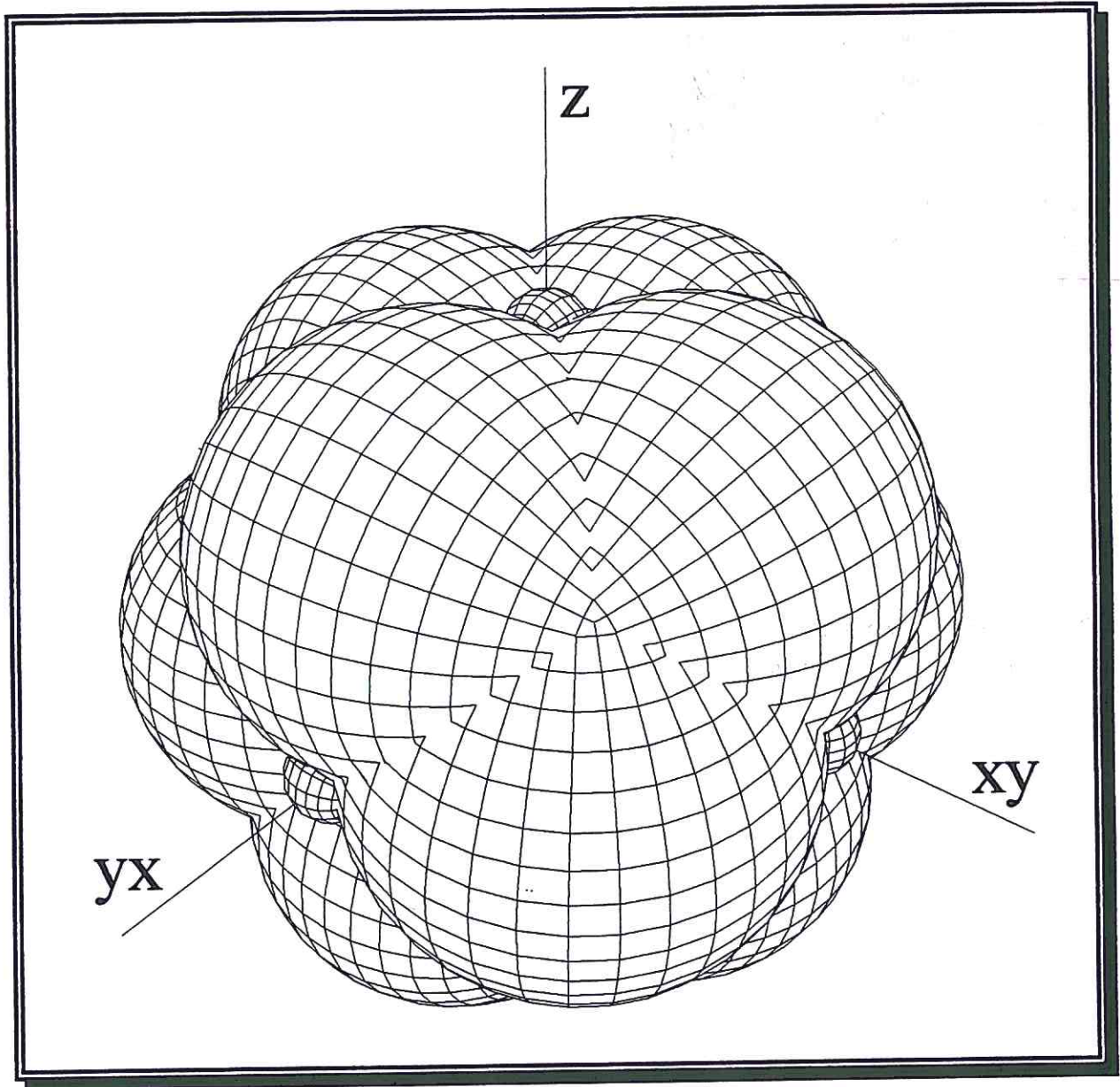


The Vortex Model of Matter[©]



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- A signature that appears to be "Ignatius" written vertically.
- A signature that appears to be "Peter" written vertically.

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Dedication

"Make things as simple as possible, but no simpler."

"As far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality."

"Imagination is more important than knowledge." - Albert Einstein

"Not only is the Universe stranger than we think, it is stranger than we can think."

"An expert is someone who knows some of the worst mistakes that can be made in his subject and how to avoid them." - Werner Heisenberg

"Everything we call real is made of things that cannot be regarded as real." - Neils Bohr

*"Research is to see what everybody has seen, and to think what nobody else has thought"
- Albert Szent-Gyorgyi*

"Seeing consists of the grasping of structural features rather than the indiscriminate recording of detail." - Rudolf Arnheim

**This missive is dedicated to all those who have challenged
the status quo and have experienced the exhilaration of
discovery.**

With special acknowledgements for their contributions:

Dr. Ferdinand B. Zienti, former research director at Monsanto Company who in the all the phases of this investigation gave his complete support and encouragement.

and

Robert Forbis whose enthusiasm for discovery led to careful proofing of the periodic table and its relationship to the Vortex Model.

"You are not thinking. You are merely being logical." - Neils Bohr to Einstein during a debate on Quantum Mechanics

**"The original motion of the 'atoms' was in all directions; it was a sort of vibration; hence there were collisions and, in particular, a whirling movement. ...this happened not as the result of any purpose or design but rather merely as the result of 'necessity'; it is the normal manifestation of the nature of the 'atoms' themselves."
- Democritus 460 B.C. - 370 B.C.**

Justification

The present state of theoretical physics is at an intellectual impasse. While particle research plunges onward with little to no predictive capability, explanations for the nuclear structure and nucleonic organization are no closer to reality. Evidence for this trend culminates today with such grand and expensive projects like the Super Conducting Super Collider. To decipher the code that tells the story of nuclear organization using that approach is like firing a fine Swiss watch at a brick wall, gathering up the pieces, and analyzing the clutter to determine how it worked. What we need today is not more of the powerful machines but more powerful theories that explain more clearly the data we have already collected.

Too many interesting ideas and alternative paths have been ignored over the decades in favor of the status quo. One time proponents of the occult "wavicle" theories of matter stepped back only to be ignored (DeBroglie). The father of modern quantum theory, Max Planck, never agreed to the Bohr model as the best and final offering. He opted instead to pursue other possibilities only to be shouted down by a more youthful and energetic Neils Bohr. With the mathematical sleight of hand offered by Heisenberg, that duo succeeded in locking in only one accepted possibility. The philosophical application of the uncertainty principle beyond its laboratory limitations signified the end of an intellectual search for more detail. The idea that nature is governed by uncertainty is unfounded. Our ability to use nature to verify our theories is governed by uncertainty but our imaginative capacity is most certainly not. *The notion of a quantized angular momentum of a classically orbiting electron proposed by Bohr and Heisenberg is "an assumption which cannot be further justified" so stated Nobel laureate Gerhard Herzberg. Yet the entire body of theoretical research and national expenditures rests upon this single building block, for it is upon this "assumption" that everything else has been derived.*

If the starting point is wrong, then it should be expected that the farther one gets from this point, the more error should be introduced, hence the repeated renormalizations so prevalent in quantum mechanical thought. When we must "cancel the infinities" created with such theories so as to make sense of the formulae, we are stretching the bounds of logic, common sense, and mathematical soundness in order to accommodate a beloved but untenable model. The basis for present

theory rests upon the Hydrogen model, a planetary system balanced by "charge" and kinetic energy. Yet this system proposed by Bohr violated every electromechanical observation laid out by Maxwell. The coulombic attraction of proton and electron does not exist within the confines of the atom. This we know by observation for the atom neither radiates nor has charge. But instead of trying to explain the cause of the force of charge, theorists continued on the same path. Bohr's planetary vision was a model that could not accommodate the data. Enter quantum mechanics.

Coulomb's law breaks down in the atom--- why? A question not pursued at the time was, "What is the field?" The nature of the field has never been adequately explained. Yet what we observe demands better explanation. Just ask the chemist how useful quantum mechanics is as a tool for chemical research.

The discovery of the neutron should have caused serious questioning of the starting point of Bohr. When the neutron was observed to decay into proton and electron, in violation of quantum mechanical predictions, more renormalization ensued. The fact that the electron mass was shed by the neutron, an impossibility using quantum mechanical theory, should have caused a fundamental re-evaluation. Even more astonishing is the mass difference of hydrogen and the neutron. Where did the mass go after the expansion? This question is conveniently side stepped within accepted theory. Now with billions of dollars in expenditures and trillions of dollars in debt, the time for alternative thinking has come. We can no longer afford as a nation the rejection of alternate theories without first testing their mettle. Intellectual research is relatively inexpensive and there is a wealth of data to examine. It is time to close the doors of the colliders for a time and open the minds of the researchers and theorists. What we need is a new baseline formulated from more than one insupportable assumption. One legged chairs are inherently unstable but with great care may be balanced. Two legs offer fatigue relief for a time but stability requires three legs. So now we offer a pedestal upon which we can build. Give it the scrutiny it deserves but use an open mind in probing its offerings. We would be glad to talk about the possibilities and perhaps offer answers to some of the most fundamental questions. For this to happen however, you must ask and if you ask, listen to the answer. One side has spoken for over 70 years now. It is time for rebuttal.

"The important thing is to not stop questioning." - Albert Einstein

"I can't imagine God playing dice with the Universe" - Albert Einstein

**"God not only plays dice, He sometimes throws the dice where they cannot be seen."
- Steven Hawking**

History

What follows is a relatively short history of an investigation into the structure of matter that began over thirty years ago. My colleague, Marshall Freerks, had just completed an investigation into a chemical process then known as the OXO, a process now generally recognized as olefinic carbonylation.

Since such a reaction proceeds catalytically in the presence of olefin, hydrogen, and carbon monoxide, regulation of all the ingredients is not a simple task. It is one, however, soon mastered by competent practitioners. It is also standard practice in industry for the researcher to fully document his work, delineate a mechanism for the reaction and propose a thermodynamic model from which engineering can competently scale up to an appropriately sized plant.

With the proposal of a pictorial representation of the coming together of the individual chemical entities, the clash with published theory began. Every mechanism visualized, following the rules then extant and largely still out there today, violated existing chemical and atomic theory.

The chemist, knowing the thermodynamics of his process, will in most cases opt for his own interpretation and let sleeping dogs lie. In this instance, he decided to kick the dog. There followed thirty years of dogged effort as to why atomic theory does not conform to chemical reality. In the process of doing so, a total review of the history of developments in physics was inevitable. Years were spent sorting through the arguments of the giants beginning with Newton and Descartes, the contributions of the astronomers, to Bohr, Rutherford, Planck, Schrödinger, and Einstein to the presently recognized greats such as Feinman, Bohme and Seaborg. Let me assure the reader that we have no intention to encapsulate that history. There are many excellent versions of these available. Any master text of physics will do as well in detailing the concepts we will address in what follows. Perhaps the best of the current publications is that of Crease and Mann, "The Second Creation".

Anyone completing a year of chemistry instruction in high school or later will have been introduced to atomic theory and thus to Bohr's model of the atom. Later pursuits into physics and chemistry revealed that beyond the Bohr construct of atomic hydrogen, the concept supporting atomic structure (or lack thereof) has come under withering attack. Alternative proposals ultimately lead to quantum mechanics, Relativity Theory, and finally to string hypothesis etcetera. How to pick and choose within this mathematical labyrinth to arrive at three dimensional reality is no easy task and defies solution to this day.

The penultimate find was coming across and reading the work of Nobel Laureate Maria Geppert-Meyer on the subject of Magic Numbers or islands of nuclear stability among the elements of the periodic table. This led to the reexamination of a variety of phenomena with regard to all the elements. This in turn led to what is later discussed in the section on proton-neutron ratios. All of the various comparisons between families of elements and groups of elements pointed to symmetry as the basis of atomic structure be it in the neutron, proton or electron band. The question became, "What symmetrical structure could be conceived and depicted in three dimensions to satisfy the demands of physics and chemistry?" The answer was as old as Mendeleev's periodic table. EIGHTEEN, EIGHTEEN, EIGHTEEN. Geppert-Meyers' magic numbers, two, eight, eighteen plus two etcetera, became the Rosetta Stone to physical reality.

The elements of symmetry manifest themselves in the most remarkable fashion in the formation of the nuclear particles. A close examination of the elements beginning with the hydrogen molecule shows two protons and two electrons. Helium on the other hand does not simply add another proton but two neutrons as well. What is revealed with the first two elements is that the odd element goes to great lengths to achieve nuclear symmetry while at the same time forming the appropriate molecular structure to achieve maximum electron symmetry. It is the latter that the chemist exploits, particularly in the area of catalysis. Thus, many models were tested. Only the one that fixed the electron in a suitable location about the nucleus in a manner that finds carbon always to be tetrahedral, the halides and noble gasses octahedral, and the general manifestation of the rule of eight (six plus two) satisfying symmetry had to be the answer.

