In my own work at universities I have been much struck by the paralysis of thought induced in pupils by the aimless accumulation of precise knowledge, inert and unutilized. It should be the chief aim of a university professor to exhibit himself in his own true character - that is, as an ignorant man thinking, actively utilizing his small share of knowledge.

Alfred North Whitehead
The Aims of Education, 1929

If you can't explain it simply, you don't understand it well enough.
Albert Einstein

In Summer 2018, I was given a paperback book, Strange Matters by Tom Siegfried, Berkley Books, New York 2002. I did not make it very far into the book before I was struck by several things. One was a quote from Einstein that “space is not nothing”. Another was that only a small percentage of the mass of the Universe can be accounted for, and there is an even greater discrepancy in accounting for the Energy of the Universe. The most striking thing to me was a suggestion that the Universe might be filled with tiny particles which are so small that they can't be detected because they permeate all Visible Matter as we know it. That combination of information set off my imagination. Are such tiny bits possible? If so, how did they get here and what do they do?

I am an Experimental Physical Chemist by training, what my mentor Loren G Hepler referred to as an “R-T Physical Chemist” as opposed to an “h-v Physical Chemist”. I know very little of Relativity or Particle Physics, so in these matters I qualify as Whitehead's “Ignorant Man”. This is not a theory. It is a model of the properties these tiny particles would need to possess in order to exist and how they could have come into existence. It presents a simple physical concept for qualitative understanding without resort to Quantum Mechanics and Relativity. It does involve some numbers that boggle the mind with their smallness.
CONCLUSIONS

1. Such matter is not only possible, I now believe that something like it exists. I have given these tiny bits the name of GEMMs for Gravitic, Electric, Magnetic Matter.

2. All of the visible matter in the Universe is composed of similar matter, which I have called FIMs for Fundamental Increments of Matter. GEMMs are the Antimatter of FIMs. The mass of a FIM or a GEMM is of the order of $10^{-48}$ grams.

3. Interconversion of Energy and Mass involves change of a fundamental increment of Energy into a GEMM and a FIM or the reverse process. The distinctions between mass and energy are clearly defined.

4. FIMs make up all of the visible mass in the Universe and there is an equal mass of GEMMs as Dark Matter. Similar amounts of energy are associated with these two types of matter. There must be other types of Dark Matter, as well.

5. Energy, GEMMs, and FIMs contain positive and negative zeptocharges ($10^{-21}$ electron charges) which have mass, Force without mass, and Antiforce (the repulsive form of Force). The concept of a Weak Force is replaced by a combination of Force and Antiforce.

6. GEMMs and FIMs are electric dipoles with the charges held together and apart by a mixture of Force and Antiforce. The dipole of a FIM is surrounded by Force and the dipole of a GEMM is surrounded by Antiforce. FIMs are attracted and held to other mass by the Strong Force and GEMMs are repelled by mass.

7. FIMs form clusters of dipoles which create and interact with all particulate matter and visible antimatter. All visible mass is composed of FIMs, mostly in atoms with bits of mass distributed as electrons and nuclei in “empty” space.

8. GEMMs are formed with a primal spin which creates magnetic fields interacting with each other. They form an active energetic network throughout space, including the space within atoms. They permeate all space except nuclei and possibly electrons.

9. The GEMM network provides a medium for information transfer throughout the Universe with radiant energy and gravity. Both of these travel outward from any mass above the absolute zero of temperature. Both of these travel throughout the Universe at the speed of light.

10. The existence of GEMMs provides an explanation of why the energy of a photon is exactly twice the kinetic energy of the equivalent mass traveling at the speed of light.

