption of the Aether, the electromagnetic sink-vortex



only exists around the conductor when the circuit is closed and collapses upon disconnection.

In both cases the rotating Aether exerts a tangential and a radial components of a force on a mass-particle placed in the vortex field. The force is directly proportional to the chemical potential difference between the poles. The vortex, centered on the wire, is the kinematical cause of the circular magnetic field, and the Aether circulation through the conductor-battery system is the driving force that carries the *electron current*.

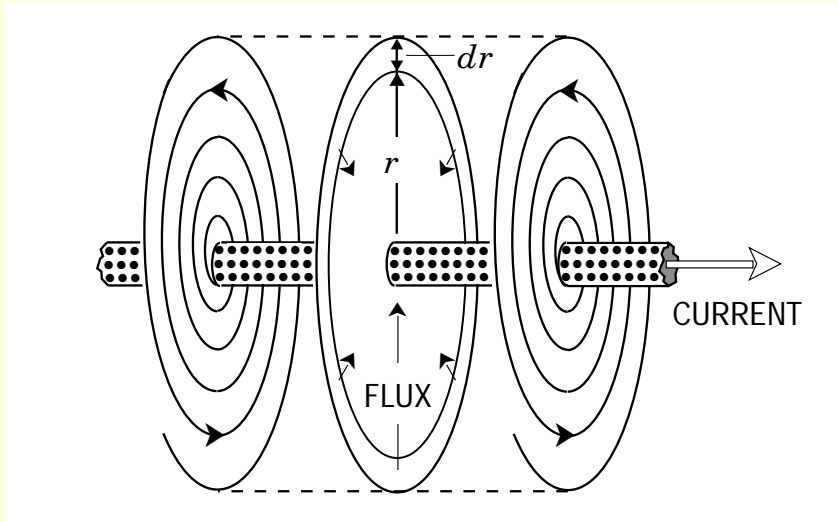


Figure AII.-1

Keeping these in mind, the mathematical derivation of some of Maxwell's Equations, like Ohm's, Biot-Savart's, Faraday's and Ampere's Law from the kinematics of the cylindrical sink-vortex can be rendered as follows:

Let us consider the kinematics of the cylindrical sink-vortex. The sink consumes a given amount of fluid at a rate of  $Q/sec$ . A layer of fluid,  $dr$ , as shown above, will be totally consumed during the time interval  $dt$ . The volume of this fluid is the area times the density,  $\rho$  of the fluid. In agreement with Bernoulli's theorem the flow of the fluid toward the sink can be expressed by the equation:

$$\rho 2\pi r dr = Q dt,$$

thus, the radial velocity of the fluid particle toward the sink is

$$V_R = \frac{dr}{dt} = \frac{Q}{2\pi\rho r} \quad (1),$$

where  $\rho$  is the average density of the Aether.

From Bernoulli's equation it follows that, the pressure difference toward the center,  $dP = -\rho V_R dV_R$  which also equals to Huygens' centripetal force

$$F = \frac{dP}{dr} = - \frac{\rho V dV}{dr}$$

substituting for  $V_R$  from Equ.(1), we have

$$F = -\rho \frac{Q}{2\pi\rho r} \times \frac{Q}{2\pi\rho} \left(-\frac{1}{r^2}\right)$$

and by simplifying

$$F = \frac{Q^2}{4\pi^2\rho r^3}$$

From Huygens' law, it also follows, that the circular velocity,  $V_C$  required for this centripetal force is

$$\frac{V_C^2}{r} = \frac{Q^2}{4\pi^2\rho r^3}$$

therefore

$$V_C = \frac{Q}{\sqrt{\rho} 2\pi r} \quad (2).$$

Let's consider now the layer of the circular sink-vortex again.

The *circular momentum density* is

$$\mathbf{P}_o = \rho \times V_C = \rho r \omega,$$

where  $\rho$  is the density of the fluid and  $\omega$  is the angular velocity. The total circular momentum of the layer is

$$\int \mathbf{P}_o dl = \int \rho r \omega dl = r \omega \int \rho dl = V_C \times 2\pi\rho r.$$

Substituting  $V$  from (2):

$$\int \mathbf{P}_o dl = \frac{Q}{\sqrt{\rho} 2\pi r} \times 2\pi\rho r = Q \sqrt{\rho} \quad (3).$$

For the sake of conceptual clarity of the further mathematical derivation, the magnetic flux around the current-carrying conductor can be compared to the hydrodynamic behavior of the vortex flow of water when it forms a whirl-pool as it discharges through a hole in the bottom of a shallow tank. See Figure AII-2.

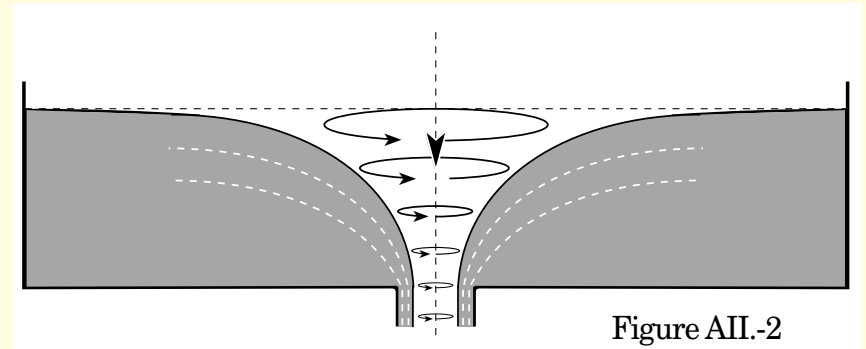


Figure AII.-2

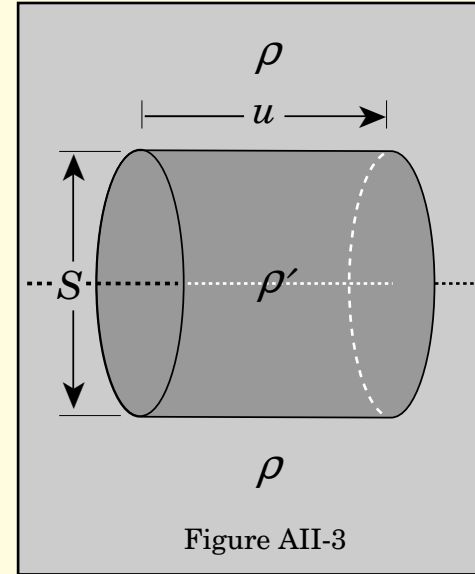
Unlike the forced vortex which is caused by the transfer of mechanical energy to the fluid from an external force (rotating bucket), in the case of an irrotational vortex, no outside energy is imparted to the fluid and it rotates from some internal action. Since no torque is applied to the flow, the total static and dynamic pressure energy should be constant. To analyze this type of flow the principle of angular momentum may be used.