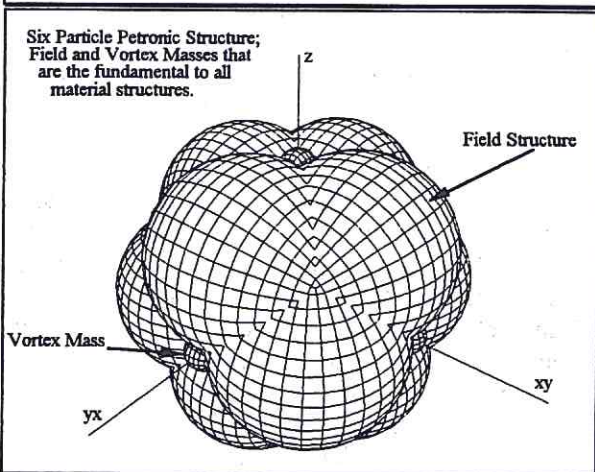
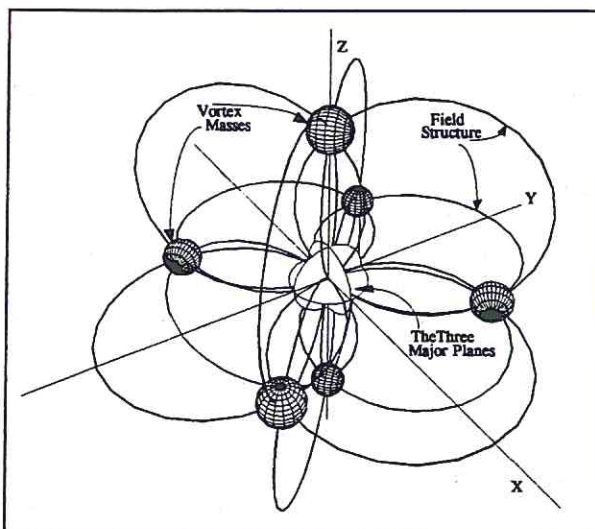
The process the electrons followed or obeyed should also be manifested in nuclear organization. Since there is no evidence to suggest that neutrons and protons differ from the electrons in this filling process, we assume that they too follow the same pattern. Electrons, protons, and neutrons add in concert to balance the structural field system that is the atomic containing field. *It is thus suggested that element formation obeys a single rule, the rule of symmetry.*

Meanwhile, the reading also led to such realities as parity, subatomic particles, field, field theory, electricity, photons, neutrinos, and a host of other items with which only a true physicist is totally familiar. *Our ultimate goal thus became, construct a model of the atomic system that would encompass all the data of reality.* If anything has been weighed,

measured, observed, or quantified by some physical means, it must conform to the model. Without question, a great deal of time and effort lead to many a dead end. Not unusual would be recent pictorial effort held up for criticism only to see a learned colleague point out a shortcoming. Gradually, applications of certain concepts were tested in the laboratory to solve chemical problems, ultimately leading to breakthroughs in a variety of catalytic processes. Details of some of these are discussed in the text.

Over a period of years other developments were taken to various colleges and universities for discussion and criticism. Individual pieces were sent to publications such as New York Academy of Sciences, Science, Physical Review Letters, and individuals such as Glenn Seaborg and Harold Urey. When outright rejection of our proposals did not come and in some cases valuable suggestions actually followed, it gave us the energy to continue our dogged pursuit of Quanta and Reality.

The three dimensional structure depicted here holds for not only atomic systems but for the structure of the nucleons as well. Shown is a fundamental set of six at one quantum level, the z-shell, named for the particle pair that occupy that major axis. A nucleon is this system in maximally contracted form while the atomic system is an expanded version of the same repeating construct. Within the constraints of this repeating pattern of spin-paired masses contained by a three dimensional d-1 field of the structural makeup shown, we will show a cohesive system leading from the fundamental quantum, $m = 2h/c^2$ ($v = 1$), to the electron mass and neutron and then to the atom and beyond.



The above illustrations depict octahedral symmetry within the constraints of the Vortex Model

The Case for the Vortex Model of Atomic Structure

... By 1930, many experimenters had measured alpha. It was almost exactly 1/137.

The constant 1/137 was, as it happens, first described by Arnold Sommerfeld, who supervised Heisenberg's dissertation at Munich. ...More important, however, alpha put together many of the mysteries of twentieth-century physics. Alpha is the ratio $e^2/\hbar c$...It was hard not to think that the magnitude of alpha must somehow be necessary, must be a consequence of deep and hidden connections among e, h, and c.

" People were fascinated by that number," remembered Markus Fierz, Pauli's assistant and co-worker in the late 1930s. "...The hope was that if one could figure out why this number had its particular value —1/137 — the whole thing would be solved. It was a magic number!"#

When investigations of catalytic chemical processes did not conform to conventional models of atomic structure, the approach using a fixed electron structure rather than a probabilistic quantum electron cloud was examined. Starting with the established equations of photon-electron interaction in the atomic field, a derivation of a true structure emerged.

Planck's study of black body radiation revealed the quantized nature of electron-photon interactions. This relationship coupled with Schrödinger's spectral studies of atomic absorption led Bohr to devise his system of quantized angular momentum. Using the same equations and data available then, but not assuming a quantized angular momentum, a different structural system was derived.

It is known that atomic absorption produces ionization, an endpoint of sorts for the electron mass. It has reached a maximum energy in a containing field. The maximum energy attainable by a mass is that involving the speed of light. Since, the electron upon ionization is at zero velocity, yet has maximum energy available from the atomic system, it must therefore be spinning gyroscopically with that energy.

Planck's work led to the relationship

$$E=hc\nu$$

a description of the energy added to a system to produce ionization, a point we now consider to be the electron maximum spin kinetic energy, $\frac{1}{2}m_e c^2$. At this point, the electron mass is free of the field for a time. In the case of hydrogen the electron leaves the field unbalanced with only the proton mass remaining. The field recaptures the electron mass, steals energy from the electron spin, and releases a photon. In so doing, the field contracts bringing the electron mass with it.

This field has a structure and a filling process revealed in the periodic table. The structure of the field is not immediately visible, however. We do know the quantum level of the electron in hydrogen referenced to its maximum spin energy condition. The ionization energy is expressed as $E = 1/n^2 \cdot \frac{1}{2}m_e c^2$, derived as follows.

From observation we know that the radius of an excited atom is larger than the same atom at ground state. We also know that ionization energy follows a $1/n^2$ relationship where n is defined as the quantum level of the excited electron. Planck's equation defines the photon energy that ionizes the atomic electron.

$$E = h\nu$$

This energy is related to the electron mass by

$$E = h\nu = \frac{1}{2}m_e v_o^2$$

where v_o is the value when the system is at the Bohr radius.

We know that $v_o = c/137.036$. The Bohr radius, r_o , may also be defined as $137.036(\lambda_c/2\pi) = r_o$, where λ_c is the electron Compton wavelength and $\lambda_c/2\pi = R_o$, the Compton radius. The striking correlation here is that both v_o and r_o are related to fundamental constants by the Sommerfeld fine structure constant ($\alpha = 1/137$). The nature of ν is that it has units of sec^{-1} . v_o/r_o also has the same units. v_o/r_o may be rewritten as:

$$\begin{aligned} [v_o/r_o &= (c\alpha)/(R_o/\alpha)] \propto \nu \\ E \propto v_o/r_o &= c/R_o \cdot \alpha^2 \\ E = h\nu &= hc/Kn^2R_o \end{aligned}$$

where $R_o = \lambda_c/2\pi$ and $n = 137.036$ inferring that the fine structure constant is defining a quantum level referenced to the constants R_o and c . The constant K is a pure number since the term c/R_o has the same units as ν . This leaves us with the relationship:

$$\nu = c/Kn^2R_o \tag{B.1}$$

When the atomic system is at the Bohr radius, $E = 13.6\text{eV}$. The electron and field each absorb $\frac{1}{2}m_e v_o^2$ in photon energy to achieve the maximum energy state possible for a containing system.

The wavelength of light that will liberate the electron mass is known by the shortest wavelength in the excited spectrum of hydrogen. It has a wavelength of 914 Angstroms or:

$$\nu = 3.28 \cdot 10^{15} / \text{sec} \tag{B.2}$$

We can now solve for K in B.1 since we know all the other terms.

$$\begin{aligned} K &= v_o/r_o \nu \\ r_o &= 5.29177 \cdot 10^{-9} \text{ cm.} \\ \nu &= 2.18769 \cdot 10^8 \text{ cm/sec} \\ K &= 12.60407 \end{aligned}$$

From "The Second Creation" by Crease and Mann 1986 page 111.

This number is too close to the value 4π to be coincidental. That number is also μ_0 , the magnetic permeability constant. Having a relationship to π is natural since we are dealing with the radius of a system. The value of 4π does not fit into a single circle of that radius. $4\pi r_0$ describes a system whose length is $4\pi r_0$ within a system of radius r_0 . The most natural solution to this picture is shown in Figure 1 relative the Bohr model. This comparison is presented to give the reader a reference point. The field circulation pattern shown accommodates paired spins in the vortices. Two vortices are "syn" while two are "anti". No masses may occupy the anti vortices of that field plane.

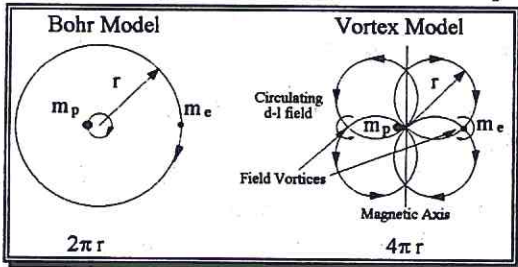


Figure 1

We have derived the equation:

$$h\nu = hc/4\pi R_0 \cdot 1/n^2 \quad B.3$$

To see if it is in agreement with Bohr's starting point, a remarkably efficient model for describing the hydrogen spectrum, we rework the equation knowing the end result. If it agrees, we have another verification of the treatment. Bohr derived his model long before the neutron was discovered so it is excusable that he could not quantify an atomic field. [The development of this concept is shown in a later chapter.] An accurate measure of the neutron mass would not come for many years. But for describing the excited spectrum of hydrogen, his equations were useful. Beyond hydrogen, we have serious problems however.

Bohr's starting point equations are:

$$\Delta E = h\nu = \frac{1}{2}m_e v_0^2 \quad B.4$$

$$m_e v_0 r_0 = h/2\pi \quad B.4$$

$$\text{and } m_e v_0^2 / r_0 = e^2 / r_0^2 \quad B.5$$

B.5 can be reworked into the form:

$$2h\nu = m_e v_0^2 = e^2 / r$$

This equation can now be reworked without considering "charge" since that quantity is related to the action of the field that we are now describing. If we take the equation $m_e v_0^2 = 2h\nu$ and apply it to B.4:

$$m_e v_0 r_0 = h/2\pi$$

$$m_e v_0^2 r_0 = h\nu / 2\pi$$

$$m_e v_0^2 = h\nu / 2\pi r_0$$

$$\frac{1}{2}m_e v_0^2 = h\nu / 4\pi r_0 = hc / 4\pi R_0 \cdot 1/n^2$$

From this derivation we can see that the equation B.3 has equation B.4 and B.5 as special cases of itself. We also recognize that by ridding the equations of the unexplained term called charge, the equations reduce to the equation derived from the spin energy and mass balance of a containing system. One major difference is that the angular momentum term, B.4, is quantized in Bohr's picture but remains constant in the Vortex model since both v_0 and r_0 are related to n , one decreasing by the same factor that the other increases.

Here we must recognize the relationship, $hc/4\pi R_0 = \frac{1}{2}m_e c^2$. This term is true at $n=1$. It describes the energy absorbed at that quantum level and radius as the amount to give the electron mass maximum spin kinetic energy.

$$R_0 = r_0 / 137.036 = 3.86159 \cdot 10^{-11} \text{ cm.}$$

This number is essential in dealing with the atomic system. The atomic system is only the expanding version of the contracting system that formed particles. In the process of the field striving for balance, the expanded field was the result, carrying the electron mass to a position of balance with the proton mass. The electron does not continue down to the proton as required by the charge equation. Instead, it is carried to the position it occupies away from the proton until the system attains balance. When the system loses the electron mass through ionization, it is again unbalanced as it was in the neutron. [The development of the hydrogen atom from neutron expansion is treated in a later chapter.] Instead of pushing the electron mass away from the center of the field as in the neutron expansion, it is drawn toward the center of mass in order to achieve balance once again. When balance is achieved, the net forces drop to zero and the system remains stable until excited by the proper photon frequency, a mass whose time factor and total energy match the simultaneous conditions of system size and remaining electron spin.

The Sommerfeld fine structure constant is related to the energy absorbed by the electron mass as revealed by v_0/c . This becomes obvious when one relates the maximum electron spin kinetic energy at ionization to that of the energy absorbed from the ground-state of hydrogen.

$$13.6\text{eV} / 25553\text{MeV} = 1/137^2$$

What this enables us to do is accommodate all 92 elemental electrons of the periodic table in integral quantum levels between 137 and 144. Bohr's quantum levels 1 and 2 actually correspond to the Vortex levels 137 and 274.

Atomic Structure and the Atomic Field

Assuming the validity of the proposed Vortex Model of hydrogen, we now examine the nature of the field and its origin. With the knowledge that hydrogen is the end result of neutron decomposition, the neutron becomes the focal point of the development of a cohesive system encompassing a quantized repeating structure in which the rules of spatial symmetry apply and hold for nucleonic, nuclear, and atomic periodicity.

We start by not assuming as true the occult notion of "massless energy". Everything that exists is matter. All matter is composed of energetic mass.

Here, let us examine what history teaches us concerning light and the photon-electron interaction in the electromagnetic field.

Light. According to Genesis, it was the first of all things created. It is the symbol of intellect, of knowledge, of good. It dispels the darkness and renders the unseen, seen. Yet this source of illumination remains in a sense, unseen itself. We know many of its properties yet its mechanisms are a mystery still. Is it particle? Is it wave? Is it both? Is it "massless"?