11. If information transfer occurs through a network of GEMMs, changes in the spacing of that network must change either the speed of light or our concept of time. Such changes in spacing may explain why light bends TOWARD a star and AWAY from a Black Hole.
Matter and Antimatter – FIMs and GEMMs

The energy transmitted by an electromagnetic wave is calculated as Planck's constant multiplied by the frequency of the wave ($\nu$), with Planck's constant representing the energy carried by a single cycle of the wave. That increment of energy has the same value for ALL radiation ranging from beyond cosmic rays down to the longest imaginable waves. The mass equivalent associated with all photons (Planck's constant multiplied by the frequency of the radiation divided by the square of the speed of light)

$$E = h \nu = mc^2 \quad \text{(Kinetic Energy} = \frac{1}{2} mv^2)$$

[Note that the energy of a a photon is twice the kinetic energy of the same mass moving at the speed of light,]

from any source is related to the transfers of the same increments of energy at different rates, all moving at the same velocity in a vacuum. That mass equivalent must be an integral multiple of the mass of a FIM (the Fundamental Increment of Matter). Classifications of radiation by frequency do not go below 0.1 cycles/second (wavelength of 3 million kilometers). By Einstein's relationship this corresponds to a mass equivalent of the order of $10^{-48}$ grams.

Physics considers visible matter to contain mass, charge, The Strong Force, and The Weak Force. Radiant energy would have to contain similar elements in order to be transformed into visible matter. I have proposed GEMMs as the antimatter of FIMs. In order to exist without mutual annihilation with visual matter, GEMMS must contain a repulsive force, an Antiforce. The properties of both visual matter and antimatter must include Force, Antiforce, mass, and charge. Electrons must contain negative charges and positrons must include positive charges. The mutual annihilation of electrons and positrons destroys both charge and mass (except for uncharged neutrinos), requiring that mass and charge are inseparable elements.

Both FIMs and GEMMs have mass, therefore they must contain charges while remaining electrically neutral. The simplest such structure is an electric dipole of a positive and a negative charge. These charges must attract each other with an increment of Force while they are kept apart by an increment of Antiforce. When radiant energy is absorbed, half of the created dipoles are surrounded by Force as FIMs and half are surrounded by Antiforce as GEMMs. FIMs are strongly attracted to and become part of any visual mass. GEMMs are repelled by any mass, including other GEMMs, remaining as single spinning entities and spreading throughout all empty space. These spinning dipoles interact with neighboring dipoles though their magnetic fields, eventually forming a network throughout the Universe and a medium for gravity and electromagnetic forces.
Radiant energy is created by the combination of a GEMM and a FIM, releasing equal amounts of Force and Antiforce. Mutual annihilation of the positive and negative charges with their mass provides the power to drive Force and Antiforce through the network of GEMMs. These massless forces travel in tandem through the network of GEMMs at the speed of light until they encounter mass, usually as electrons or nuclei. Mass and charge emerge, probably as a quadrapole with Force and Antiforce, which separates into a GEMM and a FIM. The FIM becomes part of the absorbing mass and the GEMM goes spinning out into the spacial network. In this process, a FIM and a GEMM have been transduced into a single cycle of a wave in which the half-waves are represented by increments of Force and Antiforce integrated over distance as energy equal to one-half the value of the Planck constant (h/2). That wave travels until it reaches an absorbing mass where the FIM is deposited and the GEMM is expelled. Two units of mass (matter and antimatter) have been moved from one bit of matter to another without existing along the path. There is an accompanying recoil of GEMMs from the area of the absorbing mass to the area of the emitting mass which might contribute to gravitational force.

