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Radius of Curvature

CONTENTS

CHAPTER TWO

GRAVITY

Perhaps the greatest obstacle to man's achievement of his dream of space travel has been a factor which has been given the name of Gravity. Its 'discovery' is usually credited, in elementary school text books, to a seventeenth century mathematician and physicist, Sir Isaac Newton. Actually, of course, every man 'discovers' gravity soon after birth; and the stone age man who first rolled a boulder down upon the head of the cave bear who was attempting to scramble up the cliff after him, was making a practical application of this force. It was, however, Sir Isaac Newton who first made a complete mathematical analysis of the subject. His conclusions were compatible with subsequent observation and test, and were virtually unchallenged until the dawn of the era of relativity.

In brief, his conclusions were that gravity is a quality which is inherent in all matter, and that it manifests itself as a mutual attraction between all bodies of matter. The value of this attraction between any two given bodies was said to be directly proportionate to the product of their mass, and inversely proportionate to the square of

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the distance between them.

The attraction between the earth and an object near its surface is an example of this force, although it is usually described as being the 'weight' of the object.

The difficulty with the statement that the force varies inversely as the square of the distance lies in the implication that if the distance becomes zero, the force should, become infinite. Thus it would at first seem that a man standing or lying upon the surface of the earth would be one of two bodies between whom the distance was zero, therefore, the weight of the man should be infinitely great. The reply to this assumption is that the force acts as though it originated at the center of the mass, called the 'center of gravity', and that the man on the surface of the earth is still some four thousand miles from its center of gravity. This explanation, however, creates a new problem in that, if we accept it literally, we must assume that if there were a well or shaft extending to the center of the earth, and if a man descended this shaft, his weight would increase as he approached the center of gravity, becoming infinite as he reached it. Actually, of course, his weight would decrease, becoming zero when his center of gravity coincided with that of the earth. So we are forced to the further explanation that gravity is inherent, not in 'bodies', but in particles of matter, and since a man at the center of the earth would have an equal number of particles attracting him from every direction, the resultant of the forces would be zero.

If we assume the gravity to reside independently within each atom, our problem is solved as far as the man and the earth are concerned, but if we look within the atom itself in the attempt to find the point where the distance becomes zero, and the force infinite, we find that the same problem again confronts us. We have not solved it, we have only changed our scale of observation. There is conclusive evidence that the attraction, called the binding energy, which exists between the Newtonian particles, (the protons and the neutrons) is intense almost beyond our ability to describe. This force, however, does not increase uniformly with increasing mass, but at certain points not only reaches zero but actually becomes negative.

We can demonstrate this fact by adding a single unit of Newtonian mass, a neutron, to the nucleus of an atom of Uranium 235. When this is done, we find that the gravitational force within the nucleus, instead of increasing actually becomes negative, that is, the attraction between its parts becomes a repulsion, and the parts begin to separate with considerable brisance. During the expansion, however, several new centers of gravity are formed, which, because of the smaller amount of mass involved in each, are strongly positive. The result is that two or more simpler atoms are formed, plus a few neutrons which have acquired too great a velocity to be captured by this regrouping process.

In most text books, this phenomena is described as the 'splitting' of the atom. There is an implication that it is the 'impact', or the kinetic energy of the neutron which causes the atom to split. If this were true, then obviously, a high speed neutron would split the atom more easily and surely than one with much lower speed. Actually, the

opposite situation is true. The high speed neutron will not split the uranium atom at all. It must be slowed to thermal velocity so that it can ***settle into the nucleus*** before fission occurs.

Occasionally a neutron will be captured by a uranium atom, without falling directly into the nucleus. The neutron may orbit the nucleus for a very long time (as time is counted in nuclear physics), perhaps several seconds or even minutes. Eventually the neutron drops into the nucleus, and 'delayed fission' occurs, again demonstrating the fact that it is not the impact of the neutron, but its ***presence*** in the nucleus, which results in its expansion.