Long ago, Newton proposed the corpuscular theory of light in which he suggested that light was tiny particles that were thrown out of a luminous body in all directions. Huygens proposed the wave theory of light based on the similarity of the behavior of light and water waves. Planck's experiments made it clear that light emitted from a heated, luminous body was acting as though it were quanta, packets of light with discrete energy. Einstein explained the experiment that showed the relationship between the quanta, its energy and its frequency. It seemed as though the theories of Newton and Huygens had been merged, that the nature of the photon was both particulate and wave-like. At this point the investigation into a model of the photon reaches an end. The wave nature is used when the situation requires and likewise for the particulate analogy. One therefore asks: *"If light is a wave, a wave of what? If light is a particle, what is its mass?"*

The notion of a "wave" is easy to depict when dealing with a medium, but an incredibly difficult situation arises when someone states that there is no medium by which light "waves" are transmitted. The evidence for the "ether" as coined by 19th century physicists has been satisfactorily ruled out through a variety of experiments. While those experiments were looking for an ether with certain preconceived notions as to the "required" properties, Fitzgerald and Lorentz proposed that the ether affected the instruments to negate the effects of the relative motions. Nevertheless, the concept of this "motionless ether" no longer carries any weight in the scientific community. The notion of

an ether never left the minds of the theorists who in time replaced it with another, "space-time", that is responsible for the transmission of gravitational effects.

The particulate nature of the photon is much easier to resolve against the propagation problem through an "ether-less" space. Newton's tiny particles emanating from a luminous body would carry energy as translational kinetic energy of mass in motion. They would disperse uniformly obeying the inverse square law of the intensity of the light versus distance. They would deliver momentum, energy and mass to an object that captured them. The problem with this simple analogy is that all the particles of light would carry the same energy and would act independently. The quanta of Planck and Einstein have widely varying energies. Stranger still, they have characteristic "frequencies" that are directly proportional to the energy delivered by the quanta.

The electromagnetic nature of the light as revealed by Maxwell clouds the issue even further. It becomes easy to see why the attempts at describing light have reached a kind of impasse. Working the varied properties into a single model seems an insurmountable task, hence the wave-particle duality with which we must contend today. Yet this model, while proving useful in many situations, leaves one feeling at a loss as to what the "true" nature of the photon really is and that part of the picture always seems to be missing.

For many of the last one hundred fifty years, light was thought to be "massless". The equations of Maxwell have that conclusion as a consequence. Coulomb's law is another "ideal" equation whose inverse square law requires a "massless" photon. Yet the absolute rigidity of the inverse square term is hardly established fact. Many experiments have been done to establish the actual relationship in Coulomb's equation, with one of the earliest attempts in 1769 by John Robison. In 1971, Williams, Faller and Hill experimented to determine more accurately the inverse square relationship in Coulomb's law and arrived at an upper limit to the mass of the photon. Earlier, Schrödinger, using Maxwell's equations and the magnetic field of the earth, had proposed that the upper limit for the mass of the photon was between 1 and $2 \cdot 10^{-47}$ grams. The value determined by Williams, Faller, and Hill was $2 \cdot 10^{-47}$ grams, within experimental agreement.¹ While this value is exceedingly small, it is not zero. However, there is a seeming conflict with the established theories of a rest mass traveling at the speed of light. Here is light, with a rest mass traveling at "c" and without having "infinite" mass or energy. While

¹"The Mass of the Photon" by Alfred Scharff Goldhaber and Michael Martin Nieto. Scientific American, May 1976, pg. 86

Goldhaber tried to resolve this seeming inconsistency by proposing that light did not travel at exactly the speed of light, that its speed varied with energy and therefore frequency, this assumption does not have to be made to formulate a consistent approach to the nature of the photon.

Maxwell established the electromagnetic nature of the photon. One origin of the photon is the result of the interaction of masses in "field", electrons moving and causing the electric field to "oscillate". If the photon is massive and is the result of field interaction, it might also be proposed that the field responsible for the photon emission is also massive. If it is to have mass, how will it be determined and what would have to be its properties?

There are certain things we do know about the photon. For instance, we know the energy it delivers to an electron in the atom or in the photo-electric effect. By examining these phenomena and asking some pointed questions, keeping in mind the massive nature of the photon, a determination of the mass of the photon can be made, and through its interaction with the field of the atom, a "measure" of the mass of the field.

We will assume that this rest mass is actually moving at the speed of light since there is no evidence that it is doing otherwise, which leaves us no alternative but to use the "classical" equations to define the energy of this mass. The translational kinetic energy of the photon mass is determined by the equation:

$$E = \frac{1}{2}mc^2 \quad \text{Velocity K.E.}$$

The total energy of any mass is,

$$E = mc^2 \quad \text{Total Energy}$$

leaving us the task of assigning this mass another quantity of energy that equals its translational energy. This is done by assigning this same mass a spin kinetic energy equal to the translational kinetic energy for a total of:

$$\text{Spin K.E.} + \text{Velocity K.E.} = \text{Total K.E.}$$

$$\frac{1}{2}mc^2 + \frac{1}{2}mc^2 = mc^2$$

When the photon "collides" with an electron as in the photo-electric effect, it delivers kinetic energy to the electron. Since the photon is not re-emitted in this reaction, and since it also has mass, we can say that the photon came to rest in the atom that emitted the electron. The photon delivered its translational kinetic energy to the electron that left. This energy of the photon is known by the equation:

$$\Delta E = h\nu = \frac{1}{2}m_\nu v^2$$

If the electron received all the translational energy, then the photon that came to rest in the target atom still has half its original total energy, the spin portion. The mass of the photon that came to rest in the surface of the target atom and moved into the

surface field can then be determined by using the above relationship. The kinetic energy of the photon that released the electron is:

$$E = h\nu = \frac{1}{2}m_\nu c^2$$

where m_ν is the mass of the photon. If we want to know the mass per unit frequency of the photon:

$$m_\nu/\nu = 2h/c^2 \quad (C.1)$$

$$m_\nu/\nu = 1.474523 \cdot 10^{-47} \text{ gm} \cdot \text{sec} \quad (C.2)$$

This number falls almost exactly between the limits determined by Schrödinger and is in agreement with the experimental results of Williams, Faller, and Hill. The above equation will give progressively lower values for the mass as the frequency is lowered which is also in agreement with other experimental methods using very low frequency electromagnetic oscillations. At this point, we will assume that the photon has mass and it follows the relationship shown in L.2. We will also assume that the field that spawned the photon also has mass but always has only half the energy of the equivalent mass in the form of a photon. This assumption will become clear later when we deal with the atom of hydrogen and its formation from the "expanding" neutron.

We now have a definition for the photon that includes: mass, spin, and velocity. Structure is still an unknown but we do have information on which to build a description that will accommodate the data. We also have a similar description for the "field", from which the photon is inseparably linked.

What still has to be defined is the underlying structure that allows the transformation from field mass to photon mass. We know that this transformation takes place in the atomic system, the exchange of energy from an electron to the atomic field that releases or absorbs a photon. Also known is the transformation of "particle" mass to photon mass that takes place when the proper particles meet in a field structure. The positron-electron reaction is one such transformation.

The product of the reaction is high energy photons that carry away the mass of the particles *and the field*. If the photon is the source of particle structure, which is evident from such a reaction, then the moving and spinning light mass that forms the field-particle pair (the positron mass or the electron mass), should do so without losing energy. How would such a conversion take place and where would the energy of translation and spin be placed inside the "stationary" particle?

What follows is a scenario that allows this kind of transformation while maintaining the photon energy in the particle structure.

If the photon is a structure of mass that has both spin kinetic energy and velocity kinetic energy, then it is logical to assume that whatever mass it forms, contains all the energy that the photon brought with it, both the spin and translational components. If a larger "particle" mass, (a neutron for example), is formed of masses contained by field, then this particle would have half its mass in the field portion and the other half would be the particles, (electron masses), contained by the field mass. This is not an easy topic to visualize, so let us consider the proton as an example.

The proton is a mass of incredible stability. One striking feature is the nearly integer multiples of the electron mass that describe the proton mass. The periodic table also reveals a fascinating tale of repeating structure that shows itself in the sequences of 18. The periodic table is the Rosetta Stone of physics. Decipher the underlying code of structure and the invariant symmetry of the nuclear portion of the atoms and the whole of atomic structure will be laid open along with an understanding of the photon and its role in particle formation.

If we apply the repeating sequence of sets of 18 particles to the structure of the proton, a stunning correlation is revealed.

If we are to set the structure of any particle mass as one of field mass containing spinning masses, the result is that the containing field would have only half the energy of the equivalent photon mass that spawned the particle's field mass. This was proposed earlier in the discussion of the photo-electric effect where the photon gave half its energy to the electron released, moving into the surface field of the target atom.

The reaction of photons and electron masses in the atom result in the photons giving half their total energy to the electrons. This relationship implies that the containing field of the system absorbs the photon mass and half its energy while the particle mass increases its total energy by an equal amount. The field structure that defines the dimensions of the proton is the result of light matter that "contracted" into the proton mass, half the light matter becoming the containing field and half its mass becoming the particulate masses contained by the field portion. This leaves us with a structure of field containing "spinning" masses, with the masses at the maximum spin kinetic energy possible for any particle, $\frac{1}{2}mc^2$. This spin energy of the particles is exactly matched by the field energy that is containing the particles. The energy and mass of the light matter making up the proton would be distributed in the proton structure as follows:

$$\begin{aligned} \text{photon energy} &= m_p c^2 = \text{proton energy} \\ \text{field mass} &= \frac{1}{2}m_p \\ \text{field energy} &= \frac{1}{4}m_p c^2 \\ \text{particulate mass} &= \frac{1}{2}m_p \\ \text{particulate spin energy} &= \frac{1}{4}m_p c^2 \\ \text{particulate energy of mass} &= \frac{1}{2}m_p c^2 \end{aligned}$$

If we apply this concept to the periodic progression of 18 particles per completed quantum level, then the proton mass would contain several levels of 18 particles. These particles would be contained by an equal amount of field mass in a three dimensional structure with symmetry and dynamic balance. Since half the mass of the proton is particulate, that leaves us with:

$$1836m_e/2 = 918m_e$$

in field-contained electron masses.

This represents:

$$918m_e/18 = 51 \text{ levels of } 18$$

This complete structure of 51 levels of 18 represents an extremely stable and symmetrical system of field-particle compliments reflecting the periodicity of the table of elements.

If we now extend the process beyond the 51 levels, the next stable configuration should occur when a "magic number"² is added to the completed structure. The first magic number is 2, which would place the mass of this particle at $1840m_e$. We have extensive data that this is not a stable configuration since the heaviest stable (or quasi-stable) particle is the neutron.

While symmetry appears to be maintained, instability is the result. Density must be the limiting factor in the contraction of the field structure.

For the neutron to have been formed, this $1840m_e$ particle decays, sheds an electron mass along with its complimentary field unit leaving $1838m_e$, a structure of 51 levels of 18 plus 1, which is an unsymmetrical and therefore unstable configuration. In the process that formed the neutron from its equivalent photon mass, this unstable remnant would be somewhat stabilized by additional field and the spin it would give to the contracting mass. This low spin particle would have relative stability over the zero spin version of the same configuration.

What we see from the data on the neutron and the resulting constituents is:

$$\begin{aligned} m_N &= 1838.68m_e \\ m_p &= 1836.15m_e \end{aligned}$$

The mass of hydrogen is:

$$m_p + m_e = 1837.15m_e$$

²See the work of Maria Geppert Meyer on the role of magic numbers in the sequence of stable atomic nuclei

The "missing" mass difference from the mass of the neutron, $1.53m_e$, is contained in the atomic field components, $1m_e$ associated with the atomic electron and $.53m_e$ forming the beginnings of the nuclear field structure.

The expansion of the neutron to the atom of hydrogen has increasing stability as the goal. The unsymmetrical distribution of electron masses in the field structure of the neutron cannot be maintained so the system attempts to rid itself of the offending odd electron mass. The field expands outward from the center of the system carrying the electron mass with it. The mass left behind, the proton, is caught within the expanded field structure. This "electron mass of field" effectively captures the proton. However, no particulate mass may occupy the center of the field structure so the proton takes up a position as close to the center of the field structure as possible. This situation is one of unsymmetrical mass balance since the proton mass alone does not stabilize the expanded field structure's desire for symmetry.

The "spinning" electron subsequently fills the requirement of mass balance, giving up 13.6eV of its $.25553\text{MeV}$ in spin kinetic energy to the field that releases a photon that carries away the spin energy loss and an equivalent energy from the field. The mass of this photon is calculated using the same method in determining the mass per unit frequency,

$$E = \frac{1}{2}mc^2$$

if we are only considering the spin energy loss of the electron. However, the photon also carries an equal amount from the field that released it for a total of $27.2\text{eV} = mc^2$.

The mass then calculates to be:

$$27.2\text{eV} \cdot 1.602 \cdot 10^{-12}\text{erg/eV} = mc^2$$

$$m = 4.848 \cdot 10^{-32}\text{ gm. or}$$

$$27.2\text{eV}/511\text{MeV}/m_e = 5.32 \cdot 10^{-5}m_e$$

This mass is not in disagreement with currently postulated values of the neutrino mass, but at this point, we are not claiming that this photon is the neutrino, only that the mass released by the field in the electron's drop to balance would have the above value.

Another dramatic revelation occurs with this system of spin and balance. Since photon excitation follows the inverse square of the quantum level, what quantum level would the electron occupy in this relaxed state of hydrogen if the reference point for the quantum stages is the electron zero spin state? The electron at maximum spin has a spin K.E. of $.25553\text{MeV}$. The photon energy delivered to the "ground state" electron in hydrogen is 13.6eV . This returns the electron to maximum spin and ionization

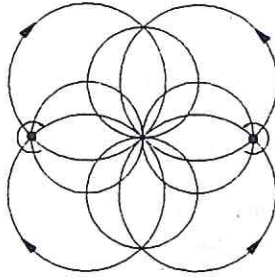


Figure 2

from the expanded field. If photon energy varies as $1/n^2$, then:

$$13.6/255530 = 1/n^2$$

$$\text{or } n = 137 \quad (\text{L.3})$$

This is more than mere coincidence! The quantum level of the first electron in the Periodic Table has the value of the Sommerfeld fine structure constant! The Sommerfeld fine structure constant is a direct consequence of the assumption of a mass-field structure driving

to a state of mass balance through the vehicle of spin kinetic energy exchange in an atomic field.