"In the case of an irrotational vortex, no outside energy is imparted to the fluid and it rotates from some internal action. Since no torque is applied to the flow, the total static and dynamic pressure energy should be a constant. To analyze this type of flow, the principle of angular momentum may be used.

"The fact that the water surface itself lowers as it nears the hole shows the increase of circular velocity toward the centre. As the surface approaches the centre, its elevation will fall rapidly and a funnel-shaped core will be formed, drawing air at the centre. This may also be verified from Bernoulli's equation." (M.Mahonar,P.Krishnamachar, Fluid Mechanics,1982. [127]).

We have assumed, that there is a circulation of the Aether inside the conductor and through the bat-

tery. Consider a section of the wire and for deriving the circulation, use the following symbols :



- $\Delta P$ , pressure difference
- $j$ , Aether flow intensity inside the conductor
- $\rho$ , average density of the Aether in space
- $\rho'$ , density of Aether inside the conductor
- $u$ , circulation velocity
- $S$ , cross area of wire
- $L$ , the length of the whole conductor
- $I$ , the intensity of the electric current

Then the following equation can be written :

$$j = \rho u \times S \quad (4),$$

Thus, the drift velocity has a direct proportionality relation with the pressure difference per unit length. Let  $k$  be the constant of proportionality. Then

$$u = k \frac{\Delta P}{L}$$

Substituting  $u$  into (1), we have

$$j = \rho u \times S = \rho k \frac{\Delta P}{L} \times S$$

$$= \frac{\Delta P}{L / \rho k \times S}$$

Since the pressure difference is equivalent to the electric potential difference (Volt),  $V$ , then

$$j = \frac{V}{L / \rho k S} \quad (5).$$

Compare (2) with *Ohm's Law*; where the electric current,  $I$  inside the conductor directly proportional to the potential difference,  $V$  and inversely proportional to the resistance,  $R$ :

$$I = \frac{V}{R} \quad \text{where} \quad R = \gamma \frac{L}{S},$$

and  $\gamma$  is a constant; the rate of the resistance of the metal.

It follows, that

$$I = \frac{V}{\gamma L / S} \quad (6).$$

Comparing Equ. (5) with Ohm's Law, Equ, (6) shows that

$$j \propto I \quad \text{and} \quad \gamma \propto \frac{1}{\rho k}$$

where the constant,  $k$  represents the Aether circulation velocity under a unit pressure difference. Expressing the electric current intensity,  $I$  in terms of the drift velocity,  $u'$  of the free electrons in the conductor, we can write

$$I = enu'S,$$

$e$  is the electron charge,  $n$  is the number density,  $u'$  is the drift velocity of the electrons.  $S$  is the cross-section area of the wire.

Since  $j \propto I$ , it can be seen that the drift velocity of the electron current is directly proportional to the Aether flow intensity (circulation velocity) and the rate of resistance,  $\gamma$  is inversely proportional to the density of the Aether,  $\rho'$  in the conductor.

From the kinematics of the cylindrical sink vortex it is evident, that the flow intensity of the Aether in the conductor is directly proportional to the rate of consumption, therefore

$$j \propto Q \quad \text{or} \quad Q = k'j.$$

Substitute this result into Equ. (3). then we have

$$\int \mathbf{P}_o dl = Q \sqrt{\rho} = k' j \sqrt{\rho}.$$

We already know that  $I$  is proportional to  $j$ , therefore they can be made equal by a new constant as;  $I = k'' j$ . Thus,

$$\int \mathbf{P}_o dl = \frac{k'}{k''} \sqrt{\rho I} \quad (7).$$

By comparing with *Ampere's Law*,

$$\int \mathbf{B} dl = \mu_o I \quad (8)$$

it can be seen, that Equ. (7) is identical to Equ. (8), therefore the circular momentum density of the Aether in the sink-vortex is equivalent to the magnetic flux, described by Ampere :

$$\mathbf{P}_o \propto \mathbf{B}.$$

Thus, the hypothesis of Aether circulation in the battery-conductor-system renders a consistent kinematical theory, giving a conceptual foundation for the mathematical derivation of Ampere's law in agreement with the related Maxwell's equation.

Another law of the electromagnetic theory that is included in Maxwell's fundamental equations is Gauss' Law of the electric field intensity:

$$\int \mathbf{E} \cdot d\mathbf{S} = \frac{q}{\epsilon_o} \quad (9),$$

where  $\mathbf{E}$  is the electric field intensity,  $\mathbf{S}$  is the area,  $q$  is the charge and  $\epsilon_o$  is the *permittivity constant*.

Gauss' law is a different form of Coulomb's law of the electric fields around charged particles and applicable to any closed surfaces. The most general case of Gauss' law its application to the closed surface; a sphere around a negative or a positive charge.

Both laws, borrowed from fluid-dynamics, are using the concept of *flux*, as the property of a vector field, or as a uniform flow of a fluid with constant velocity,  $\mathbf{v}$  through a given point or area.

When the flux is originated by a *source*  $\mathbf{v}$  is radially outward, while if it is produced by a *sink*,  $\mathbf{v}$  is radially inward. The electromagnetic parallel to this is a positive or a negative charge respectively.

Thus, when Gauss' law is applied to the closed surface of a sphere around a negative charge, it is taken as equivalent with a sink in an isotropic fluid,

producing a radially inward uniform flow, or flux, with a constant, uniform velocity,  $v$ .

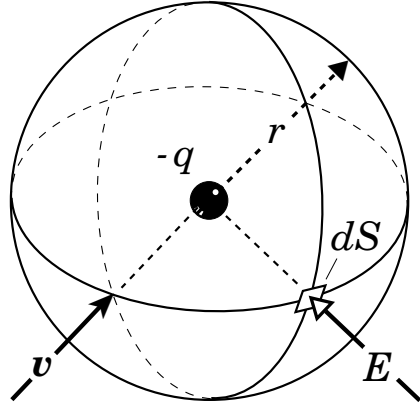


Figure AII-4

As Figure AII-4 illustrates,  $q$  is a negative charge,  $E$  is the electric flux flows through the unit area  $S$ , and  $r$  is the radius of the sphere.