The expansion and subsequent condensation into several simpler atoms is a completely random process. Many simpler types of atom can, and do result from the condensation, in each case however, the smaller atoms cannot contain as many neutrons in proportion to the number of protons as the larger atom, so there are always several neutrons left over.

This phenomenon, if carefully examined and considered, will furnish several strong clues to the nature of gravity itself, but let us for the moment, content ourselves with the observation that it demonstrates that a gravitational field can, under certain conditions, become negative.

Because of the manner in which our gravitational laws have been expressed, it has commonly been assumed that a gravitational force can manifest itself only as an attraction between two bodies of matter. This is not, however, a necessity of thought, since there is no logical reason why it should necessarily be true: In fact if it were true, it would set gravitational fields apart as the only force fields with which we are familiar which could not produce a repulsion, as well as an attraction between bodies of matter. The reason for the assumption of a universal attraction is simply that all of our early and limited observations seemed to indicate that this was true. However, as we have already mentioned, any number of observations, if made on a sufficiently limited scale, will tend to indicate that the earth is flat, rather than spherical.

For many years a school of thought existed which recognized that gravitational fields, like all other fields, must possess a duel polarity. They called these poles, gravity and levity. They assumed that some objects and materials normally possessed the quality of gravity, while others normally possessed the quality of levity. An object possessing levity would be repelled by all objects possessing gravity. The theory eventually became discredited, and was almost universally discarded, not because it was ever disproved, but because so many attempts had been made to assign this quality of levity to objects and materials which did not actually possess it. For instance it was, for a time, assumed that gases such as hydrogen and helium possessed levity because when they were contained in a light bag or envelope, they were observed to rise against the gravitational field. It was soon demonstrated, however that their rise was caused, not by any quality of levity, but simply because of the fact that their specific gravity was less than that of the air they displaced. After a number of unsuccessful attempts to assign the quality pf levity to specific

materials or objects, the theory fell into disrepute to the extent that the very word levity has become synonymous with humorous nonsense. Nevertheless, the philosophers who developed the theory were perfectly correct in their primary postulate. They erred only in failing to realize that gravity and levity are not properties of specific materials but are conditions under which all matter may come.

We have now observed negative gravitation in the microcosm (the interior of the atom), we also observe it in the macrocosm, (between the galaxies).

Many technical articles have been written in concerning "Our Expanding Universe," yet

A number of interesting but hardly convincing theories have been advanced in the attempt to reconcile the observed state of the universe with the existing concept of universal attraction. Some of our cosmic theorists have proposed that at one time all of the matter in the universe was contained in a single tremendous star, or 'atom'. For some reason, which is not given, this atom exploded, hurling outward the matter which has become the star clusters, and imparting to them the motion which we now observe, several billions of years later. This theory, first propounded by Abbe Lemaitre, has become known in colloquial parlance, as "The big bang theory". It is apparently becoming even more popular since Dr. Steven Hawkins released his AA Brief History of Time@. However, as knowledge of the size and nature of the universe increases, it becomes obvious that such a theory will not stand up if examined under the existing concept of linear natural laws. Certainly Dr. Roger Penrose, who shared the 1988 Wolf Prize with Steven Hawkins, is questioning the whole structure of our classical concepts of gravitation, singularity theorems, and Black Holes in his book "The Emperor's New Mind". Even our holder of Newton's Chair, Dr. Hawkins himself, seems to have trouble with the big bang singularity and a possible antigravitational effect which he refers to as a supercooling phenomena.

Taking a closer inspection of the big bang theory, such an inconceivably huge mass of matter, even at the very great temperature which was assumed for it, would, under Newtonian laws, produce a gravitational field so intense that no velocity less than that of light itself would be an 'escape' velocity. In fact it has been calculated that even the light emitted by this huge sun would not escape completely, but would circle in a comparatively small orbit about it. Through the concept of the curvature of physical law, however, we see that the addition of mass to an existing body does not, necessarily, increase the force of attraction between its parts, but may, under certain conditions, cause the field to become negative, and the attraction to become a repulsion. We can explain the observed actions of the present universe by postulating that an attraction exists between the individual bodies within a galaxy, because their total mass and distance is such that they are within the positive portion of the gravitation curve with respect to each other. In the vast spaces between the galaxies however, the curve dips below the zero line with the result that a repulsion exists between the galaxies themselves. This also explains why matter, although rather evenly distributed throughout the known universe, is not distributed uniformly, but found

in quite similar concentrations at comparatively regular distances.