The following speculation on the process of particle formation from the light mass reaction results from the ground rules concerning the particle mass structure of field and spinning masses. In the initial process of transformation from light mass to contracting particle mass, the light particle fields overlap forming the vortex structure of Figure 2. This structure is *derived* by re-solving the energy balance equations for hydrogen that we have shown in the previous section. Half the mass of the reaction moves into the structured field and half into the vortices formed in the overlap. Each of these vortices is a center of structure all to itself, a place where a mass can attain maximum stability and spin kinetic energy. Since the mass that is entering this stationary structure already has maximum spin kinetic energy, it tends to a spin-only condition that is the most stable. However, the translational kinetic energy that is brought with the spinning mass prevents the structure from remaining stationary, and so the structure itself begins to spin. The masses that moved into the vortices remain fixed in relation to the structure as it spins. The mass that forms the field structure also desires this spin-only condition that results in the field structure's contraction to maximum density and spin kinetic energy. This process of mass-field pairing continues with each additional pairing and contraction. The contracting structured mass-field pairs fill the space of the continuing overlap with opposing spin kinetic energy layers for a net zero spin momentum. The culmination of this process is a mass with zero net spin momentum that would occupy a vortex in any subsequent stage of particle formation.

The stages subsequent to this would have the light mass moving into the field structure keeping its spin energy component and giving its translational kinetic energy to the zero spin mass of the previous stage. Within these and all subsequent stages of particle formation, the containing field structure as a whole, remains spin-stationary while contracting, with the vortex masses moving to maximum spin. It is a static structure that remains so until the structure is

completed and it becomes a zero spin particle for the next stage. It in turn is placed in a vortex and achieves maximum spin kinetic energy.

This process continues until the structure can no longer support contraction, a state of maximum density for the light matter that initiated the process. This structure is the neutron, the most massive quasi-stable particle. This mass is stable in the nucleus and has a relatively long half life outside the nucleus when compared with the half lives of other sub-atomic particles.

The neutron is a structure of the type defined above, a near zero spin mass containing masses in vortices at maximum spin kinetic energy. The masses in the vortices are electron masses that are balanced with an equivalent mass in the field containing each spinning electron mass. If the neutron is representative of the number of particulate masses in vortices in each stage, then we can calculate the number of stages from the unit frequency photon mass to the neutron. This is accomplished by successively dividing the number of prior stage mass equivalents into each successive stage mass until we arrive at the photon unit mass. If the unit frequency photon consists of three pairs of opposite spin mass units, m_u , then each of these mass units has a mass of one sixth the mass per unit frequency or,

$$m_u = 2.457538 \cdot 10^{-48} \text{ g.}$$

The neutron mass resulted from the decay of a particle of $1840 m_e$. By successively dividing the neutron mass by 1840 until we reach m_u , the number of divisions will be the number of stages. The result yields between 7 and 8 stages. The process stops at the neutron because of the density limit, otherwise the process may have continued. If instead we now assume that there are six stages between the electron mass and m_u , then the number of prior stage masses per stage is calculated from:

$$\sqrt[6]{(m_e/m_u)} \approx 2680 \text{ prior stage masses/stage}$$

Since half the mass is in vortices and half is in the field of each stage, then there would be 1340 vortices in each stage or *74 levels of 18 particles plus 6 plus 2 in each stage up to the electron mass.*

This speculation assumes a "unit" mass for the photon that is based on the observed phenomena of frequency of a photon. If unit frequency implies a single structure or mass unit, then any photon frequency is just the number of these mass units that pass by a given point in a given amount of time. This also says that any unit wavelength of the photon also carries the same mass since wavelength is related to frequency by the speed of light. It was presented to enable the reader to visualize the process by which the photon

mass becomes particle mass, such as the neutron or electron.

This overview of photon, field, mass, spin and balance, is a precursor to what we feel is a radically different alternative approach to understanding and predicting the behavior of energetic matter. We do not intend to challenge existing experimental evidence. On the contrary, what we are proposing with this model is a vehicle that accommodates more fully the plethora of experimental data on chemistry, sub-atomic particle physics, and astronomical observation. By giving the photon its due and conceding that it is massive, obeying the same laws of matter in motion as observed by Newton, we sidestep the inherent difficulties of theories such as relativistic quantum mechanics with its "canceling infinities" and no physical analogies. The photon mass and the subsequent definition of the "field" from which all matter is spawned are all that is required to form a framework of simple mathematics in which the processes of the universe unfold.

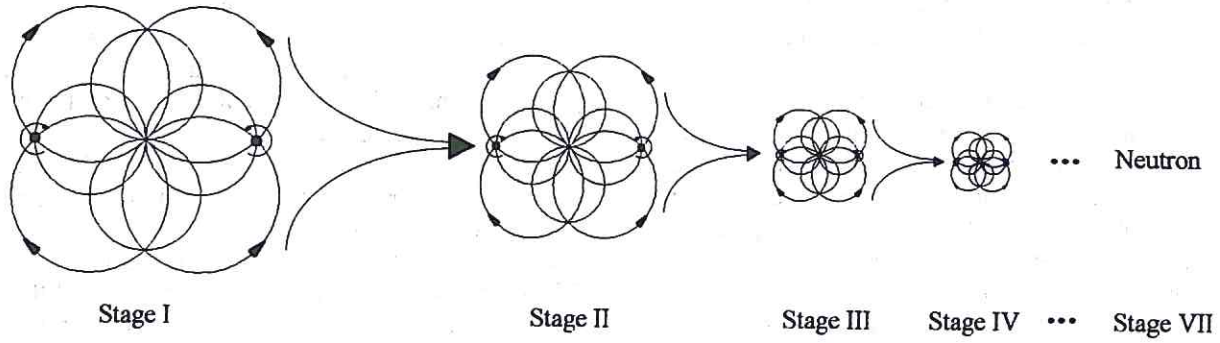
While this approach may not be a reflection of the reality of the universe, we feel that it is indeed a simpler and more concise model by which the physical properties of the universe may be explained and predicted. We feel that the universe is not absurd, not "uncertain", and that the inherent order observed is the result of the fundamental structure of the field that governs all physical interaction. Its properties are few but incontrovertible. It works between the extremes of velocity kinetic energy, spin kinetic energy, density and wavelength. Within these extremes is a system that takes matter from light to the neutron, to the atom, to the sun, the galaxy, and ultimately back to light from which it all began.

The question that remains is the definition of the exhibited field properties and the structural relationship it has to particulate masses in the organizing process. The best place to look for this structure is in the field of the atom of hydrogen since, unquestionably, this is where we have the most data to examine. Consequently, since this was the starting place for Neils Bohr and the birth of modern quantum mechanical thought, a serious direct comparison between the foundation of the present theory and the proposed Vortex Model is possible. This will enable the reader to examine the two models side by side and view the relative merits of each and the ability of each to explain more than just the atom of hydrogen. We feel that it will become clear, (painfully to some), that the mathematical treatments applied to Bohr's model to get it to fit the data are completely unnecessary for the Vortex approach to achieve the same fit. Beyond that, this simpler analogy is applicable to any structured system, any element beyond hydrogen, without the

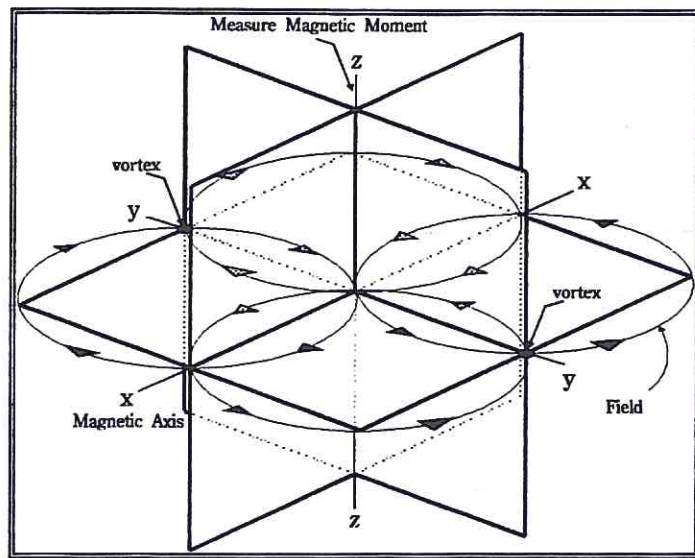
need for all the mathematical gymnastics, renormalizations, and virtual particles and virtual reality required for the present models of the atomic structure.

Pictured below is a representation of the contraction process that begins with the formation of vortices in the field and the condensation of matter in those vortices, the conversion of velocity kinetic energy

to spin kinetic energy of the masses in the vortices, and the subsequent contractions, stage by stage, from the fundamental quanta to the fundamental nucleon, from the state of maximum expansion and least density to that of maximum contraction and highest density within a zero spin structure.



Mass Balance, Symmetry and Periodicity



We know that the Bohr-Rutherford concept of atomic structure is flawed. We also recognized that the introduction of quantum mechanics leaves us with a model that defines structure from the "outside in". On the other hand, no one questions the fact that organized matter is a quantized system.

We reintroduce Bohr's calculations to illustrate the problems and contrast how the Vortex Model alleviates the difficulties. *From Bohr's introductory equations, his assumptions about the nature of charge and the state of the atomic electron, theorists have derived the current state of the art.*

$$mv_o^2/r_o = ke^2/r_o^2$$

Centripetal force = Electromotive force,
where Bohr's angular momentum model,

$$m_e v_o r_o = nh/2\pi$$

leads to the state defined as "probability and chance", the Uncertainty Principle, and the concept that mass increases with velocity as represented by the equation that shows mass going to infinity,

$$m = m_o / \sqrt{(1-v^2/c^2)}$$

When we re-examine Bohr's equations we find,

$$ke^2 = m_e v_o^2 r_o$$

$$m_e v_o^2 r_o = (h/2\pi) \cdot v_o$$

$$(h/2\pi) \cdot v_o = (h/2\pi) \cdot (c / 137.036)$$

$$hv = \frac{1}{2} m_e v_o^2 = hc/4\pi R_o \cdot 1/(137.036)^2$$

$$R_o = \text{Compton Radius} = 3.86159 \cdot 10^{-11} \text{ cm.}$$

137.036 = quantum number of the Hydrogen atom ground state relative to the state defined by $hc/4\pi R_o$. This leads to the proposed structure of the hydrogen atom as shown in the figure 3.

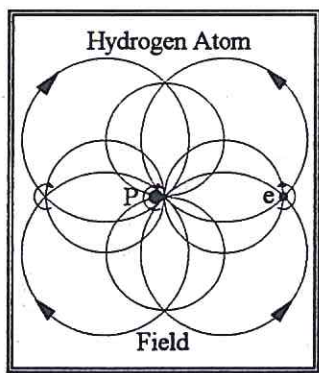


Figure 3

While hydrogen is the simplest atom to model, it is not representative of most elements. This atom lacks the neutron. For determining periodicity of the electron shell, hydrogen is an adequate starting point, but to encompass nuclear periodicity we must begin with deuterium. The problem we face is placing the neutron and proton in their proper positions in the nucleus relative to the center of the atomic field structure. To do this we will follow our fundamental precept of mass balance in the atomic field (see Figure 4).

We establish the initial positions of proton and neutron in the nucleus using balance with the established position of the electron. Starting with the Bohr radius that defines the radius of the atom and therefore the extent of the field, we place the electron in its vortex located $r_o/\sqrt{2}$. This places the electron mass at:

$$\text{Bohr radius} = 5.2917706 \cdot 10^{-9} \text{ cm} = r_o$$

$$\text{Electron location} = r_o/\sqrt{2} = 3.741846 \cdot 10^{-9} \text{ cm} = r_e$$

$$\text{Elec. Mass Moment} = m_e r_e = 3.408647 \cdot 10^{-36} \text{ gm} \cdot \text{cm}$$

Balance dictates that the proton mass moment should equal the electron mass moment in hydrogen. This places the proton as follows:

$$m_e r_e = m_p r_p$$

$$r_p = m_e r_e / m_p = 3.408647 \cdot 10^{-36} / 1.6726485 \cdot 10^{-24}$$

$$r_p = 2.037874 \cdot 10^{-12} \text{ cm}$$

This radius relative to the Compton radius is at 1/19. This is the starting location for placing nucleons in the nucleus. It is the position taken by the neutron of deuterium. The neutron balances the proton in concert with the electron.