Since the area of the sphere,  $dS$  equals  $4\pi r^2$ , an equation can be written;

$$\epsilon_0 E (4\pi r^2) = q$$

or

$$E = \frac{1}{4\pi\epsilon_0} \times \frac{q}{r^2} \quad (10),$$

Now, we have seen that the rate of suction of a sink is expressed by the equation:

$$2\pi r^2 \rho dr = Q dt,$$

consequently

$$v = \frac{Q}{2\pi\rho r^2},$$

According to the fluid-dynamic analogy the flow vector,  $v$  is proportional to the electric flux intensity,  $E$ , therefore we can express the latter as the radial momentum density of the fluid :

$$E = \rho v = P$$

and

$$\int E dS = \rho v \times 4\pi r^2 = \frac{Q}{2\pi r^2} \times 4\pi r^2 = 2Q$$

which is a constant and equivalent with  $q/\epsilon_0$ .

Compare this result with Gauss' law, Equ.(9). It can be seen, that the two equations are equivalent. Hence, Maxwell's first equation can also be derived from purely kinematical concepts. This derivation proves that the electric field intensity is physically equivalent with the momentum density of the radial component of the Aether flow toward a sink.

In general Maxwell's electromagnetic theory and its mathematical expression condensed into his four fundamental equations are accepted by both classical and modern physics as a coherent and logically con-

sistent description of all known electric and magnetic phenomena. Nevertheless, there is an accepted exemption to this; a group of phenomena, called by Maxwell, the *displacement current*, which requires a specific assumption which seems to be in direct contradiction with one of the fundamental principles of the electromagnetic theory.

As Van Nostrand's Scientific Encyclopedia [465] describes:

"Consider a capacitor hidden in a 'black box' with two terminals. Charging or discharging the capacitor requires a charge flow, or current, in the external connections. Viewed externally, let a current of positive charges flow into one terminal; the equal current of negative charges into the second terminal appears to be a positive current out of the second terminal. It is logically awkward to think of a current into one terminal and out of the other, that doesn't go through the box. Hence, to maintain continuity of current, a '*displacement*' current is postulated; in the capacitor, equal to the '*conduction*' current in the external connections.

"This concept of displacement current was invented by Maxwell to simplify the mathematical equations

of electromagnetism; it led to the prediction of electromagnetic waves.

"The displacement current is more than a convenient fiction, as is indicated by the fact that the Biot-Savart law (of induced magnetic field) hold when the circuit surrounds a displacement current as well as when it surrounds a conduction current.

"Part of the displacement current can be accounted for as the movement of bound charges within the dielectric, i.e., the creation or reorientation of dipoles. The balance, which is exhibited even in vacuum, may be better understood as quantum electrodynamics is further developed."

There is a well definable contradiction between this idea of 'action at a distance' and one of the most fundamental assumptions of the theory, that the *magnetic field is induced by the motion of charged particles*. This hypothesis originated from the empirical fact that the motion of the free electrons in a conductor always produce a circular magnetic field around the wire. Based on this connection between the electron current and the magnetic field, the idea has been generalized as a *causal relation* between the motion of the individual electron and the circular

magnetic field perpendicular to its motion. This indeed works in the case of the conduction currents, but cannot be applied to the situation within the "black box", where no charges are in motion.

Chapter Fifteen suggested an alternative description of the electromagnetic capacitor and an AETHRO-KINEMATIC theory for the origin of electromagnetic waves, but did not emphasize the role of the cylindrical-sink-vortex in the explanation of the ambiguous concept of the displacement current.

Nevertheless, the above mathematical derivations, based on the specific circulation of the Aether in the differing electromagnetic systems, render an unambiguous kinematical explanation for all the various phenomena, including that of the displacement current. It shows the identical origin of the conduction currents, the displacement currents, and the induced magnetic fields around the conductor as the combined electric and magnetic effects of the circulating Aether in the cylindrical-sink-vortex, which, of course, also exists in vacuum.

Thus, through the mathematical derivation of the AETHRO-KINEMATIC theory of the correlative phenomena of electricity and magnetism there is no

need for the ambiguous hypothesis of an 'action at a distance' displacement current.

Consequently, through some more sophisticated mathematics, – which is beyond the scope of this study, – it may be shown that in the kinematical interpretation of Maxwell's Fourth equation; the law of Ampere does not require its ambiguous extension by the term of the displacement current:

$$I_d = \epsilon_o d\Phi_E / dt \dots$$



## APPENDIX III.

### DISCONTINUITY OUT OF CONTINUITY

In Chapter Sixteen under the heading of the Ultimate Universal Constant, it has been proposed that electromagnetic radiation is equivalent to a train of compression pulses created and propagated in the ideal gas of Aether. Relative to the average isotropic energy density of the medium, each individual pulse represents a certain amount of excess momentum density in the direction of propagation which is a constant for all frequencies and equivalent with Planck's quantum of action,  $h$ .

This *constant excess momentum density*, carried by a radiation pulse, originates from the characteristic compressibility of the Aether medium and its fundamental value is the *minimum sensible and measurable* change in momentum density, or *directional*

*action*, superimposed on the isotropic energy density of the free Aether. Thus, the origin of the quantum,  $h$ , and the problem of *continuity and discontinuity* is a problem of Fluid Kinematics.

Appendix III. is an attempt to prove this hypothesis in greater details both conceptually and mathematically.

Because of the immense diversity of Natural phenomena, experimental physics must work with isolated systems and derive the rules and laws of Nature by simplification and generalization. In classical Aero-dynamics one of such general simplifications is that in the analysis of the fluid resistance against the motion of a solid body, the fluid can be taken as incompressible. According to this simplification the fluid density and the resulting resistance force against the motion of a body can be taken as a *constant*. The small density changes of the fluid, that actually occur in front of the body are quickly dissipated with the speed of sound and therefore they are negligible. It follows, however, that the simplifying assumption of incompressibility can only be allowed in cases where the relative velocity is much lower than that of the speed of sound.

For example, the air resistance against the subsonic motions of airplanes can be calculated by Newton's law of hydrodynamic resistance, based on the assumption of incompressibility. However, close to sonic or supersonic velocities produce resistance to a much larger degree due to the change in the density of the fluid in front of the airplane. In these extreme cases the theory of *compressible flows*, i.e., the theories of shock-waves, must be applied to calculate the resistance, using the ratio of the velocity of the body to the velocity of sound, and the theoretical formula is called the *Mach-number*.