At this point we hear someone say, "These explanations may be very interesting to the astronomer or to the theoretical physicist, but how can they help us in locating and utilizing gravitation's opposite field effect?" The answer is, of course, that we must have some understanding of the physical laws before we can make the proper use of them in attaining

In his dream of space travel, man has generally considered only three possibilities of escaping from the earth. First, gravity must be destroyed. That is, the operation of the gravitational field must cease between the space craft and the earth, so that it will not hinder the departure of the craft. While a number of highly imaginative stories have been written along this line of thought, no theory has ever been evolved, or test conducted which could give us any hope that such a condition can be achieved.

Despairing of the first possibility, we pass on to the second. Gravity must be shielded. Some type of screening material must be interposed between the craft and the earth to cut off or absorb the gravitational field so that while it still exists, it will no longer act upon the craft. Here again we have found imagination raising our hopes, and reality disappointing, for no material has been discovered which shows any promise of fulfilling such a function. With our hopes considerably subdued, we pass on to the third possibility. Gravity must be overcome. We must apply a greater force, so that we can rise against the pull of gravity, even though we must pay an exorbitant tribute of energy for each foot of progress. In this last plan, we have achieved a certain degree of success. Rocket motors have fought and struggled their way upward against the implacable, if impersonal, pull of the earth's gravitational field, crawled their way into orbit, some snailed to the moon (i.e. 'snail's pace'), and a few have inched their way to the outer reaches of the solar system with a time count of years.

It does not appear however, that the proper solution has yet been achieved.

When man attempts to attain his ends by pitting one natural law against another, he usually finds that it is a wasteful and laborious process. While it is true that it is perfectly possible to propel a rowboat by throwing rocks from the stern, it is not a method which an intelligent man would choose if he were aware of other possibilities. In the first place, the thrown rock must

In a rocket motor, the 'rocks' are represented by a gas produced by combining or 'burning' the fuels within the combustion chamber. The gas, at a high temperature and pressure, is expelled through an opening or 'venturi' in the stern. Since the amount of fuel is limited by the size of the rocket, the only means of increasing the total thrust is to increase the velocity of

Attempts are being made to overcome this problem through the concept of the 'Ionic' or the 'Photonic' drive, in which ions or photons are used as the 'rocks' to be thrown overboard. Ions and photons have a basic advantage over atoms or molecules in that they achieve

much higher velocities without the necessity of higher temperatures or pressures. This was in the 1960's. Apparently, great obstacles to the embodiment of these concepts in practical devices still exist.

Actually, the rocket has been obsolete for centuries. There has not been a single basic advance in the rocket concept since the year 1214 A.D., when the invading hordes of Genghis Khan were met by the military ordnance rockets of the Chinese defenders in their walled cities, more than seven hundred years ago. True, we have produced stronger combustion chambers, we have improved slightly the shape of the venturi, and we have developed fuels with considerably higher specific impulse, but we have done nothing to advance the basic concept. We are still propelling our boat by throwing rocks over the stern.

Men now living will stand upon the surface of Mars and Venus, but they will not go there in a rocket. There are better and simpler ways.

It is time to reexamine our position to see if there is not something we have overlooked. Have we forgotten the old saying, "If you can't lick 'em join 'em?"

Isn't it about time we gave up the idea of fighting the force of gravity, and began to consider the possibilities of making use of it?

We have tried for centuries to `lick' the force of gravity. We have tried to destroy it, and failed. We have searched for some method of shielding ourselves from its effect. We have not discovered it. We have attempted to overcome it by opposing it with superior force, and found it a wasteful and cumbersome process. Isn't it about time we gave up the idea of fighting the force of gravity, and began to consider the possibilities of making use of it?