THE BIG BANG

Theoretically the Big Bang involved a “singularity” of infinite density and infinite gravity such that there was neither space nor time. I prefer to think that this singularity was pure raw energy from the annihilation of a previous Universe – the “stuff” of radiation, perhaps non-mass at infinite temperature. The actual source and “stuff” are unknowable and immaterial to this study. This energy suddenly expanded, cooling (like an adiabatic expansion?) to a temperature where it could be transformed into mass. The general claim seems to be that protons, neutrons, and electrons were formed within seconds and years passed before some of them combined to form the various atoms higher than Hydrogen. This energy that was transformed into mass in the Big Bang had to be a higher level of the same energy that carries the “equivalent mass” of photons. The conversion to actual mass must be in the form of the tiniest increments of mass, far smaller than electrons. These tiny increments of mass forming in space of extreme density and gravity would have formed aggregates that quickly grew
into neutrons, protons, electrons, quarks, and other forms of matter and antimatter. The smallest particle known is the neutrino at about $2 \times 10^{-33}$ grams (about half-a-million times less than the mass of an electron). It contains about $10^{15}$ FIMs. The Big Bang created equal masses of FIMs and GEMMs. FIMs form all of the visible mass in the Universe, so there is an equal mass of GEMMs as one type of Dark Matter. FIMs with the dominant Strong Force collected to form neutrons and possibly quarks or other particles associated with high energy interactions. The zeptocharges of some FIMs within highly energetic neutrons becomes separated. The small amount of Antiforce in the dipole goes with either positive or negative zeptocharges and grows within the neutron until large enough to be emitted (possibly along with some FIMs) as electrons or positrons, leaving the opposite charges tightly bound to the mass of FIMs in protons or antiprotons. There apparently is a bias toward electrons and protons over positrons and antiprotons. The greater percentage of Antiforce in electrons and positrons relative to neutrons, protons, and antiprotons prevents them from being absorbed by nuclei of opposite charge under ordinary conditions. It also gives them a more diffuse structure than nuclei. This could be compatible with some estimates that give the radius of an electron as 2.5 times the radius of a proton which has 2000 times as much mass. This raises the possibility of FIMs and/or GEMMs within electrons.

RADIATION

Electromagnetic radiation is the transfer of Energy across space, perhaps as waves. Mathematical representations of waves are based on observations on the behavior of waves in media with finite density rather than in a vacuum. GEMMs could be providing that medium. Emission of radiation must involve the conversion of mass to Energy and the absorption of radiation must involve the conversion of Energy to mass. All radiation can be described as waves traveling at the same speed in a vacuum which might contain these tiny bits of Matter, irrespective of the frequency. The Energy of radiation is related to the frequency rather than the amplitude of the wave, requiring that all radiation has the same Energy associated with a single cycle of the wave. This is the fundamental quantum of Energy represented by Planck's constant, and must be some integral multiple of the Energy associated with the smallest possible increment of mass. A radiant body (any visual mass above the absolute zero of temperature) is constantly converting mass to Energy at frequencies determined by the rates of conversion. This Energy travels through space at the speed of light until it encounters Matter, which might absorb some or all of the Energy by converting it back to mass as FIMs and GEMMs.

The conversion process must be reversible. Ordinary matter composed of FIMs becomes excited by interactions between nuclei and electrons, and within
nuclei. Highly active FIMs interact with GEMMs to form quadrupoles and are transformed into pure radiant energy. All matter as we know it is continually absorbing and emitting radiant energy, gaining and losing FIMs with equal amounts of GEMMs going along for the ride. The surfaces of nuclei and electrons must be covered with a thick “gumbo” of FIMs, GEMMs, free zeptocharges, Force and Antiforce from the interactions with quarks, electrons, other nuclei, and radiation from other sources. This provides a medium and a “temperature” suitable for energy/mass conversion in either direction.

**MAGNETISM**

Magnetism is based on movement of electrical charge, either as a current or as “spin” of charged elementary particles such as electrons. A permanent magnet has a crystal structure such that the spins of a majority of the unpaired electrons (and their magnetic moments) are aligned. Somehow this magnetic field goes off into the space around it which is usually air or a vacuum but can also be a liquid or solid. This field is powered by the thermal energy within the atoms of the magnet. The energy involved is far less than that involved with loss or gain of mass. An electromagnet creates a magnetic field powered by the electrical current. These fields are continually being emitted into the medium, spreading out until they either find a medium where they encounter less resistance to flow or their density is diminished.