It has been established in Chapter Thirteen, that there is a straight forward analogy between the aerodynamic Mach-number and the AETHRO-KINEMATIC Lorentz Formula, both based on the ratio of the velocity of the propagation of disturbances and that of the motion of a solid body relative to the medium. The increase in the resistance depends on the ratio between the speed of the body and the speed of sound in air, and the speed of light in the all-pervading Aether. When the relative velocity of the body approaches the propagation velocity of disturbances, it produces great changes in the density of

the media in front of the body and the retarding forces become extreme in both cases.

As a general result of this simplification, classical physics separates the analysis of fluid resistance into two groups; subsonic and supersonic phenomena and applies two different conceptual and mathematical theories to explain and calculate them. In fact, it is customary to state that the division between the two methods is at the 0.3 value of the Mach-number. Under that, air can be taken as incompressible, over that, compressibility must be considered and the theories of shock-waves to be applied.

In the Aetherless electromagnetic theory of modern physics this simplification, or the problem itself are not even recognized. The familiar conception of resistance has been unfamiliarized by the relativistic innovation of *mass-increase*. In special relativity's empty space resistance has been described by the two equally mysterious and totally contradictory theories; Newton's constant inertial mass, and Einstein's variable mass-increase. Nevertheless, with regards to the extreme resistance against motion approaching the speed of light, something similar to the 0.3 Mach-ratio was established, stating that at

velocities under one third of the speed of light, the relativistic mass-increase is unmeasurable and at that level the relativistic mass corresponds with the classical inertial mass.

This ambiguous division of the two part of one phenomenon created a confusion even about the normal resistance against the slow moving objects, since theoretically the factually existing effects of compressibility of fluids were to be neglected.

In the following this misconception will be eliminated and an alternative description of the phenomenon will be attempted;

The theoretical separation and the empirical facts are described by the following quote from Van Nostrand's Scientific Encyclopedia [48] and by the schematic illustration of Figure AIII.-1.

"The flow pattern in a perfect incompressible fluid is instantaneously influenced at all points by pressure changes occurring at any point in the flow field. A consideration of the theory of elasticity as applied to fluids, however, indicates, that the effects of small pressure changes in a real fluid are transmitted throughout the fluid *in the form of waves* which travel at the speed of sound."

From all above, it seems that this phenomenon cannot be explained by either of the existing simplified theories, since the slow speed of motion would call for the incompressible flow theory, but the resulting compression pulse clearly shows the compressibility of the fluid.

Thus, seemingly there is no explanation for the empirical fact that the uniform, continuous motion of a body produces *periodical compression pulses* in an isotropic medium, which propagate away from the body with the characteristic dissipation speed of that medium. Nevertheless, there exists a mathematical theory discovered by Riemann and elaborated by Rankine and Hugoniot in the 1860-s, dealing with the '*Origin of discontinuity in an Ideal Fluid*' which has been initially formulated to describe the basic properties of *shock waves*, but the final mathematical conclusion shows that the theory is equally applicable to the origin of regular waves.

"Under certain conditions the nonlinear effects result in the appearance of surfaces at which the flow variables, such as, the velocity, density, pressure etc., become discontinuous, even if the initial disturbance of the medium was sufficiently smooth.

"The statistical inequilibrium takes on a particular, sharply expressed character near these discontinuity surfaces and determines the complex structure of shock waves." X.Y.'s 'Experimental Study of Shock-wave Structure' [3].

Describing the fluid-dynamical formation of a one-dimensional shock-wave generated by accelerating a piston in small increments from zero velocity to some final constant velocity, an article from Lerner-Trigg, Encyclopedia of Physics [1121] states :

"The first infinitesimal compression of the piston face results in the propagation of a sound wave. However, subsequent compressions at the piston face take place with the material (medium) at higher densities and result in higher local sound speeds. This produces a train of waves in which the first is at the speed of sound in the undisturbed material and the last, closest to the piston face, is supersonic. *Because the last wave can catch but not pass the first, all waves eventually coalesce into a single steep wave-front across which exists a sharp discontinuity in pressure, density and temperature.* The width of the discontinuity is generally a few molecular mean-free-path lengths."

From all above it may be conjectured, that the characteristic compressibility of a fluid and the resulting density changes even in cases of slowly and uniformly moving bodies cannot be simplified away without losing the values of these minute effects in explaining some very fundamental phenomena.

Let us repeat the question again; what can be the kinematical reason for the empirical fact, that the effects of small density increases or pressure changes in a fluid, caused by a uniformly moving body are transmitted throughout the fluid in the form of waves or periodical compression pulses instead of a kind of continuous dissipation ?

As Figure AIII.-1 below schematically illustrates, an empirical fact. A blunt object, like a ball, moving slowly and uniformly in an isotropic fluid, due to the elasticity of the medium, produces periodical compression pulses which are propagated away from the object with the speed of sound. *Why?*

For the sake of simpler mathematical analysis we should concentrate only on a small section of the picture; a one-dimensional planar portion of the moving body and the medium. Thus, we might as well consider a piston moving in an air-filled tube with a uni-

form velocity,  $V$  from left to right and the small density changes, produced in front of the piston are propagated away with the speed of sound,  $U$ , which is greater than  $V$ .

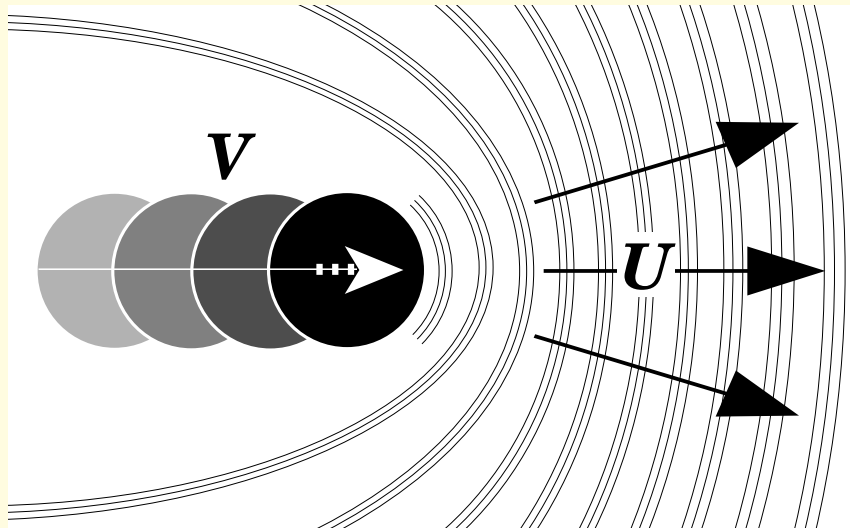


Figure AIII.-1

Let us assume that the piston moves from  $A$  to  $B$  in the time interval  $t$ . Thus the distance  $AB$  that the piston moved in time  $t$  equals  $AB = Vt$ . During the same period of time the initial disturbance, or compression, propagates in the air with the *finite velocity*  $U$ . Therefore, the *disturbance front* will be at  $C$  and

the distance travelled by the compression will be equal to  $AC = Ut$ .

