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THE ORIGIN OF ATOMIC STRUCTURE

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KEYWORDS

ATOM, MACH'S CRITERIA, COMBINATORIAL GEOMETRY, RING MODEL, FINITE SIZE EFFECTS, MAGNETIC MOMENT, LOGIC, EVOLUTION THEORY, THEORETICAL FOUNDATION, SHELLS, PACKING MODEL

ABSTRACT

Historically the theory of evolution has always been an appendage of the theory of matter and specifically the theory of the atom. The current quantum mechanical theories of the atom represent the matter of the universe as being governed by random statistical processes. Thus they provide the necessary theoretical foundations for the theory of evolution. The theory of evolution of living things requires random processes to occur to produce mutations or changes that can be directed by certain selection principles, such as survival of the fittest.

This work identifies the false assumptions of the quantum models of the atom. It shows that these theories violate the logical principles that undergird the development of scientific theories and do not qualify as science. A new rudimentary theory of the atom based on combinatorial geometry is presented that can satisfactorily predict all the properties of the periodic table of the elements as well as explain the basis of chemical valence and bonding. This new theory of the atom is based on classical electrodynamics and represents an orderly universe governed by the laws of cause and effect. It satisfies the logical principles undergirding science, and it does not support theories of evolution.

INTRODUCTION

According to Encyclopedia Britannica's [Great Books of the Western World](#) the idea of evolution is one of the 100 great ideas of western civilization. In the two volume syntopicon for the great books[16], the history of the idea of evolution is traced from the ancient philosophers Democritus, Lucretius, Plato, and Aristotle down to Harvey, Freud, and Darwin. For 2500 years the idea or theory of evolution has been an appendage to the theory of matter.

The ancient theory of matter, called atomism, as well as the current modern theory of the atom based upon the relativistic quantum-mechanical Dirac equation describe matter as governed by statistically random chance processes. From the beginning the theory of evolution involved the evolution of physical matter as well as living things. Both aspects require that the parent theory of matter support the existence of statistically random chance processes that will allow changes in nature over time. For living things these changes are supposedly subject to some selection principles, such as selection of the fittest, to determine the direction of evolutionary change.

The Bible represents the earth as having been created in an orderly purposeful fashion and not by random chaotic events.

**For thus says the Lord, who created the heavens (he is God!), who formed the earth and made it (he established it, he did not create it a chaos, he formed it to be inhabited!): "I am the Lord, and there is no other. I did not speak in secret, in a land of darkness; I did not say to the offspring of Jacob, 'Seek me in chaos.' I the Lord speak the truth, I declare what is right."
(Isaiah 45:18-19 RSV)**

The biblical description of the earth is in strong disagreement with the current theory of matter based upon relativistic quantum electrodynamics (QED) which describes the universe as being governed by random statistical processes or chaos.

In recent years scientists in the Judeo-Christian community have become aware of the situation. They have investigated the fundamental assumptions of relativity theory and found many of them to be false[9,14]. The logical rules upon which the scientific method has been based for thousands of years, commonly known as Mach's Criteria for Scientific Propositions[17], do not allow any theories in science whose assumptions are known to be false.

Physicists Tom Barnes[1] and Charles Lucas[10,11] discovered an error had been made in electrodynamics in that the finite size and charge structure of elementary particles had been approximated by a point particle representation. They went on to show by rigorous derivation from classical electrodynamics that the equilibrium shape of finite-size elementary particles changes with velocity from spherical to ellipsoidal. Their derivations showed that the change in the shape of elementary particles at high velocity was responsible for the "so-called" relativistic effects. These include the change in the particle's electromagnetic fields at high velocity, the change of the particle's mass at high velocity, the change in the particle's binding energy at high velocity, the change in unstable particle's half-life at high velocity, as well as the general relativistic formulas for velocity and energy, i.e. $E = mc^2$.

The work of Barnes and Lucas on finite size particles was significant, especially since relativity theory assumes all particles are point-like particles. This point particle assumption is also central to the Dirac quantum theory of the atom and the nuclear quantum shell model.