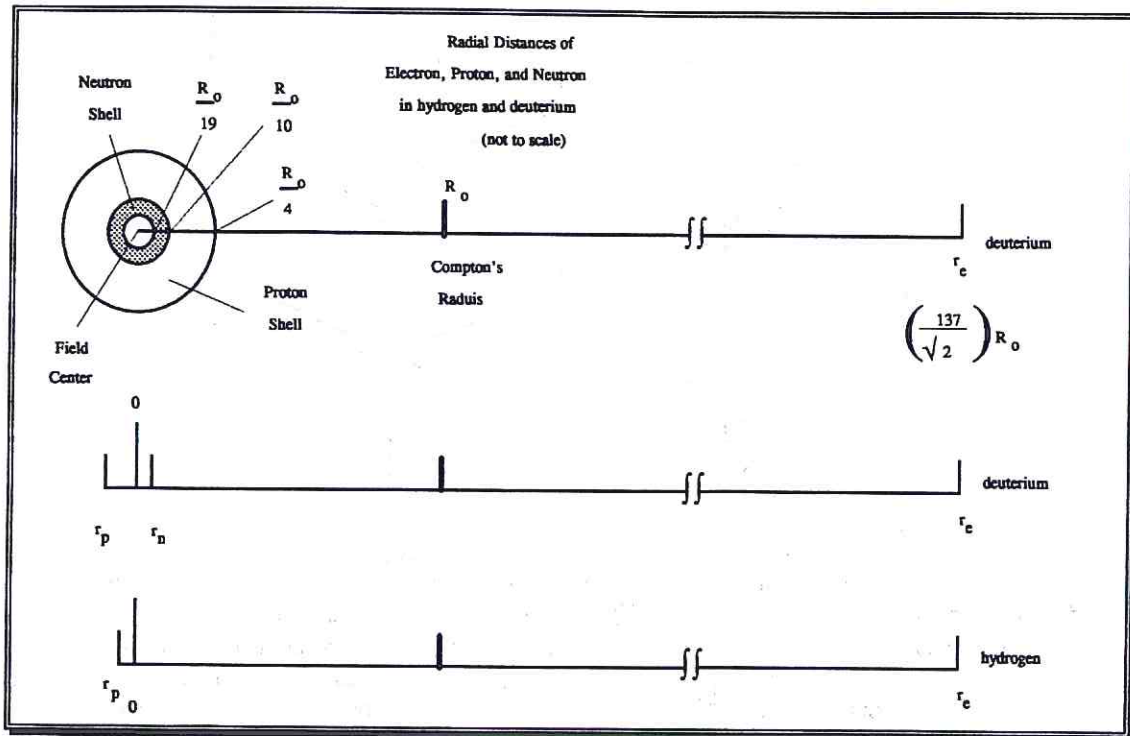


Figure 4

$$m_e r_e + m_n r_n = m_p r_p$$

$$3.408647 \cdot 10^{-36} + 3.413346 \cdot 10^{-36} = m_p r_p$$

$$r_p = 6.821993 \cdot 10^{-36} / m_p$$

$$r_p = 4.078557 \cdot 10^{-12} \text{cm}$$

This places the proton of deuterium at quantum number 1/9.48 relative to the Compton radius.

These positions inside the nucleus are in agreement with magnetic moment data available on the atom of deuterium. We use the reference position of the electron mass to determine the primary positions of the neutron and proton in deuterium. It should be noted that the primary position of the electron does not change. Moseley's Law shows that the X-ray edge of uranium is directly related to the quantum number $137.036R_0$.

The periodic table follows a geometric pattern in three planes, XY, YZ, ZX. The systematic arrangement of the atoms in the Periodic Table correlates with the facts of chemistry and physics when we correctly account for the lanthanide contraction.

Because we define quantum number one at $hc/4\pi R_0$, the ground state of the hydrogen atom electron is at quantum number 137.036. With each quantum number advance, the vortex structure accommodates 18 particle sites. In the structural system the pattern advances 45° per quantum number (see Figure 5).

There are three identical sets of six vortices (particle sites), that make a complete set of eighteen. The spatial relationships of the three identical sets

(subshells) are set against the three major axes and the six minor axes. A single subshell has two vortices on a major axis and four on the perpendicular minor axes. The z-shell is depicted in Figure 5 among the complete set of 18 at one quantum level.

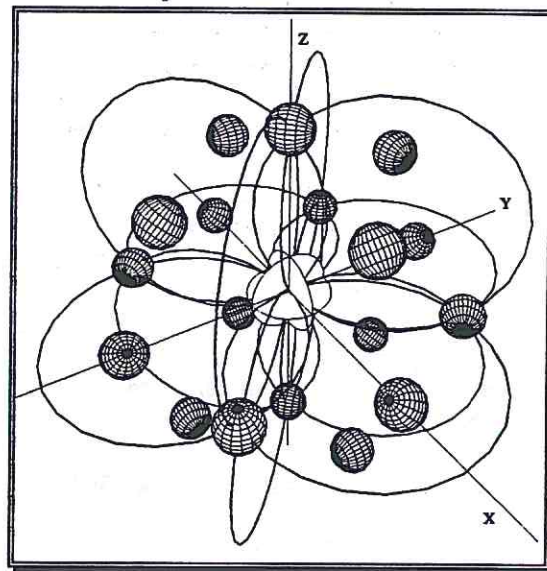


Figure 5

The illustration depicts the field orientation of one of the three sub-shells relative to the total of 18 sites that make a single quantum level. From the figure we see that only two of the six vortex locations of that subshell lie on a major axis. That is the axis for which the subshell is named. In this case, the z-shell,

Symmetry

The beryllium atom depiction shows the 1s and 2s energy levels. It further shows that the entry of the first two electrons at a quantum level occupy the major axis sites. We assume that the nucleus is filling in similar fashion in each shell (proton and neutron). Next we see the addition of 2 "p" electrons and the formation of carbon. The 2s electrons have moved to the minor axis sites of its original subshell position to accommodate the known tetrahedral structure that carbon exhibits in its chemical environment. The 2p electrons are on minor axis sites of the second level y-subshell.

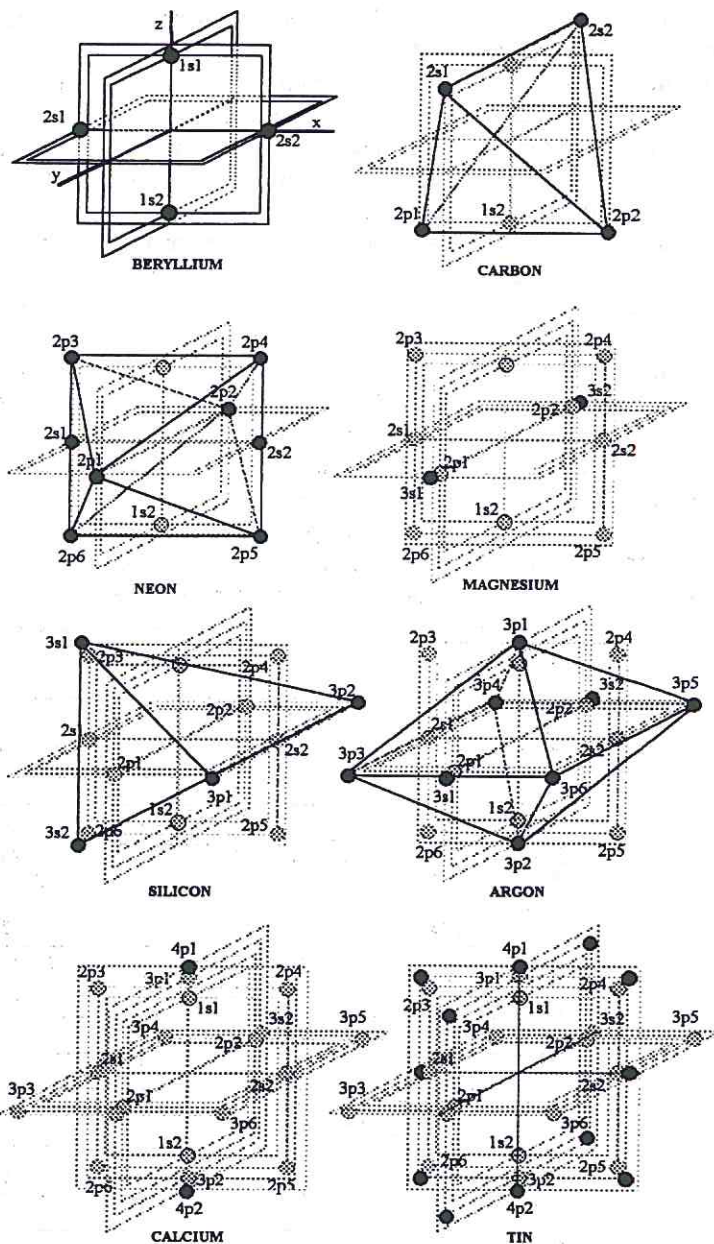
Arriving at neon, we have completed the "p" sequence. The process produces octahedral symmetry on the y-axis subshell. This symmetry is reflected in all subsequent noble gas configurations.

With a completed octahedral configuration, the next set of "s" electrons take their positions along the last major axis, in this picture the y-axis, and we are now at magnesium. The addition of the 3p electrons of silicon will start with minor axis sites of the third z-subshell and the 3s electrons migrating to minor axis sites on the y-subshell achieving tetrahedral symmetry much like carbon but in a different spatial orientation.

With the formation of calcium and the 4s electrons eclipsing the 1s electron sites, it is becoming obvious that this filling process is producing gaps. It is because of this that the sequence breaks and the transition begins in order to fill the vacant x and y subshells at the third quantum level to maintain maximum stability and balance in three dimensions. This process then repeats for the next series of 18 elements. At lanthanum, the sequence again breaks to back fill the four remaining sites at the first level and the ten vacant sites at the second quantum level.

It is appropriate at this point to discuss the nuclear sequence as it involves electrons, protons, and neutrons and their role in three dimensional symmetry. While the hydrogen atom has no neutrons, molecular hydrogen exhibits planar symmetry.

Figure 6 shows the actual relationship between the electron and proton in the atom and the relative change with the formation of the molecule. The formation of the bonding center is an action of the field, not the electrons. When atoms come together in chemical formation, the field "flows" into a common



center and the electrons move to a position of balance in the vortices created in the overlapping fields. This very same concept should hold when taken into the nucleus as a descriptor of nuclear fusion. A more complete description of this process will follow at a later date. What we have included in this document are several examples of the use of this concept in chemical processes.

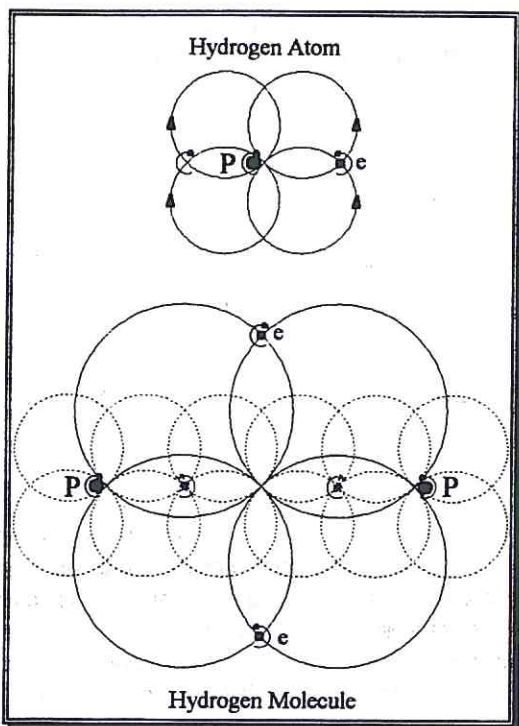


Figure 6

With the addition of two neutrons and the formation of the helium atom, the system attains octahedral symmetry encompassing all three nucleon shells, proton, electron, and neutron, each of which occupy a major axis site. This assumption has validity when we examine the filling sequence of the neutrons in concert with the protons. Here we refer to the table of isotopes that reveals that for every odd proton element, there are even numbers of neutrons. There is a single exception in element number seven, nitrogen. (We will leave it to the theologians to explain this anomaly.)

This move toward symmetry is particularly evident when the neutron compliment is approaching or is at a magic number value. Examples are potassium and calcium, vanadium and chromium. The magic number sequence can occur at the proton or neutron level or in combination with each other. Examples are calcium and nickel or in the case of the neutron, rubidium through zirconium all of which have 50 neutrons. Elements with an even proton compliment will accommodate a host of stable isotopes while the proton compliment at a magic number will

accommodate an even greater number. For example, there are 10 stable isotopes of tin, element number 50.

Referencing Table 1 and in particular element 80, mercury, we see that it is the first element at the completion of a transition stage following the lanthanide contraction. This represents the most compact and complete shell configuration to this point. All previous quantum levels are filled with 18 and the first level with its complement of six. There are only two on the outside, the s electrons of barium. This element with 80 protons stabilizes 7 isotopes with neutron compliments ranging from 116 to 124.

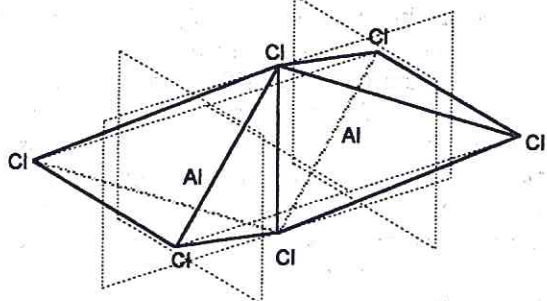
Anyone examining a table of the isotopes can find a variety of other examples other than those mentioned to verify what we have stated here concerning symmetry and the filling order and their interrelationship. For more information on magic number sequences and their effect on the stability of the atomic system, refer to the work of Maria Geppert-Meyer.

Table 1 shows the filling sequence of the quantum levels in the proton and neutron shells of the nucleus. What is not immediately obvious is the changing ratio of protons to neutrons with increasing atomic number. Looking at a table of isotopes we again see that after calcium, there are no longer any atoms whose neutron compliment matches that of the protons. It is because of the shell locations, with the neutrons inside the proton shell, and the neutrons with the electrons balancing the protons that the ratio goes in favor of the neutrons. The filling process has all the nucleons moving into progressively higher shell locations. The protons contribute more to the moment arm because they are on the outside. Progressively more neutrons are therefore required to balance and stabilize the proton compliment whose mass-distance product rapidly outruns that of the neutrons. This results in the neutron shell filling more rapidly than the proton shell ultimately leading to the neutron-proton shell interference. It becomes obvious looking at Table 1 why the proton/neutron ratio curve breaks at uranium. The neutron shell is nearly full and beginning to crowd against the first quantum level of protons. The table also predicts the maximum possible neutron compliment of 162. The transuranic elements from 100 to 106 all have 157 neutrons.