As Figure AIII-2. illustrates, it follows that there will be a layer of air between  $B$  and  $C$  within which the density will be higher than the average isotropic density of the medium.

Thus, the distance in which the density of air is effected is :

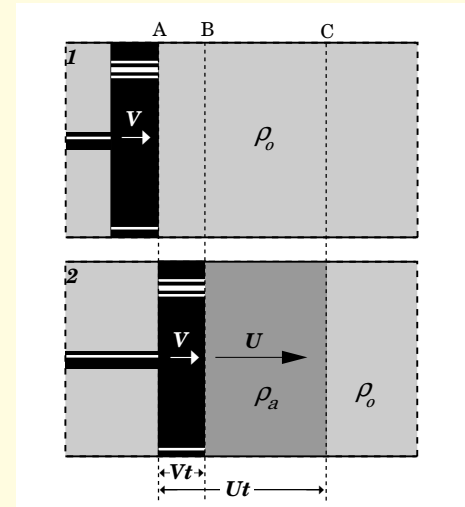


Figure AIII.-2

$$\begin{aligned} BC &= Ut - Vt \\ &= (U - V)t. \end{aligned}$$

Suppose now that the original air density is  $\rho_o$  then the total mass of the air between  $A$  and  $C$  is  $\rho_o \times Ut$ . But because of the motion of the piston this total mass of air is now compressed within  $BC$  and therefore its new density,  $\rho_a$  is:

$$\rho_o \times Ut = \rho_a \times BC$$

$$= \rho_a \times (U - V)t.$$

or

$$\rho_a = \frac{\rho_o Ut}{(U - V)t}$$

$$= \frac{\rho_o U}{U - V}$$

or

$$\rho_a = \frac{\rho_o}{1 - V/U} \quad (1)$$

Note, that since both velocities are constant, the density increase does not depend on time.

In order to find out the density distribution between the piston and the front of disturbances (BC), let us examine two consecutive disturbance, created by an infinitely small further motion of the piston. Let us call the first disturbance  $a$ , where the average density between the piston and the disturbance front is

$$\rho_a = \frac{\rho_o}{1 - V/U_a}$$

where  $\rho_a$  represents the first infinitesimal density

change in the medium propagated with the velocity of sound,  $U_a$ .

It is evident from above that  $\rho_a > \rho_o$ .

Considering the next infinitesimal move of the piston, it can be seen that it is already moving in a denser layer,  $A$  and creates a further compression in the layer,  $B$ . Therefore,

$$\rho_b = \frac{\rho_a}{1 - V/U_b}.$$

Substituting  $\rho_a$  into above from Equ.(2), we have

$$\rho_b = \frac{\rho_o}{(1 - V/U_a) \times (1 - V/U_b)}.$$

Since  $(1 - V/U_b) < 1$ , it follows that  $\rho_b > \rho_a > \rho_o$ .

Thus, the distribution of the density-increase in front of the piston is such, that the density of the medium is the greatest closest to the piston. Since the propagation velocity is proportional to the density of the medium, it also follows that from layer  $B$  on, the propagation velocity is supersonic;  $U_b > U_a$ .

As it is illustrated on [Figure AIII-3](#) each subsequent infinitesimal movement of the piston will pro-

duce a similar disturbance and because of the same reasoning, as above, the result will be that  $\rho_d > \rho_c > \rho_b > \rho_a > \rho_o$  and  $U_d > U_c > U_b > U_a$ .

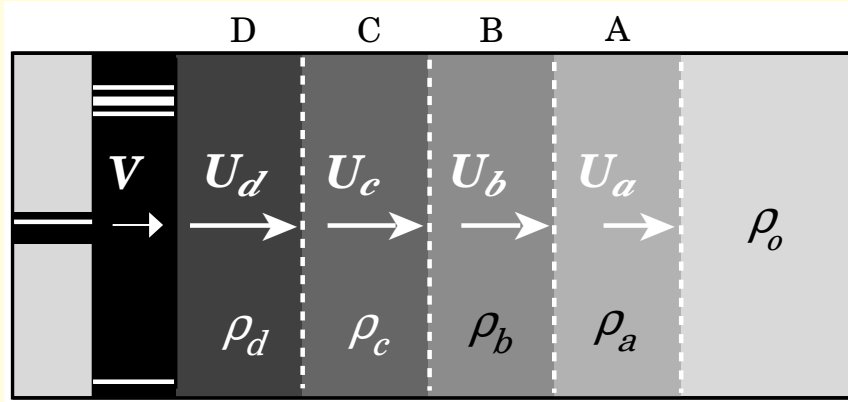


Figure AIII-3.

Hence, there exists a progressive increase of density in front of the piston which gradually dissipates towards the front of the initial disturbance. Figure AIII-4 illustrates a graph, drawn on the density,  $\rho$  as the abscissa and the distance,  $x$  from the piston as the ordinate values.

Since the propagation velocity is a function of the density, the same curve represents both the increases of  $\rho$  and  $U$ .

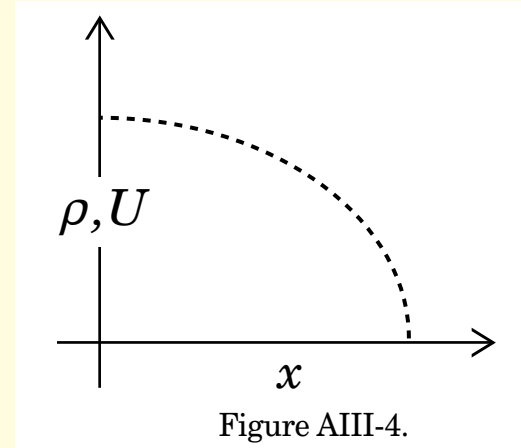


Figure AIII-4.