The purpose of this paper is twofold. The first purpose is to identify the false assumptions of the quantum mechanical models of the atom. The second purpose is to present the foundation for a new model of the atom. Using combinatorial geometry a new rudimentary model of the atom is developed. This new model represents an orderly universe governed by the laws of cause and effect instead of random chance processes.

False Assumptions of the Quantum Model of the Atom

The first widely held quantum model of the atom was known as the Bohr model. It was a planetary model in which the electrons moved in orbits about the nucleus with specific angular momenta. The Bohr model was based upon the following postulates:[3]

- o An atom, consisting of a nucleus together with its system of electrons, possesses certain dynamical states having the property that as long as the atom remains in one of these states it does not radiate.
- o The dynamical equilibrium of the special states of the atom can be treated by ordinary mechanics; but the transitions between them can not be so treated and are not subject to explicit description.
- o When an atom makes a transition from state of energy E_1 , to another, of lower energy E_2 , the excess energy is emitted as radiation of a single frequency, ν , related to the energy difference by Planck's relationship, $E_1 - E_2 = h\nu$.
- o For a single electron moving in an orbit around the nucleus, the angular momentum, L , is an integer multiple of $h/(2\pi) = \hbar$.

These postulates were deliberately designed to cover up the inadequacies of the model. For instance all electrons moving in a planetary orbit about the nucleus with a specific angular momentum should radiate electromagnetic energy continuously and eventually fall into the nucleus according to the empirical laws of electrodynamics. The first postulate says that the electron will not radiate electromagnetic radiation without any physical explanation or basis. According to Mach's Criterion for scientific theories, such an assumption is not allowable in science.

Bohr's second postulate is similar. It says that the transitions between electronic equilibrium states of the atom can not be calculated or understood using the proven laws of electrodynamics. Thus we see that Bohr's quantum model of the atom is not fully compatible with the empirical laws of electrodynamics.

After DeBroglie[4] showed that particles should possess wave properties, Schrodinger[15] combined the matter wave idea with Hamilton's formulation of Newtonian mechanics to obtain the equation for matter waves. This matter wave approach was found to be able to describe the states of matter in the atom more successfully than the Bohr model.

The Schrodinger matter wave model for the atom had the same problems with electrodynamics as the Bohr model and used similar postulates. However, it had additional problems. The form of the Hamiltonian formulation that it used is for point matter particles involving only action-at-a-distance forces. For an electron with no size the Coulomb electrical forces are infinite attempting to blow it apart. Also the real world consists of only finite-size particles involving friction and other local forces.[6,7,8]

Another philosophical problem with the Schrodinger equation had to do with the interpretation of the matter wavefunction. Normally wavefunctions are observable as in the case of water waves and sound waves. However, this matter wavefunction involves a complex number, i.e. the square root of -1, so that it can not represent a real observable quantity. Real observable quantities are always real numbers. The customary interpretation given is that the matter wavefunction is a probability amplitude. The measurable quantity is the probability density, or absolute square of the probability amplitude, and describes the probability that the electron will be found in a given region of space. Unlike other types of waves, the electrons in the matter waves are not regarded as being distributed in a cloud according to the probability distribution.

In 1928 Dirac[5] developed a relativistic version of the matter wave equation, which is now called the Dirac equation. He incorporated the magnetic moment and spin of the point electron into the matter wave equation in a more fundamental way than Schrodinger had done. The Dirac equation enabled the prediction of the existence of the positron, which was subsequently found experimentally. Despite this success, the Dirac model suffered from using exactly the same logically bad assumptions as the Schrodinger model.

In the late 1940's the theory of quantum electrodynamics was developed upon the foundation laid by Dirac much earlier. The quantum electrodynamic model of the atom is the most accurate one to date in terms of predicting the properties of the various electron energy states. However, it still has most of the same philosophical problems as the Schrodinger formulation.