The Vortex Model and the Chemistry of Phosphorus

After some five or six years of trial and error we came to the conclusion that the secret to fully understanding chemical bonding and chemical reactions was to be found in symmetry. The symmetrical distribution of electrons in space about the nucleus in specifically fixed positions had to be the key. An opportunity to test this hypothesis presented itself in the 1960s with the advent of the soon-to-fly SST. The historically minded may remember that the American version had its life curtailed by Congress because of such concerns as the destruction of the ozone layer by the exhaust gases but in reality, because of the cost to the taxpayer. Before the demise became reality, research had devised a potential functional fluid for its hydraulic system.

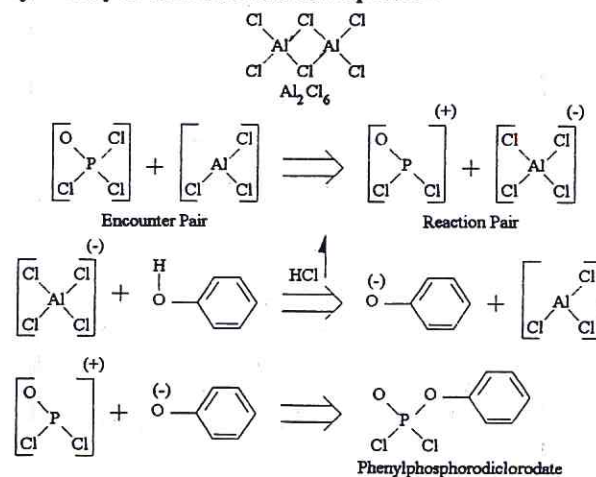
This candidate fluid was a phosphorus based chemical (a phosphoramid) for which a large scale process had to be developed. The method used for its small, lab scale preparation had involved the reaction between phosphorus oxychloride and phenol catalyzed by aluminum chloride as the first step to the key intermediate. This proved a rather inefficient method as it resulted in the formation of the di- and tri- substituted phenolic derivatives. Since only the mono substituted portion could be used in the subsequent steps, separation of the isomers was necessary. The process development goal thus became a catalytic process that would deliver the desired mono substituted phenylphosphorochloridate in 98+% yield negating the need for post process separation expense.



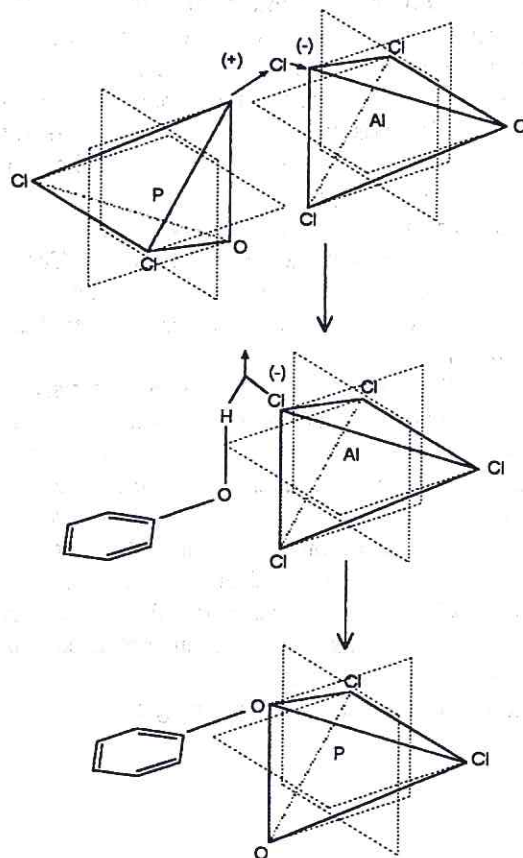
Orthogonal Al_2Cl_6

First, why does aluminum chloride as a catalyst do a less discriminating job yielding approximately 75% mono product? On the basis of symmetry the trichloride is an odd electron molecule that is in reality the dimer Al_2Cl_6 , satisfying its desire for symmetrical distribution. In solution as a catalyst, the AlCl_3 achieves tetrahedral symmetry by indiscriminate attack on phosphorus oxychloride. It will in fact continue to attack the nearest chlorine thus creating higher substitution products. The proposed process is pictured following the illustration. The first illustration is as normally shown in your average chemical text. This is

followed by using the three orthogonal planes of symmetry to illustrate the same process.

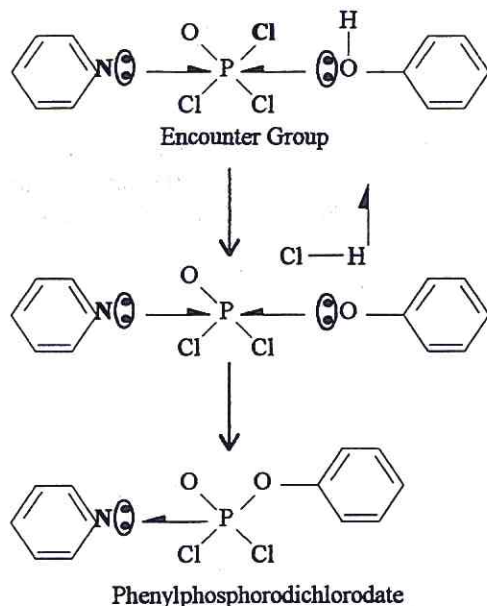


Electro-negativity governs the reaction between aluminum chloride and phosphorus oxychloride. In the process the aluminum achieves tetrahedral symmetry while readying the phosphorus for reaction with the phenate ion. All the reactants involved are tetrahedral as shown when the sequence is repeated using the orthogonal plane structures.



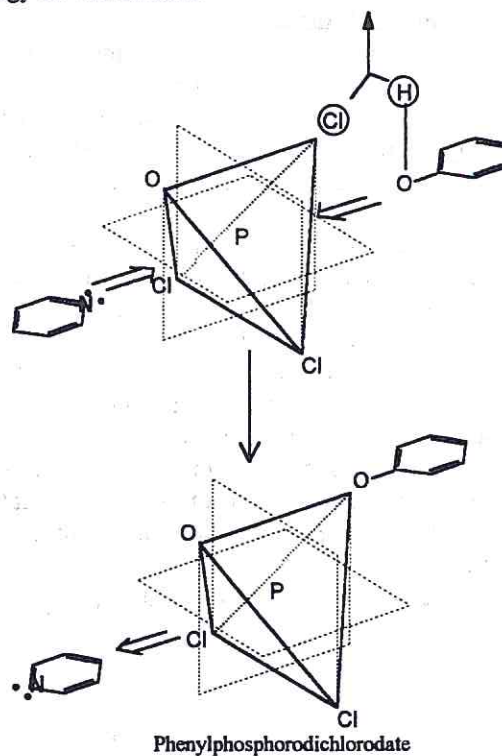
With the realization that the chemical reaction might be governed by simply assigning fixed positions

to electrons based on symmetrical distribution in space, and assuming that Friedal-Crafts catalysts such as aluminum chloride pull the chlorine away in this case, it was assumed that a compound with a pair of available electrons, such as pyridine, would push the chlorine off the phosphorus. As shown by the orthogonal illustration of the oxychloride, one of three chlorines is in the same plane with the oxygen. This imbalance should cause that chlorine to be the one to leave when pyridine approaches the molecule. The tetrahedral phosphorus oxychloride has an electron deficient third plane into which pyridine donates its pair of electrons. This momentary enrichment then suggests a desire for octahedral symmetry to be satisfied by the addition of phenol. The entrance of the phenol causes its hydrogen to react with the loosely held chlorine that is in the plane of the oxygen on phosphorus. The phenol in turn occupies the position vacated by the chlorine restoring tetrahedral symmetry. Subsequent research confirmed this assumption. Meanwhile, the use of pyridine, (a Lewis Base), proved highly successful in achieving the desired result.



As stated above, later investigation into the utility of base catalysts for this reaction showed that a variety of structures containing an available pair of electrons would catalyze the process and a number of them were patented. (Patented processes discussed in this manuscript can be found in the index.) A study was also undertaken into the general utility of pyridine in the further reactions of the phenylphosphorodichloridate. The preparation of mixed esters, with as many as three different phenols attached to the phosphorus were studied. Indeed this was also found to proceed in good order. All that was necessary was to increase the

temperature to the desired level for substitution to occur. For the first chlorine to react the reaction was run at 95° C. The second phenol attaches itself at 135° C and the third at 155° C. The smaller difference in temperature change for the third (20 vs 60 degrees) supports the notion that the second and third chlorines in the same plane are more stable than the one that originally left, and that once the second was removed, the remaining chlorine, again unbalanced, requires less energy for its removal.



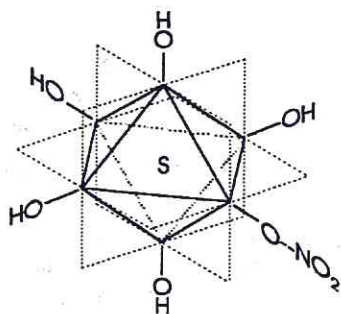
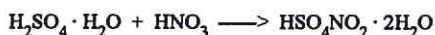
This chemistry was practiced for a number of years when the triphenyl esters were used as functional fluid to replace the functional fluid role played by a variety of Arachlors when they were banned as an item of commerce because of alleged carcinogenic properties.

A number of years later another set of circumstances occurred that again brought the use of phosphorus to the forefront. This time it involved an attempt to control the isomer distribution during the nitration of chlorobenzene. Here the well-known reaction, practiced world wide, uses a combination of sulfuric and nitric acids to affect the reaction. It has historically produced a roughly 2 : 1 ratio of para to ortho substituted product with 1.8 - 2% meta as byproduct. Changing market demand required a sizable increase in the ortho isomer and a major effort was underway to achieve this goal. Some of these included a variety of methods to selectively remove the

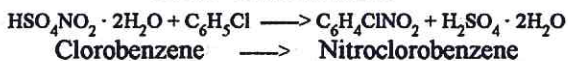
para group and to cause it to rearrange to the ortho position.

It was decided to attack the problem using the orthogonal plane approach. To do so required a re-examination of the long held explanation for the mechanism of nitration. Perusal of the literature revealed that the isomer ratios obtained by the nitration of chlorobenzene varied not only with the conditions employed but also with the nature of the acid media. For example, when benzenesulfonic or methanesulfonic acid was used, the ratio changed to 3 to 1, para to ortho. Substituting acetic anhydride for sulfuric produced an 8 to 1 ratio in favor of para. It was therefore decided that what governed ortho versus para was the geometry of the active intermediate. Therefore the question posed was, what was the geometry of the sulfuric acid intermediate?

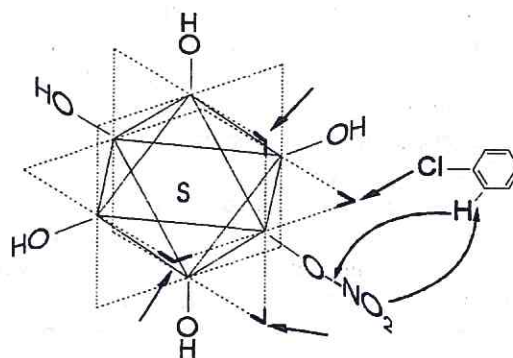
Standard practice for the nitration of chlorobenzene is the use of 85% sulfuric acid in combination with a mole of nitric acid. Not generally noted, but extremely important here, is that 85% sulfuric acid is in fact equimolar quantities of sulfuric acid and water. When this combination is then combined with a mole of 100% nitric acid, a reaction intermediate is produced that has octahedral symmetry. Sulfuric acid by itself (based on vapor phase data) is an octahedral acid. The structure of the intermediate should thus look as follows



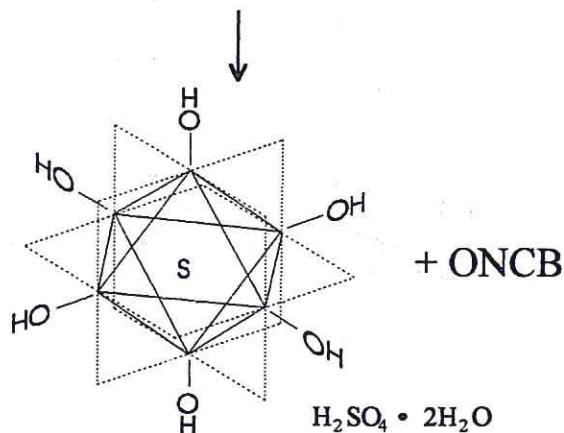
Sulfuric - Nitric Intermediate



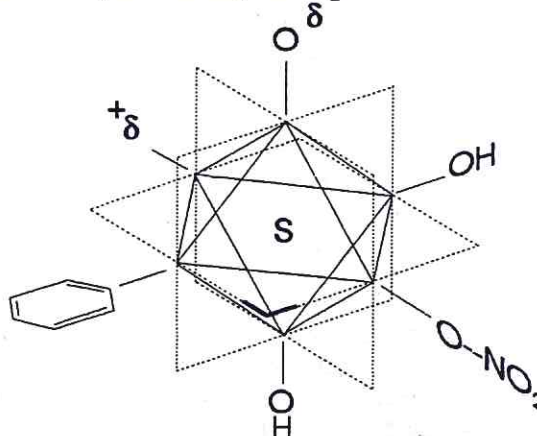
The positions on the reaction intermediate that are highlighted below are the four equivalent positions where chlorobenzene attack will produce the ortho isomer. The remaining eight corners when attacked by chlorobenzene will produce the para isomer because the nitronium ion must migrate a greater distance to find the chlorobenzene. The 8 to 4 ratio of available positions produces the normally achieved 2 to 1 ratio of para to ortho NCB.