From the equation of motion of an ideal fluid and the related equation of continuity the following conclusion can be reached.

We know that the first infinitesimal compression at the face of the piston

is propagated away with the speed of sound.

However, subsequent compressions happens in fluids of gradually higher densities and consequently these compressions are propagated with higher and higher supersonic velocities.

Evidently, each infinitesimal subsequent compression layer propagated faster than the one in the front of it, thus it catches up with it but for the same reason loses its excess density and speed and therefore can never pass it.

Thus, the two combined layers now catch up with the next in front, and so on and on...

Analyzing compression pulses it is convenient and customary to choose a reference frame in which the pulse itself remain stationary while the fluid move through it with the speed of propagation. The two different methods are totally equivalent.

In our case, where the piston moves against the stationary medium. it is more purposeful to choose a reference frame in which the piston and observer are stationary and the fluid moves toward the piston with a given velocity.

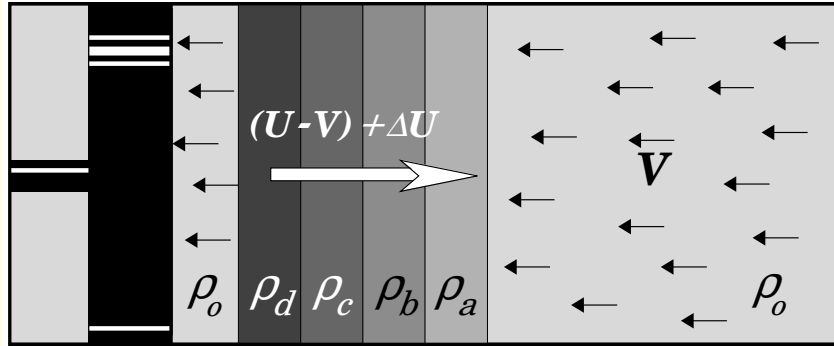


Figure AIII-5.

On Figure AIII-5. as the fluid moves to the left with uniform velocity,  $V$ , there will be a density increase in the fluid when it reflects at the wall of

the piston. This disturbance will be propagated away against the flow of the fluid with the characteristic propagation speed of the medium,  $U$ . From other experiments, the observer knows the value of  $U$ , and he is also capable of measuring the flow of the fluid toward the piston. Thus, he expects to measure the speed of the compression pulse, as it propagates away from the piston and against the flow of the fluid as  $U_a = U - V$ .

From the facts that both velocities are uniform and finite, – as it has been shown on [Figure AIII-2.](#) – there will be a constant accumulation of excess density in front of the piston. However, [Figure AIII-3.](#) has also shown, that the propagation velocity increases in proportion with the increase of the density of the fluid.

Let us call the infinitesimal increase in the propagation velocity in each consecutive density layer,  $\Delta U$ . Since the density is continuously increasing, within a certain time interval  $\Delta U$  will reach the magnitude of  $V$ . At this instant, the observer will find

$$U_a = U - V + \Delta U = U,$$

therefore *in his reference frame* the flow of the fluid



will gradually slow down and finally seem to stop, relative to the propagation of the of disturbances. Since the piston is in the same frame of reference, – for an infinitesimal time interval, – there will be no accumulation of density in front of it, and all excess density propagates away from it by  $U$ . In other words, the last infinitesimal layer finally acquired a density and a propagation velocity high enough to separate it from the piston wall, taking all the accumulated excess density with it.

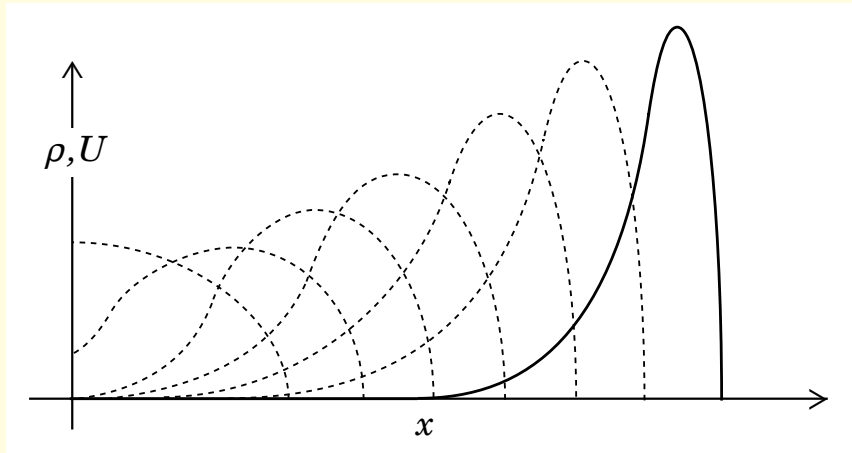


Figure AIII-6.

The final result is, that, due to the increasing propagation speeds of the consecutive layers, the

total compression caused by the motion of the piston will coalesce into a narrow pulse within a certain period of time and at some distance in front of the piston. See the approximation of the schematic curves of this evolution on Figure AIII-6.

It follows from the above argument that at the time of separation, due to the forward transmission of the highest density by  $U$ , for an instant the layer behind becomes normal density and the whole procedure starts all over again. The piston starts collecting new compressions which, by the same evolution, eventually becomes another pulse.

This is then the kinematic birth of the discontinuous excess momentum density that propagates through space, superimposed on the average isotropic energy density of the medium. It exists in air as the periodical pulses of sound, we hear as a tennis ball whizzes by, and it exists in the Aether, as the limiting measurable action; a constant quanta of excess momentum density, carried by an electromagnetic compression pulses of light.

As it will be shown later these periodical pulses, created by the uniform motion of a particle in the Aether, is equivalent with DeBroglie's pilot waves.

## THE BULK MODULUS OF THE AETHER

There are further consequences of the above hypothesis. Once the density increases were all coalesced into a single compression zone and propagated in the medium as a unit excess energy density, or a pulse, Newton's laws can be applied to the mechanics of the phenomenon.

In this case it is customary to choose a frame of reference in which the compression zone remain stationary and the medium flows through it with the normal speed of propagation of disturbances,  $U$ .

Figure AIII-7. illustrates this view where the vertical lines represent a division of the fluid to equal 'slices'. each of which contains the same mass. It also marks the distance each element moves in the undisturbed medium with the velocity,  $U$ .