Foundation for a New Model of the Atom

In 1990 Bergman[2] published the first fully successful physical model of the electron and other elementary particles. This model depicts the physical electron as a very thin ring of negative electric charge as shown in Figure 1. The charge is continuous around the ring. The ring rotates about its symmetry axis with a rim velocity approximately equal to the speed of light. The electric force of repulsion between the elements of charge in the ring is exactly balanced by the induced magnetic fields due to the current flow that causes a magnetic pinch effect. There is no radiation from the ring, because the charges occupy the entire circle of the ring continuously causing the total radiation field to vanish.[12]

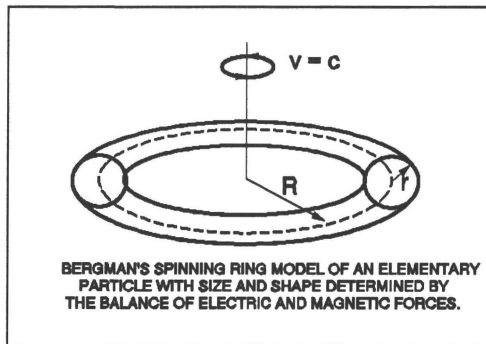


Figure 1

The essential weakness of previous models of the electron, including the Dirac model of the electron and QED models, has been that additional forces have had to be postulated ad hoc to hold the electron together against electrostatic repulsion. The Bergman model of the electron is completely stable under the action of classical electromagnetic forces alone. No strong or weak interaction forces mediated by quarks or other particles need be postulated.

The principal fundamental constant of quantum mechanics and all quantum models of elementary particles, including QED, is known as Planck's constant h . It can be determined entirely from classical electrodynamics in the Bergman model, i.e.,

$$h = e^2 \log(8R/r) / (2\pi\epsilon_0 c) \quad (1)$$

where:

- h = Planck's constant
- e = charge of the electron
- c = velocity of light
- ϵ_0 = dielectric constant for the vacuum
- R = radius of ring in Bergman's model
- r = half-thickness of ring in Bergman's model

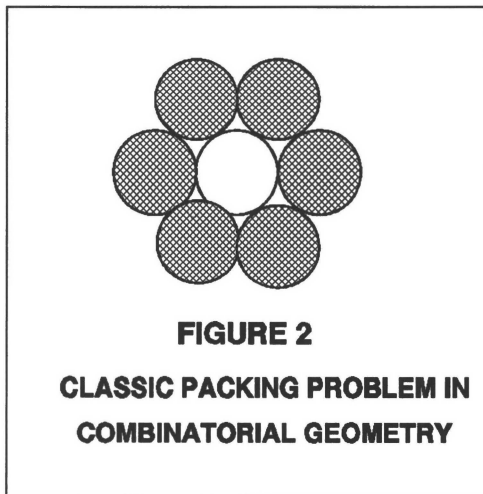
Note that h depends on the size or dimensions of the internal structure of elementary particles. That structure is determined by the balance of electric and magnetic forces in the physical particle. According to the rules of logic, whenever one theory is able to derive the value of the fundamental constant of a second theory, it is automatically superior to that theory. Thus the Bergman model appears to be more fundamental than quantum mechanics and QED in which h is a fundamental constant.

The progress made by Bergman in modelling the physical electron and other elementary particles warrants a new attempt at a physical model of the atom. This is of particular interest to the Christian community, because these classical models of the atom would be consistent with a universe governed by order and purpose instead of random chance.

Previously Barnes[1] and Lucas[10,11] had shown that the principal results of relativity theory were due to changes in the shape of finite size elementary particles. In the case of the atom, the so-called "quantum effects" must be due to the finite size of the electron and its physical magnetic properties.

At the lowest level the structure of the atom is represented by the structure of the periodic table of the elements. This table may be thought of, in a physical sense, as showing how the electrons pack in layers about the nucleus.

There is a branch of geometry, called combinatorial geometry, which deals explicitly with physical problems of packing and covering. An example of this is the packing of equal sized disks in a plane about a central disk as shown in Figure 2. It is easily seen that six equal circular disks may be placed around another disk of the same size such that the central one is touched by all the others but no two overlap. In the three dimensional case, around a spherical ball it is possible to place twelve balls of equal size all touching the first one but not overlapping it or each other.