We have learned that gravity, like all natural factors, has a negative, as well as a positive value. If after building our space craft, we could arrange conditions so that the ship was in the negative portion of the gravitational curve, it would fall away from the earth as easily and as naturally as a stone dropped from a tower falls toward the earth.

The answer to this question lies in the fact that, as we have already learned, the natural laws are not absolute, but relative. That is, the size and shape of the curve of one law is dependent upon the value and position of the others.

Of course, we hear at once the objection that, while negative gravitational fields have been shown to exist, they have been found only within the atom and at inter-galactic distances. How can we place a space ship within the negative portion of. the curve, with respect to the earth? The answer to this question lies in the fact that, as we have already learned, the natural laws are not absolute, but relative. That is, the size and shape of the curve of one law is dependent upon the value and position of the others. We have seen that the nucleus of the atom of uranium 235 dips below the zero line with the addition of only one mass unit, making a total of 236, yet the nucleus of the atom of uranium 238, although close to the zero line is still on the positive side of the curve because of the fact that the shape of the gravitational curve is modified not only by the mass present but also by the number

and position of the electrical charges.

Lest someone charge us with ignorance by pointing out that there are the same number of electrons (92) in each of these atoms, we will make haste to state that we refer not only to the charges in the outer shell of the atom but to those within as well, and especially to the fact, not always realized, that the neutron possesses both a positive and a negative charge, although when united within the neutron they are not discernable as charges, but exist as energy which produces the gravitational field .

When we acquire a better understanding of the laws, we will be able to produce any shape of curve we desire, with the earth as one reference point and the spacecraft as the other.

Suppose you were to hand a bar magnet and a similar bar of soft iron to a man who was intelligent, but uneducated, with the request that he examine and test the two objects in order to determine their properties. One of the properties which the researcher would be certain to list would be the 'inherent' property of mutual attraction between the two objects. He would

We know, of course, that if a length of insulated wire were wound around the soft iron bar, and flow of electrons were induced in the winding, the two bars could be made to exhibit a repulsion as readily as an attraction. Note that in this case we have not destroyed the field of the permanent magnet, we have not shielded the field, nor have we overcome it. We have simply produced a field which is in opposition to it, or to state the case more concisely, we have polarized the field, by placing one end of the soft iron bar within the negative portion of the magnetic curve with respect to each end of the permanent magnet which is already so

The same possibility exists with respect to gravitational fields except that the results are not obtained in quite the same way. It is not too difficult, however, to work out means of polarizing a gravitational field, once we discard the old assumption that it is impossible.

From the Electrogravitic research files at Wright Patterson Air Force base, it would appear that this has already been done. T. Townsend Brown states it this way: there is between electricity and gravity a relationship parallel and/or similar to that which exists between electricity and magnetism. As the coil is the coupling link in the case of electromagnetism, so is the condenser in the case of electrogravitics.

Prior to summarizing this chapter on gravity with our new perspective, let us take a brief stroll through some of the more recent and advanced thoughts on the subject coming from the scientific paradigm. Notice where common sense and intuition are breaking through the constraints of a uni-dimensional view to a multi-dimensional concept. Grasp the uncanny accuracy with which the "hidden variables" and "zero point energy" theory aim at the sine wave curvature of natural law (whose radius of curvature is the constant C), specifically at its zero point intersect. Yet, note carefully where "hyperspace", "other dimensions", "space-time distortions" and "many worlds" interpretations still wreck havoc upon the mind by

attempting to create Alice in Wonderland models of fantasy and intrigue. These mathematical misinterpretations will become clear even to the layman, by the time the reader has finished this book. Remember, grains of sand become a beach (i.e. expanded dimensions), not "other dimensions", when viewed from a larger viewing point.