Encounter Pair for ONCB

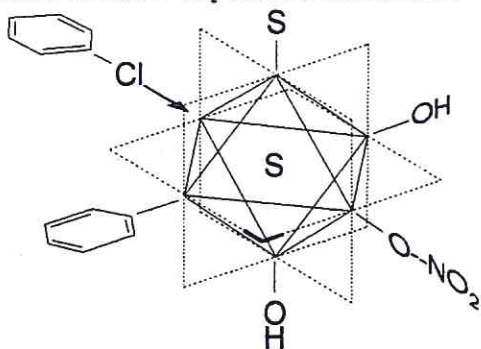


When, as shown below, benzenesulfonic acid is substituted for sulfuric acid, the ratio is further altered in favor of the para isomer. When this structure is examined using the orthogonal approach it becomes immediately obvious why this is so.



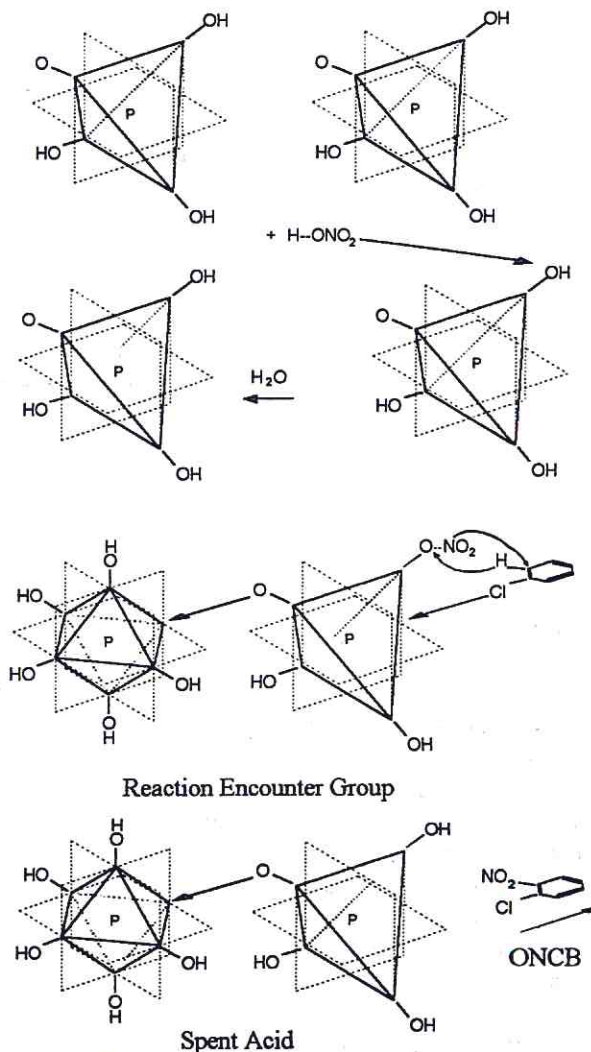
The highlighted corner indicates lack of approachability due to the shielding effect of the benzene ring. This leaves only three positions from which ONCB can be formed. The structure also leaves no doubt that the desirable reaction position most available is the one opposite the one occupied by the nitro group. This results in an average 72% to 75% yield of paranitrobenzene.

When this approach to an explanation for the observed ratios appeared reasonable, the most obvious solution to the formation of greater yields of ONCB was to use a tetrahedral acid. The first acid tested was phosphoric, specifically the essentially anhydrous form. An excess of the acid was mixed with anhydrous nitric acid and the reaction carried out under the same conditions normal to the sulfuric mode. This produced a ratio of 1.48 para to ortho, the desired ratio for commercial purposes. However, during the investigation, higher temperatures and a ratio of 2 to 1 phosphoric to nitric (phosphoric acid has only half the capacity to absorb water as does sulfuric) the ratio of para to ortho approached 1 to 1. The orthogonal illustration will show why this result is obvious.



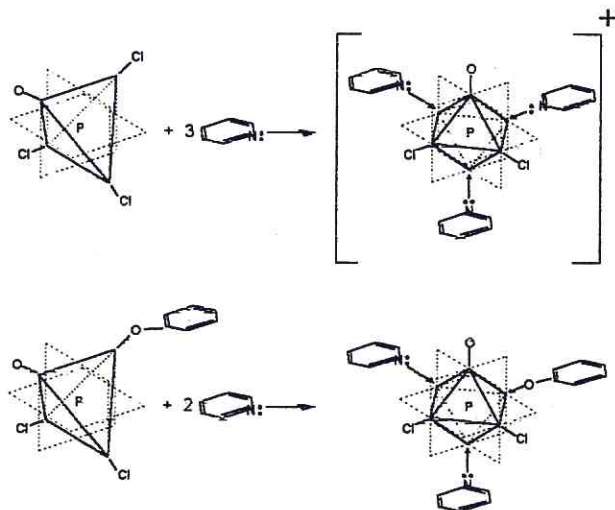
The next reaction sequence shows the use of a 2 to 1 ratio of phosphoric to nitric acid allowing for the excess phosphoric to adsorb the mole of water produced by the reaction of nitric with phosphoric. The resulting reaction mixture produces the desired octahedral-tetrahedral symmetry expected for this combination. When chlorobenzene is then added to this reaction mixture, it attacks the phosphoric-nitric portion. When the approach occurs on the side holding the nitro group, as the illustration shows, the product is the ortho isomer. Attack on the opposite results in para formation.

When combinations of phosphoric and sulfuric are used the result is a continual change in ratio from 1 to 1 for 100% phosphoric to the standard 2 to 1 for 100% sulfuric. For example, a 60-40 mixture phosphoric-sulfuric will produce a 1.5 to 1 ratio of para to ortho nitrochlorobenzene. A review of the patent literature will also teach how this approach to isomer control was later used to produce nitrochlorobenzenes under vapor phase conditions. Various solid catalysts varying from phosphorylated silica for high ortho and zirconium oxides and sulfurated silicas for high para were used.



The next section will discuss additional applications of the orthogonal system to explain a variety of phosphorus reactions, both trivalent and pentavalent, that have long puzzled those familiar with the chemistry of phosphorus.

As every industrial chemist is wont to do after he discovers what he believes to be original or patentable, the library is the first place visited. In this instance, with the indication that pyridine was unique to the phosphorylation reaction studied, a search of the literature revealed that the addition of pyridine to phosphorous oxychloride and phenylphosphorodichloridate to produce complexes had been studied. The structures reported were the tripyridyl complex of phosphorous oxychloride (as the chloride salt) and the dipyridyl complex of the phenylphosphorodichloridate. The most obvious explanation to the different results was the invocation of octahedral symmetry, and corroboration of the validity of the approach taken and the uniqueness of the new process. The two structures are illustrated here.



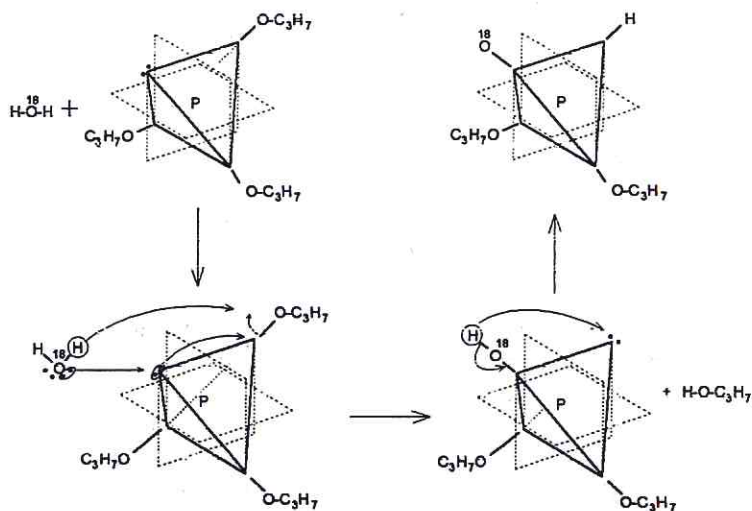
from the direction that allows the reactant to attack the available pair of electrons as illustrated below.

The next illustration shows the reaction between tripropyl phosphite and H_2O^{18} . This is a well-studied P-O fission reaction that results in the O^{18} oxygen replacing the propoxy group. Again the only explanation is that attack occurs in the unoccupied third plane of the phosphite and the subsequent rearrangement to the phosphonate.

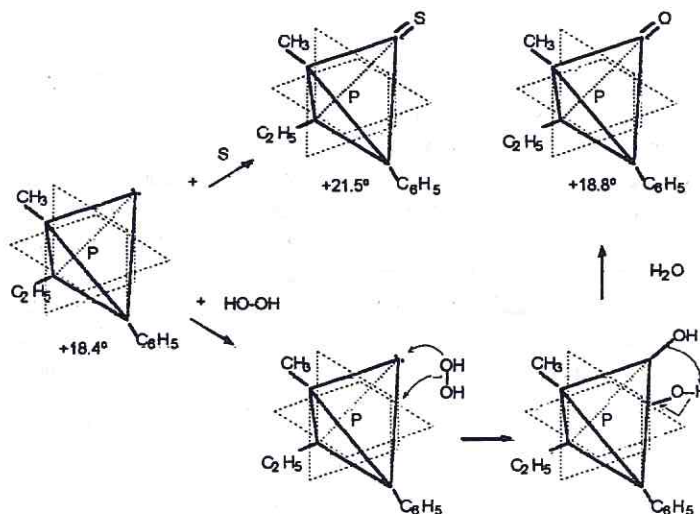
The next illustrated phenomenon shows the reaction between trichlorophosphine and epoxide. Although the expected result might be the oxidative rearrangement, the tetrahedral phosphine retains its structure by merely chlorinating the ring opened epoxide.

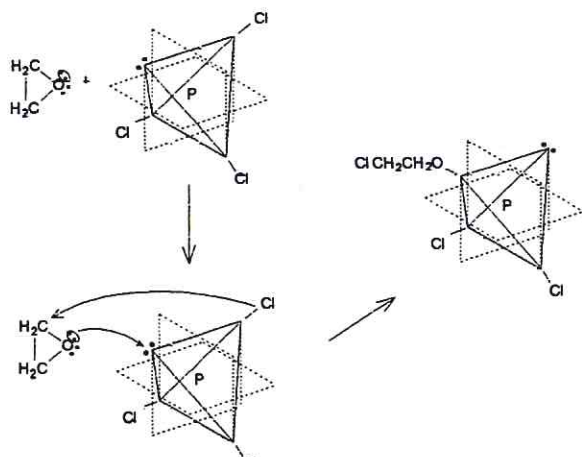
C. A. 60, 1625 (1924)

Over time a variety of interesting phosphorus chemistry was subsequently investigated to determine if there was any system that did not permit the above approach to the understanding what was fundamentally to be the chemistry of phosphorous, be it trivalent or pentavalent. To date, none have been found that would not fit the above approach. A few will be illustrated here. The ones chosen are those that came to the forefront with the introduction of the very selective catalyst system introduced to commerce with the advent of L-DOPA. The dextro rotatory methyl-ethyl-phenyl phosphine when reacted with sulfur or hydrogen peroxide retains its positive rotation. This can only occur if the attack on the phosphine is



G. Aksnes & D. Aksnes, Acta. Chem. Scand. 18 (1964) 1623

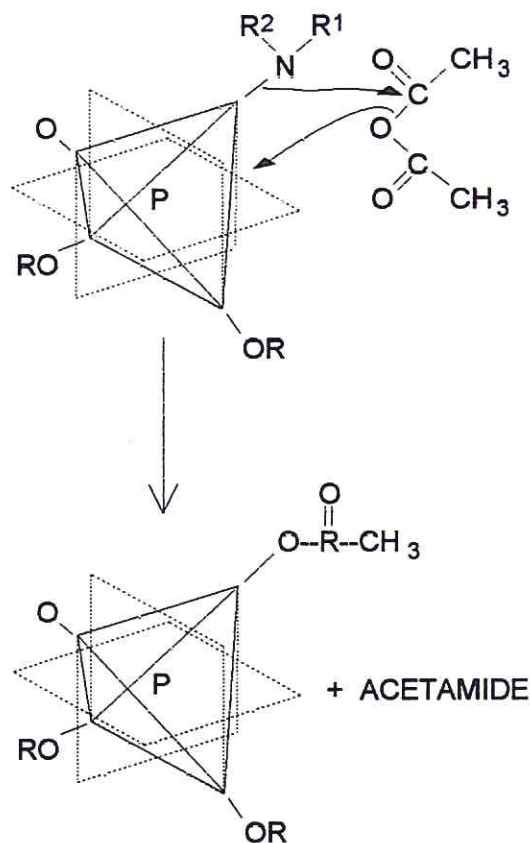




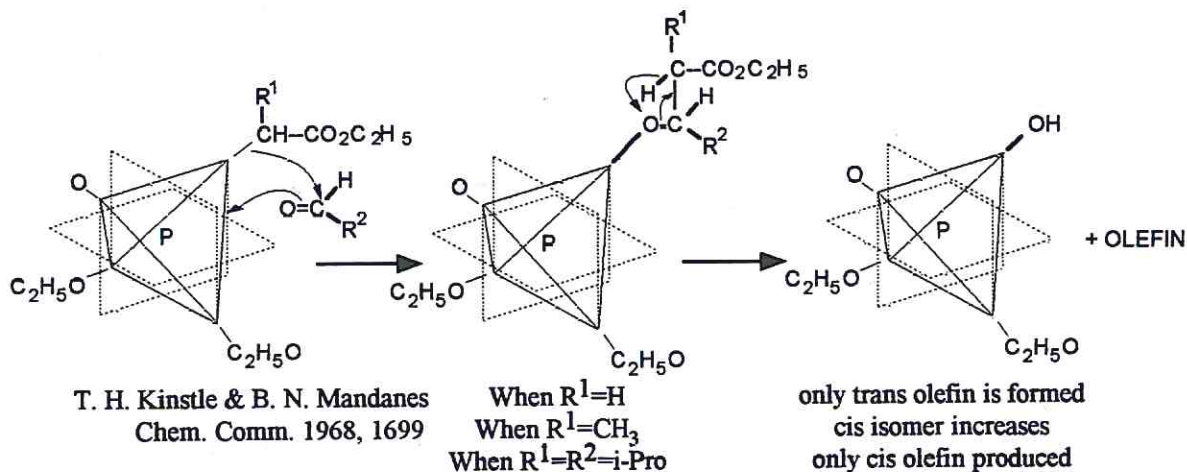
M. I. Kabochnik, et al, Akad Nask. U.S.S.R., 135
(1960) 849