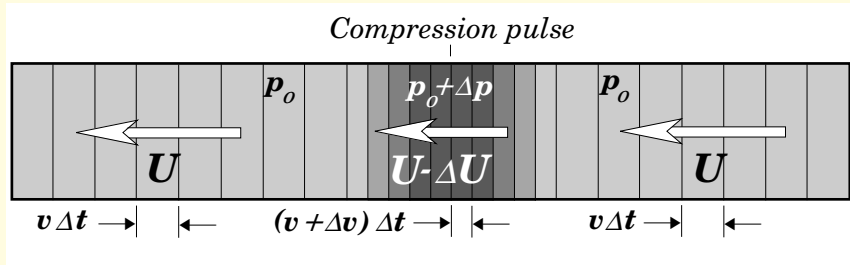


Figure AIII-7

A fluid element as it enters into the compression zone will encounter a difference of pressure,  $\Delta p$  between its leading and trailing edges. So it will be decelerated to a lower speed,  $U - \Delta U$  as it enters and accelerated back to  $U$ , as it leaves the compressed zone. The resultant force acting on the element at the entry points, directed to the right has the magnitude

$$F = (p + \Delta p)A - pA = \Delta pA$$

in which  $A$  is the cross-sectional area of a rectangular tube.

The length of the element outside of the compression zone is,  $U \Delta t$ , where  $\Delta t$ , is the time required for the element to move past any given point. The volume of the element is thus  $VA \Delta t$  and its mass is  $\rho_0 UA \Delta t$ , where  $\rho_0$  is the average density of the fluid. The deceleration,  $\mathbf{a}$  experienced by the element, as it enters the zone, is  $-\Delta U / U \Delta t$ . Thus, Newton's second law,  $F = m\mathbf{a}$  yields that the force

$$\Delta pA = (\rho_0 UA \Delta t) \frac{-\Delta U}{\Delta t}$$

which may be written as

$$\rho_0 U^2 = \frac{-\Delta p}{\Delta v / v}$$

Thus, the fluid that would initially occupy a volume  $V = AU\Delta t$ , now is compressed by an amount  $A(\Delta U)\Delta t = \Delta V$ . Hence,

$$\frac{\Delta V}{V} = \frac{A \Delta U \Delta t}{AU \Delta t} = \frac{\Delta U}{U}$$

and we obtain

$$\rho_0 U^2 = \frac{-\Delta p}{\Delta V/V}$$

This ratio of the change in pressure on a body, to the fractional change in volume is called *the bulk modulus of elasticity*,  $B$ . That is

$$B = -V \Delta p / \Delta V = \rho_0 U^2$$

Returning to the original analogy with the uniform motion of a particle in the medium (Figure AIII-1.) it can be seen that the particle, just like the piston, must move through a given distance in order to compress a certain volume of the medium enough to cause a separation. Let us call this distance,  $s$ . If the particle moves with velocity  $v$ , then the time interval,  $t$  between the formation of two pulses will be:

$$t = \frac{s}{v} .$$

Since  $s$  depends on the the average density of the medium, which is a constant,  $s$  itself is also a constant. Since  $t$  is the period of the cycle, it follows, that an increase in the velocity of the particle will decrease the cycle and the pulses will be produced at a higher frequency,  $\nu = 1/t$ . Therefore, the frequency of pulse-formation for sound in air is

$$\nu = \frac{1}{t} = \frac{U}{\lambda} ,$$

and for the pulse-formation of electromagnetic radiation in Aether, with the propagation velocity,  $c$ , the frequency is

$$\nu = \frac{1}{t} = \frac{c}{\lambda} ,$$

where  $\lambda$  is the wavelength. Now, the velocity of the particle is :

$$v = \frac{s}{t} \quad (2).$$

In order to find the momentum of the particle,  $\mathbf{p}$  let us multiply its mass,  $m$  into Equ.(2)

$$\mathbf{p} = mv = \frac{ms}{t} \quad (3),$$

or in the Aether

$$\mathbf{p} = \frac{m\mathbf{sc}}{\lambda} \quad (4),$$

The following should be noted before further discussion:

Up to this point the mass of the piston was assumed to be infinite and the description was restricted to the pressure exerted on the medium by the moving piston. It can be seen, however, that all the above can be applied to a small particle, with finite mass, moving in an isotropic medium. In this case, however, the pressure of the medium on the particle represents a retarding force, equal in magnitude and opposite in direction to the force that the particle exerts on the medium.

From this point on, with respect to the force of resistance, the analogy between the two media, air and Aether, cease to work.

The mechanism of air-resistance is understood through the kinetic theory of gases and the mutually exerted pressure between the mass particle and the gas is based on the collisions between a *solid* object and the *solid* atoms and molecules of the air.

The same interactions are assumed to be between a mass particle and the free Aethrons, as it has been proposed in Chapter Eight and Thirteen.

However, the classical concept of solid mass is not adequate for the description of the interactions between the *electromagnetic mass* and the ideal gas of Aether. In this respect an object, of even the densest and heaviest element, is merely acts like a *mesh* when it moves through the Aether, because at the same time, the Aether moves through it. Thus, the pressure and the resulting resistance force also depends on the density of the mesh. (Think of the resistance of a three dimensional steel mesh of various densities moving through water).

Hence, the resistance of the Aether against a moving mass particle and the resulting disturbance produced in the medium by the particle must be described by the Lorentz Transformation as discussed in Chapter Thirteen.

Recalling Equ.(13.6):

$$R = \frac{R_o}{\sqrt{1 - v^2 / c^2}} \quad (13.5).$$

where  $R_o$  is the Newtonian inertial resistance,  $R$  is the total resistance including the fractional extra, produced by the increasing density of the Aether in front due to the velocity,  $V$  of the body, and  $c$  is the velocity of light.

If  $R$  is the total resistance and  $R_o$  represents the inertial resistance of the mass then  $R - R_o = \Delta R$  is the fractional resistance of the Aether, caused by the inability of the finite propagation velocity to dissipate the density changes and therefore it is proportional to the ratio between the square of the velocity of the particle and that of the propagation. In every respect the Aether resistance is directly proportional to the total mass of the material object in motion.

Accordingly, the greater the mass, and the greater its velocity, the greater the compression it produces in the medium. It also follows from this, that the accumulation of a compression pulse by a larger mass and/or higher speed requires less time and shorter distance.