The Tachyon Field:

The classical physical theory of the universe is no longer sufficient to explain the extraordinary important phenomena of the acceleration of gravity. The British physicist, Dr. Rendle, compiled approximately 60 different statements by distinguished physicists starting with Newton in the 17th century. In practically all instances, it is apparent that we have foundered in our attempts at explaining gravitational acceleration. The most interesting still comes from Newton. He said that the mutual interaction between bodies is to be admitted, and that their explanation would be possible only in the future. He also stated that he was certain that the capability for a body to be accelerated by gravity was not a property of the body itself. It was based on a physically yet-to-be-discovered relation between the bodies.

In 1966, the physicist Feinberg introduced and described the properties of a Tachyon-Field which assumed that bodies in universal space are penetrated by a very energy-rich graviton or Tachyon-Field, from all directions in space and towards all directions in space. This property is called isotropy. Thus, the conduction of gravitational effects is somehow of finite velocity.

The origins of this concept, dating back to the early part of this century, presumed that universal space was filled with energy rich charges, designated as gravitons, which are partially absorbed in a body, and then are reflected at a decreased rate. The energy content of the Feinberg field is extraordinarily high. The famous physicist de Broglie already assumed an energy content in space of 10(26th) Joules/liter. The Japanese scientist, Seike, mentions a tension of 880 million volts per cm for the Feinberg field.

The traveling Tachyon-Fields are hardly slowed down by masses, and yet have a moment (the gravitational acceleration) and/or generate heat (geothermal heat). They are also braked by strong magnetic and electric fields. The interaction of large forces between masses in space is conceivable only through the action of a very energy rich field in space, and the explanation of gravitational acceleration as a push or thrust phenomena, because only pressure or push phenomena can be exerted in space by electromagnetic fields or other conceivable forms of energy.

Trapped Electromagnetic Energy is Gravitational Potential:

As is well known in general relativity, it is the trapped energy in mass that is responsible for its exhibiting gravitational attraction. Einstein's $E=mc2$ is a prescription for the amount of electromagnetic energy that is trapped in a mass m. The hypothesis is that as the relative speed of a charged particle increases from zero to that of light, the particle appears to change to an electromagnetic wave because of the expansion of the magnetic field. This magnetic field combines with

some of the static electric field, in proportion to the energy of the magnetic field, to form an electromagnetic wave.

At the speed of light, the electric field is entirely combined with the magnetic field and the particle appears as an electromagnetic wave.

At speeds less than that of light, the magnetic field of the electromagnetic wave collapses. The collapsing field distorts or twists space-time which appears to us as a gravitational field. Thus, it is the distortion of space-time which appears to us as "mass" rather than "mass" causing the distortion.

ZPE - Zero-Point Energy:

Within our physics today exist theoretical constructs that may allow the possibility of tapping energy directly out of the fabric of space, creating artificial gravitational fields for stressless, inertialess propulsion, altering the pace of time in a region of space, and even teleportation beyond our space time continuum. These possibilities arise by combining two branches of theoretical physics: Theories of the zero-point energy (ZPE) with theories of system self-organization. The theories of system self-organization are the most novel. In 1977 Ilya Prigogone won the Nobel Prize in chemistry for identifying under what conditions a system may evolve from a chaotic, turbulent state to an organized state. The system must be nonlinear, far from equilibrium and have an energy flux through it. The ZPE exhibits these properties. It is highly nonlinear in its interaction with matter or charged particles, it can be driven from equilibrium by abrupt motions of matter or plasma, and it may be a manifestation of an energy flux from a physical hyperspace. The ZPE may fulfill the conditions for self-organization.

By asking the question, Afrom where does the ZPE come, or from where does a charged particle's electric flux come?", the existence of a physical hyperspace is introduced. This concept is not new to physics. Wheeler shows how it arises by applying general relativity to theories of the ZPE, and Everett shows how it arises in his many worlds interpretation of quantum mechanics. This point of view sees all matter, elementary particles and fields as physically hyperspatial in nature and that we, like "flat-landers", can only perceive a three dimensional projection of the hyperspacial object or field. From this, the notion of a "scalar wave" or a longitudinal vacuum polarization structure arising from abruptly bucking electromagnetic fields may be introduced and shown to have a hyperspacial form that manifests its 3-space projection with scalar and longitudinal components.