The present concept of a vacuum is not a medium. GEMMs could provide the medium. The influence of an electric current or electron spin within the magnet could be imparted to GEMMs located within and/or around the atoms of the magnet, spreading and diluting the magnetic field. The field is propagated through many tiny steps and is dissipated and scattered by every step. There is no transfer of mass in creating and maintaining this force. Transmission of the force through a vacuum involves the GEMMs but does not proceed at the speed of light because of resistance due to the spinning masses of the dipoles. The decreased resistance in most metals through electron networks is easily demonstrated.

**GRAVITY**

Light, magnetism, and gravity span a vacuum which could be filled with a network of GEMMs. There are shields which can block magnetic force and radiation, but gravitational force is not affected by anything but distance and the presence of other masses. The force is not affected by the temperature or the density of accumulated mass, even GEMMs are attracted by other mass but repelled by the antiforce. Like radiation, gravity is everywhere in the Universe. Gravity is said to travel at the speed of light. If so, the gravitational field most likely involves some type of interaction through the network of GEMMs. That interaction must involve the common component of all visible mass, FIMs. The
nuclei and electrons of all atoms within visible mass interact with each other and neighboring atoms through the network of GEMMs, which connects every atom in the Universe. Gravity is the resistance of the network to expansion.

There is activity between electrons and nuclei in all atoms with continuous exchange of mass. A much greater amount of energetic activity is probably maintained in the nuclei with extremely short, fast vibrations between compressed FIMs, charges, and the strong Force. These vibrations impact the network of GEMMs, connecting all mass in the Universe.

Radiation from a star transmits energy created from FIMs and GEMMs out into space where it will eventually revert back into FIMs and GEMMs. This causes a decrease in the concentration of GEMMs in the vicinity of the star, stretching the spacing of the network toward the mass of the star. This is similar to the common depiction of a mass distorting the “fabric of space” to bend passing light toward the star. The increased spacing of the GEMM network toward the star would have the same effect. However, a Black Hole has the opposite effect on the network by absorbing the FIMs from trapped radiation and increasing the local concentration of GEMMs. This decreases the spacing of the GEMM network and bends passing light away from the mass and its gravitational effect. This effect of Black Holes is not expected to approach the effect of stars because of the relative rates in which matter is processed in the two cases.

**SUMMARY**

If mass and energy are interconvertible and energy is quantized, mass must be quantized. There must be a fundamental increment of mass and a fundamental increment of energy. Mass has the capacity of being electrically charged, therefore the fundamental entity of mass must contain the fundamental entity of charge. If there is only one fundamental entity of mass, it will have to be electrically neutral. The simplest concept of an electrically neutral entity that contains charge is an electric dipole. If mass is created from energy, parity requires creation of antimass which must also be an electric dipole. This requires an intermediate state which will produce at least two dipoles, probably an electric quadrupole. Mass as we know it is bound together by “the Strong Force”, which must also be contained in the quadrupole but perhaps in another form. Opposite electrical charges have the same mass and are attracted to each other by a massless force. To form a dipole, they must be kept apart at a short distance by a massless repulsive force – an Antiforce. Dipoles must be created from uncharged masses and a massless mixture of attractive and repulsive forces. One dipole is imbued with the Strong Force, the Fundamental Unit of Matter - FIM. The other contains the Antiforce, Gravitic, Electric, Magnetic Matter - GEMM. FIMs are attracted to any mass with the Strong
Force. GEMMs are repelled by all mass and appear to be attracted to energy sources. GEMMs penetrate into the empty space of nearly all matter except nuclei, electrons, and possibly quarks.

There is no evidence of the existence of this antimatter I've called GEMMs. They would contain the Antiforce which prevents them from forming clusters the way FIMs accumulate into neutrons, protons, electrons, and other particles. FIMs constitute all of the mass as we know it. There must be an equal mass of GEMMs which can only exist as single entities or combine with FIMs under extreme conditions to create radiant energy.