From the structure of Equ.(13.5) it follows that all related quantities, like  $s$ ,  $t$ ,  $\Delta p$ ,  $\Delta \rho$ , are effected by the ratio of the

$$\text{Lorentz Formula : } \sqrt{1 - v^2 / c^2}.$$

It can be seen from the above, that the momentum of the moving particle can be related to the frequency and wavelength of the train of periodical compression pulses that produced by the particle moving in the Aether.

Therefore, if the momentum of the particle is  $\mathbf{p}$  and the propagation speed in Aether is  $c$ , then the wavelength,  $\lambda$  can be expressed as

$$\lambda = \lambda_o \sqrt{1 - v^2 / c^2} \quad (5).$$

Recall Equ.(4). The momentum of a particle can be written as

$$\mathbf{p} = \frac{m s c}{\lambda} \quad (4).$$

therefore

$$\lambda = \frac{m s c}{\mathbf{p}} \sqrt{1 - v^2 / c^2} = \frac{m s c}{m_o v} \sqrt{1 - v^2 / c^2}$$

Note, that the distance  $s$ , in Equ.(4) is inversely proportional to  $m$ , which means that the product  $m s$  is a constant, so is  $m s c$  and that it has the same dimensions as Planck's constant,  $h$ .

$$\begin{aligned} \mathbf{h} &= \text{energy} \times \text{time} \\ &= \text{momentum} \times \text{velocity} \times \text{time} \\ &= \text{momentum} \times \text{distance} \end{aligned}$$

$$\begin{aligned} \mathbf{msc} &= \text{mass} \times \text{distance} \times \text{velocity} \\ &= \text{momentum} \times \text{distance} \end{aligned}$$

Hence,  $msc$  can be taken as equivalent with Planck's constant,  $h$  and writing the equation for the wavelength of a train of periodical compression pulses, produced by the uniform motion of a mass particle in Aether, in the relativistic formalism, we have

$$\lambda = \frac{h}{mv} = \frac{h}{m_0v} \sqrt{1 - v^2 / c^2}$$

an identical equation to DeBroglie's relativistic equation as he first proposed the *theory of matter-waves*, which was later abandoned by Schrodinger because of the difficulties to correlate relativity with the quantum theory.

One more derivation:

a) The distance,  $s$  or  $Ut$ , that the pulse-front moves in [Figure AIII-2](#), also represents the total volume,  $V$  of the affected medium.

b) We have found that the pressure difference,  $\Delta p$  that is created in this volume of the medium is directly proportional to the mass of the particle. Thus,  $\Delta p \propto m$ .

c)  $\Delta V$  is the reduced volume of the medium in the compression zone, which is inversely proportional to the propagation velocity ( $U$  or  $c$ ), because that represents the ability of the medium to dissipate the local disturbances. Thus,  $\Delta V \propto 1 / c$ .

Putting all these relations together, we have

$$msc = h = \frac{\Delta p}{\Delta V} = \text{the Bulk Modulus of the Aether.}$$

## **ABOUT THE AUTHOR**

Steven Rado was born in 1920 in Budapest, Hungary. Within a year after graduating from 'Zrinyi Miklos real-gymnasium, in 1939, he and his brother, Laszlo were drafted by the Hungarian army. In the same year, forced by Nazi Germany, Hungary declared war on the United States and transferred all Jewish and half Jewish soldiers into army-controlled labor camps.

In 1941 Laszlo was shipped to the Russian front with the Hungarian troops to assist the German invasion, and was never to return. Steven Rado escaped from his camp and as a half-Jewish army deserter, went underground, joining the Hungarian liberation movement. His graphic, mechanical, and literary capabilities enabled him to strengthen the movement. Among other activities, through the creation of a complete laboratory of document forging, he helped hundreds of Jewish and non-Jewish refugees and deserters to stay alive and fight.

Surviving World War II. against all odds, in 1945 he had found himself in a democratic Hungary, got married and worked as a journalist, play-writer and commercial artist. His political and philosophical essays appeared in leading newspapers and magazines. His play, The 'Duel' was awarded by the Hungarian National Drama Society.

In 1948, backed by the Russian army, a Communist dictatorship took over the government. His refusal to join the party cost him his livelihood in all directions. Black listed as a writer, he took up hand-weaving and subsequently became a power-loom mechanic. He continued to write a secret journal; this time an essay on 'The inherent contradictions in the theories of Marxism and Communism'. Somehow, the Communist Police had been informed about it, and only the last minute burning of the manuscript saved him. Without proof he only had to survive four months in the Communist jail.

In subsequent years he worked in a home-labor association making special textile products for state export, and once again joined the new underground liberation movement, this time against the Russian occupation.

In 1956, during the days of the victorious Hungarian Revolution, he wrote, designed, printed and organized the distribution of the 'Liberation Daily' in the form of thousands of silk-screened posters. This was the only source of information for the freedom fighters of Budapest about the state of the revolutionary war against the Russian army and which countered the lies of the Communist radio-broadcasts.

The revolution won, the Russian occupational army surrendered and for two whole weeks Hungary was again a democracy, eagerly preparing for election. Nevertheless, because of the lack of the promised Western intervention, on November 4th, 1956, thousands of Russian tanks flooded the country and killed the revolution and the revolutionaries.

On the 14th of that month, under his leadership, two truckloads of Hungarian Freedom Fighters arrived to a small border town, as 'well documented' communists functionaries, presenting strict instructions to the local officials to assist them in securing the new Russian occupation.

On the 15th, at 4.15 A.M. after 25 miles of walking and crawling through the border among the Russian tanks, 35 men, women and children kissed the

free land of Austria. Thus, miraculously, Steven Rado, his wife, Lenke and his seven years old son, Adam arrived at Camp Kilmer, New Jersey on December 11, 1956. He became a U.S. citizen in 1962.

From early studies of history, philosophy and political science, he became ever more convinced that the gradual moral liberation of the people is a direct function of the evolution of technology and therefore indirectly depends on the level of understanding of physics. Hence, most of the free moments of his adult life were spent on pursuing the accumulation of knowledge and understanding of physics, and particularly its modern perplexities, postulated by relativity and quantum mechanics.

At the beginning of his American life, the language barrier, his age, and the financial burden of starting from scratch obstructed him from gaining an official college education. Later on the financial ease of making a living rewarded him with plenty of free time to be self-taught, to think, to search and finally to write an alternate solution to the conceptually unresolved problems of physics in the form of the theory of **AETHRO-KINEMATICS**.



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