What is the zero-point energy? The zero-point energy is the ether, the all-pervading energy that fills the fabric of space. Pre-twentieth century physics viewed space as filled with a material substance that would support the propagation of light. After the Michelson-Morley experiment failed to detect the ether wind, the notion of a material ether was dropped by the physics community. In the 1930's, physicists recognized a term arising from the equations of quantum mechanics and gave it the name zero-point energy. "Zero-point" refers to zero degrees Kelvin and means the energy fluctuations are not thermal in nature. The development of quantum electrodynamics

recognized this energy existed in a pure vacuum, and Dirac predicted how electron-positron pair production could arise from it. Boyer introduced the viewpoint that quantum mechanical effects arise because of matter's interaction with the zero-point energy and derived its spectral energy density from a postulate of Lorentz invariance. Quantum gravity theories show that the ZPE spectrum is altered by gravitational fields or acceleration, and that the curvature of space-time is intimately linked to its action. Quantum electrodynamics shows all particles are intertwined in a vacuum polarization interaction with the ZPE and shows how the interaction yields the mass of an elementary particle. Nonlinear quantum mechanics also yields the mass of an elementary particle through a persistent self-interaction with the zero-point energy while avoiding the renormalization problems of perturbation analysis. A modern view is that elementary particles are a coherence in the zero-point energy and this view can be supported by system self-organization theories.

There is evidence that the zero-point energy is not a passive system but actually is a manifestation of an energy flux passing through our space orthogonally from higher dimensions. Wheeler derives such hyperspace channels (wormholes) in his geometrodynamics. Also, a picture of nonlocal connections is implied by quantum physics' EPR paradox, Bell's Theorem, and hidden variable concepts. In addition, Sarfatti, Feynman and Dirac describe quantum mechanical propagators summing across the higher dimensions of superspace.

The zero-point energy can be modeled as an electric flux flowing orthogonally through our three dimensional space. As the flux vibrates, it generates an electric field component in our space creating "mini-white holes" (flux entrances) and "mini-black holes" (flux exits). Since energy (or mass) can curve space-time, a sufficiently large energy density pinches off the fabric of space (like a black hole) in the direction of a hyperspace orthogonal to our three dimensional space. The ZPE arises from an electric flux that flows orthogonal to our 3-space. As the flux enters, it manifests itself as a virtual mini positive particle; it leaves through a corresponding virtual mini-negative particle. The scale of these particles are on the order of Planck's length, 10(-33)cm. The size of the electron is on the order of 10(-13)cm. That is twenty orders of magnitude difference. As the flux passes through our 3-space, there is jitter, and the separation (or pair production) of these mini particles gives rise to a turbulent virtual plasma, sometimes called the 'quantum foam'.

The random action of this higher dimensional process gives rise to the observed zero-point fluctuations in three-dimensional space. If a plasmoid polarizes the vacuum in a dynamic, nonlinear interaction with the zero-point flux, it could produce a cohered macroscopic fluctuation. This would result in twisting the orthogonal electric flux such that a greater component becomes aligned in our space. Note that quantum theory allows borrowing the energy for a short time period governed by the uncertainty principle. This connects the borrowed energy with time. Since general relativity relates the space-time metric to the embedded energy density, could borrowing the zero-point flux locally alter the pace of time? Could the local

space-time curvature be altered significantly to produce artificial gravity?

SUMMARY

To sum up as concisely as possible, the conclusions reached in our discussion of the factor of nature which we call gravity, we will propose the following corrections and additions to the gravitational theory as it is now commonly taught.

1. The law of gravity is not a linear law but follows a curve common to all factors of nature.

2. The gravitational field does not diminish precisely as the square of the distance as Newton believed, but because of the curvature of natural law, it diminishes normally at a slightly greater rate so that it reaches zero value, not at infinity as is usually supposed, but at a finite distance or degree of separation. Beyond this distance or degree of separation the force becomes negative.

3. We can define a gravitational field as negative when the application of the factor called time tends to increase the degree of separation between any two reference points in the factor called matter.