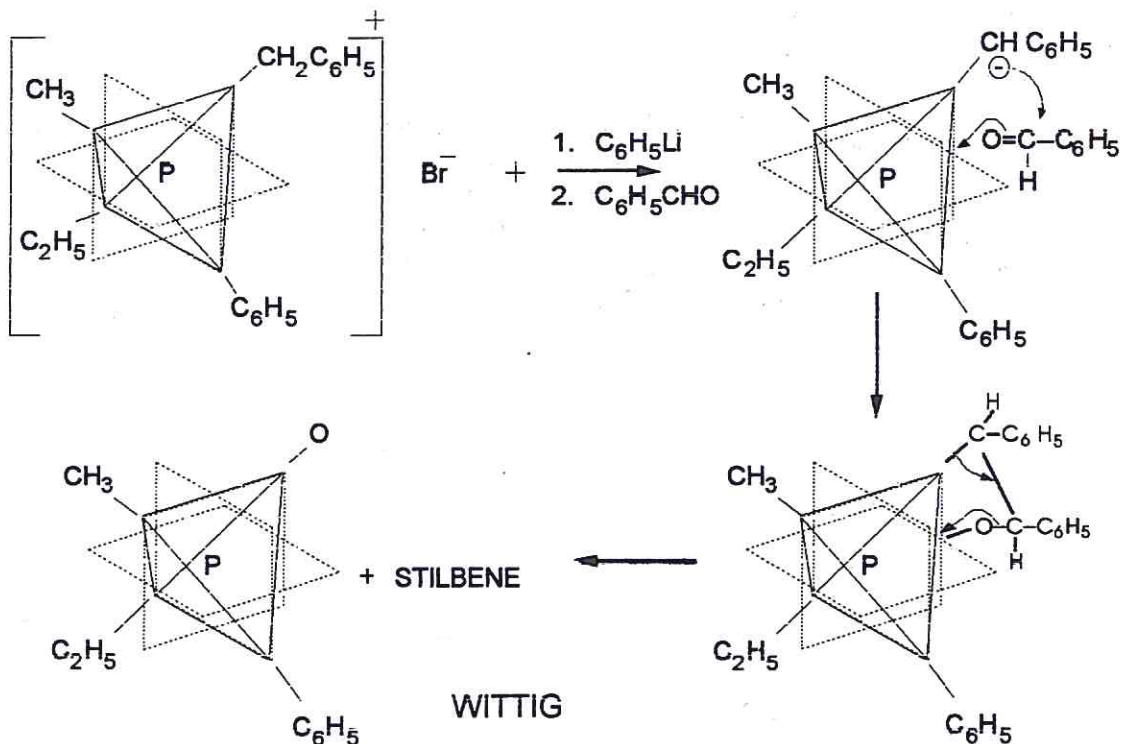
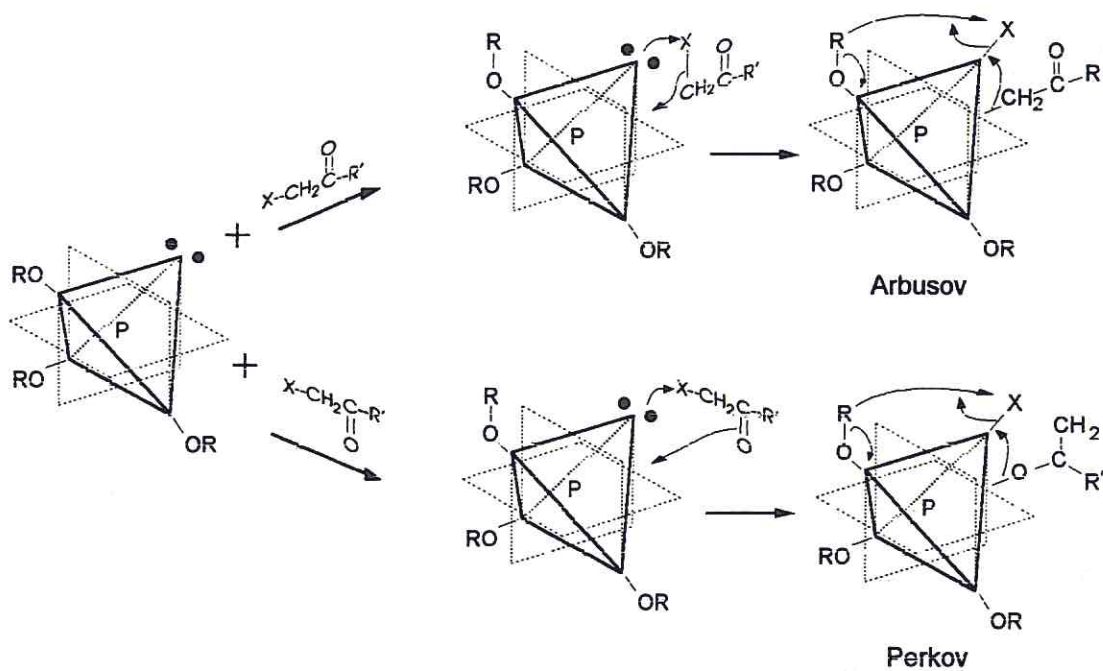
The illustration below shows how phosphonate carbanion chemistry also conforms to the use of orthogonal positioning of the groups around phosphorous. In this case the starting material is allowed to react with a series of aldehydes starting with formaldehyde, then with acetaldehyde and finally with isopropyl aldehyde. The literature indicates that with increasing size, the orientation of the attacking group dictates either cis or trans olefin. As shown, the tetrahedrally structured phosphonate can only accommodate the approaching aldehyde and the subsequently achieved products in the manner illustrated.

When acetic anhydride is allowed to react with a phosphoramidate the phosphoramidate will decompose and an acetamide is formed and the remaining acetate radical takes the position vacated by the amine group. As in all the illustrations, the weakest link in the various phosphorous compounds discussed to this point is the group attached in the plain of the P to O bond.



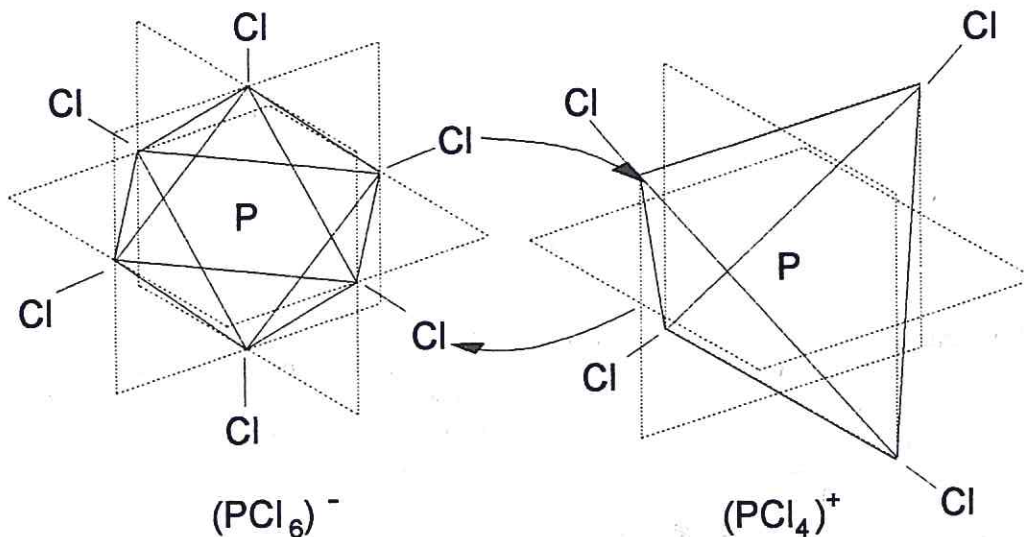
The next systems to be illustrated are the well known, highly developed and much used Arbusov, Perkov, and Wittig reactions. As can be seen on examination of the proposed tetrahedrally disposed orientation, it shows the great degree of similarity between all the reactions here and those discussed in the formation of phenylphosphorodichloridate and the use of phosphoric acid in the nitration of chlorobenzene.





The next illustration in this series is that of the familiar molecule P_2Cl_{10} that takes on the implied negative and positive ionic PCl_6^- and PCl_4^+ in solution.

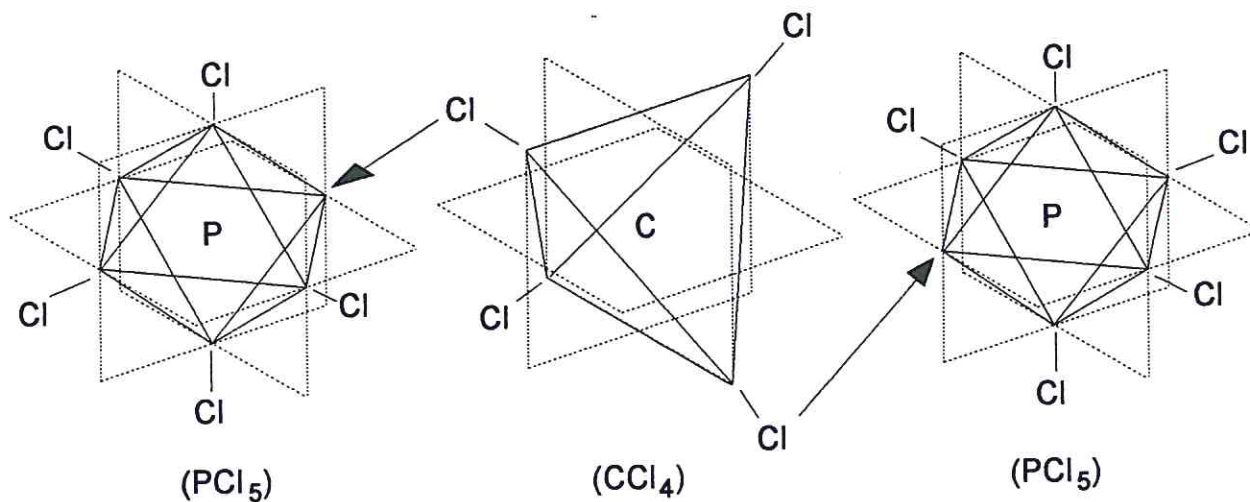
When drawn using the orthogonal planar construction, the molecule would look like that below in its pre ionic form.



Based on the success achieved with this approach to the chemistry of phosphorous and the subsequent analogous use as it involved solid catalyst systems to achieve isomer control over a broad range of ratios, it appears safe to suggest that all the periodic elements can be similarly examined as to their desired octahedral and or tetrahedral symmetries. Anyone interested in pursuing this further for his own amusement or enlightenment as it pertains to the chemistry of phosphorus should obtain copies of the ACS Monographs 175 and 176. The two volume set contains the

most detailed set of data collected for the chemistry of pentacoordinated phosphorus. A great deal of this material involves phosphorus in trigonal bipyramidyl modes as well as tetrahedral. Some of these structures are also illustrated in the previous chapter dealing with symmetry and atomic structure. The above monographs were published in 1980, edited by Robert R Holmes of the Univ. of Massachusetts, Amherst.

We close this discussion with the illustration of another well known phosphorus complex.



Epilogue

This article began with a series of quotations from the notable minds who have attempted to unravel the mystery of matter. Beginning with Einstein, we see that his thoughts were on discovery, questioning, imaginative expansion of what we know. He was never satisfied with the status quo. Then we move to Heisenberg whose thoughts betray a quiet surrender to the principle of uncertainty. He has more faith in that which is measurable than in the capacity of the mind to reveal detail beyond measurement. Bohr, taking that notion one step further, concludes that what is real is made of the unreal, a surreal conclusion indeed. Szent-Gyorgyi again ignites the thirst for accomplishment through research of the available data and coming to new and different conclusions. Arnheim voices what is true at the heart of theorization, seeing the structure underlying the available data. Finally and firstly, Democritus the ancient Greek philosopher-scientist has an insight into the nature of things so uncanny as to seem prophetic. It is in this spirit of the search that we have pursued this work, not yet completed.

We have come a long way since the publication of Pauling's work on the nature of the chemical bond. With reference to the foregoing description of the Vortex Model and specifically to Figure 6, the hydrogen molecule, a description of the simplest chemical bond is depicted. It shows that the electrons occupy vortices in the expanded field overlap of the excited atoms. A more fully developed description of this approach to chemical bonding will follow in a later publication.

Some other interesting implications based on the Vortex Model that require further clarification include explanations for alloy formation, spectral comparisons, and magnetic moment predictions. Beyond the micro scale of atoms and their environment an explanation of the macro world must ensue if we are to have a model of the whole that is the sum of its parts. Some of the topics discussed among the authors includes explanations for black holes (massive neutron stars), galactic formation, the source of atomic matter, "dark" matter, background radiation and gravity. The general conclusion is that the Vortex Model when extrapolated to the cosmos is consistent with reality. We invite all those intrigued by the implications of the Vortex Model to correspond and participate in the furthering of the theory.

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