4. The value of the gravitational field at any given point is controlled by the values of the other factors of nature at that point.

5. The electric charges within the atom are a factor which modulates the shape of the gravitational curve of the nucleus.

6. Gravity is not the enemy of space travel. It is a friend, but there must be true understanding before the friendship can bear fruit.

7. It is perfectly possible to produce a negative gravitational field between the earth and a given object on or near its surface by the proper application of moving electric charges. Such a field would be effective only with respect to the given object. All other matter in the vicinity would remain within the positive portion of the curve.

CHAPTER THREE

MATTER AND MASS

Much of the confusion which exists in our scientific concepts today is brought about by our failure to distinguish carefully between matter and mass. Until a comparatively few years ago, it was assumed that mass was a property which was exhibited only by matter. Upon closer examination, however, it appeared that energy also possesses mass, since when energy was added to a body of matter, the mass of the body was increased.

We should, perhaps, pause at this point to define the terms which we are using lest we add to the confusion instead of resolving it. Mass is defined as resistance to change in the existing state of motion. It is measured by the amount of the energy which is required to produce a given change in velocity. All matter has the property of mass, but not all mass has the properties of matter. For the purposes of this discussion, we will postulate that there are two types of mass, inertial mass, which is simply the property of resistance to change in a state of motion, and the mass inherent in matter, which we will call Newtonian mass, because it includes all mass which obeys the original laws laid down by Sir Isaac Newton. Since the reader may be under the impression that all mass obeys the Newtonian laws, let us pause here long enough to examine the facts and to point out the differences in the properties of inertial and Newtonian mass.

All physicists of today are agreed that the electron has mass. Yet if it were possible for us to hold an electron between two of our fingers and then suddenly release it, we would find that there was not the slightest tendency for the electron to fall to the earth (unless the surface happened to be positively charged at the moment). The electron is not in the least affected by the gravitational field of the earth, ***so long as it is at rest with respect to that field*** (if the electron is moving through the field, however, the direction of the motion will be affected).

The electron has mass only because it has an electric charge. As we know, when an electric charge is accelerated in space, a magnetic field is produced, and energy is required to produce this field. The energy 'spent' in producing this field, is said to be the 'mass' of the electron, since it is the entire cause of its resistance to acceleration. The greater the degree of acceleration, of course, the more intense the field, and the greater the amount of energy required to produce it. So we say that the electron gains 'mass' with every increase in its velocity. If an electron could be accelerated to the velocity C, (commonly called the velocity of light), it would have acquired the maximum velocity with which energy can be propagated. It is obvious, therefore, that no amount of energy could further accelerate this electron. (with respect to its original reference point), so it would be considered to have acquired 'infinite mass.'

Let us take time to examine this statement carefully, since it is a point upon which there is much confusion. The electron would have acquired infinite mass only in reference to its original energy level. If observed from a reference point which had itself received the same degree of acceleration, the mass of the electron would not have changed a particle. This increase of inertial mass with increasing velocity is simply the measure of the kinetic energy differential between the observer and the point which he is observing.

We will attempt a simple analogy, in the hope of making this more readily understood. An observer is stationed in 'free space' far from any gravitational or other fields which might affect the results of the experiment which he proposes to make. He has in one hand, a sphere of cork or other light material which has a mass of 10 grams. In the other hand he hand he has a pistol which fires bullets also having a mass of 10 grams and a velocity of 1000 feet per second. The man holds the ball out at arms length, and fires a bullet from the gun into it. We will postulate that - the bullet is not absorbed by

the cork, but shares its kinetic energy with it, so that after the impact, the bullet and the cork ball each have a velocity of 500 feet per second. The observer now fires a second bullet at the cork. This bullet also has a velocity of 1000 feet per second with respect to the observer, but now the target has a velocity of 500 feet per second in the same direction, so that there is a differential of only 500 feet per second which the bullet can share with its target. After this impact, the bullet and the ball each have a velocity of 750 feet per second. When the observer fires the third bullet, he finds that now there is a differential of only 250 feet per second between it and the target, so that the velocity of the target is raised by only 125 feet per second, and so on.

The observer notes that each succeeding bullet, although it has the same energy with respect to him, produces a smaller and smaller acceleration in the target. He would observe that the 'mass of the target' (its resistance to acceleration) appears to increase with its velocity. If he made mathematical calculations based upon his observations, they would show that the greatest velocity which he could ever induce in the target would be 1000 feet per second (the velocity of the bullets), and that to produce this velocity it would be necessary to fire an infinite number of bullets. His experiment demonstrates conclusively that as the velocity of the target approaches 1000 feet per second, his ability to further accelerate it approaches zero. Persons with lesser intelligence or insight than our observer might be convinced that this figure of 1000 feet per second was an absolute and inescapable limit. The observer, however, as we said, has greater understanding. After he has accelerated his target to the 'limiting' velocity of 1000 feet per second (by firing an infinite number of bullets), he steps aboard a small apace ship (with which he has thoughtfully provided himself), and takes off in the direction of the target. He accelerates his ship to a velocity of 1000 feet per second, with respect to his starting point, and now finds that he is back upon exactly the same energy level as his target. If there were no other bodies of matter in the universe, there would be no way in which he could determine that either he or the target were in motion, since there would be no relative motion between them, and no other reference points from which motion might be determined. In fact, he finds that the situation is exactly the same as it was before he fired the first shot, and he can now begin his shooting all over again. He does so and observes that his first bullet accelerates the target to a velocity of 500 feet per second with respect to his new reference point, and he notes that the 'infinite mass' of the target returns to its original 10 grams, as soon as he reaches the same energy level. He realizes then that the 'increasing mass' of the target is only the measure of the kinetic energy differential which exists between them. The mass approaches infinity ***only as the energy level approaches that of the accelerating force.*** (In this case it is 1000 feet per second.) In the case of the quantity C, usually called the velocity of light, the differential is equal to 3 x 10(10) centimeters per second, or if we convert this velocity to its equivalent energy we would have 9 x 10(20) ergs per gram of mass - ***which is exactly equal to the total energy inherent in matter (per gram)***.

As an energy differential between two reference points approaches, equates, and surpasses this C factor, we begin to note some rather odd, yet very common sense occurrences to the other factors of nature - i.e., time, gravity, and space. Specifically so, when the energy differential is of a form other than velocity, as in electrical potential. In that case, the space (distance variable) remains constant (no velocity or acceleration = no motion) yet the energy differential continues to increase (velocity substitution by electrical or frequency potential, as in excited atoms, and high energy states of electron shells). The situation is identical to the velocity of light mathematics and postulates but for the absence of motion and space separation.

Now perform the Einstein Thought experiment. The object is in front of you, not moving, yet the energy differential between you and the object approaches, then exceeds the velocity of light energy level. What happens to time? What happens to gravity? What happens to the object? We will examine these issues more closely in later chapters.

The reader is advised to keep an eye (and his senses) upon the possible parallels in the Zero Point concept. For now, we will conclude that the velocity of light energy level is a maximum or limiting velocity, but only with respect to a given reference point.

In our discussion of non-linearity of physical law, it was pointed out that the energy inherent in a gram, or any other quantity of ***matter*** is precisely the quantity of energy necessary to accelerate its ***mass*** to a velocity equal to the quantity C by energy conversion. This statement may be hotly disputed by some students who have not yet learned to distinguish between matter and mass. Their argument is to the effect that no ***mass*** can ever be accelerated to the velocity of light since the mass would then be 'infinite' and consequently the energy required to produce the velocity would also be 'infinite'. The incorrectness of this assumption can be demonstrated simply by pressing the button of a pocket flashlight. A beam of light will be produced which any physicist will agree has ***mass*** and which, by its very definition, is moving at the velocity of light. Yet all the energy required is released by a small amount of chemical change taking place within the cells of a battery.

CHAPTER FOUR

S P A C E

((to be continued StarSteps 3))

StarSteps3

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