Now combinatorial geometry can also be used for the atom consisting of a central nucleus with finite size electrons packed about it in layers or shells. In this case there are some additional constraints. The balls or electrons are in the shape of a ring with a magnetic moment plus an electrical attraction to the nucleus.

From general symmetry principles it is assumed that each layer or shell must be constructed in such a way that the total magnetic moment of the filled or complete shell sums to zero. In other words the cancellation of the magnetic moments is perfectly spherical. This is equivalent to saying that all electrons in a shell or layer must lie on a great circle of the shell and that all great circles of the shell must have the same number of electrons with no net magnetic moment when the shell is filled.

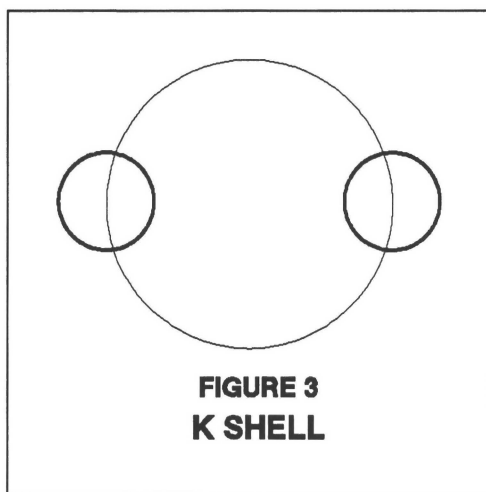
The constraint above is angular in nature. A second constraint applies to the radial direction. Dipole magnets are three dimensional and tend to arrange themselves in layers such that the magnetic moment of the atom is cancelled out even in the radial direction. In order for the magnetic moments to be cancelled out in the near vicinity of the shell, a second shell of the same symmetry but opposite orientation is needed.

The electrical attraction of each negative electron shell with the positively charged nucleus decreases with increasing shell size. This leads to a third constraint on the packing. A larger shell can displace a smaller one with fewer charges providing the space it occupies is large enough to hold the larger shell. This constraint allows larger shells to displace the second shell of a pair of smaller shells.

The three constraints above will change the results of the packing from that obtained for solid spheres. These constraints will produce an infinite series of packing layers that can be compared with the shells or periods of the periodic table.

Combinatorial geometry, like Euclidean geometry, uses the method of proofs. The method that will be employed here is the method of enumeration, i.e. all cases are listed and the ones that satisfy the constraints are selected.

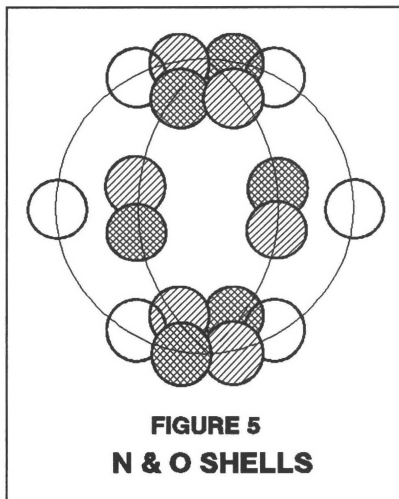
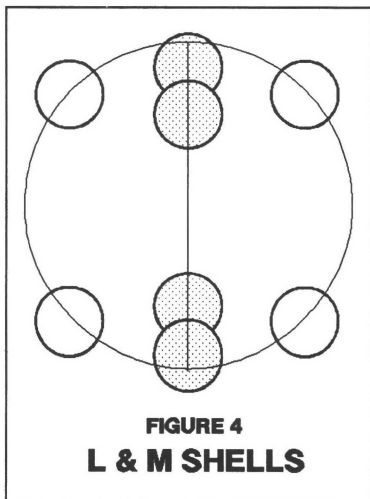
Consider the first shell. The first electron attracted to the nucleus can not be the first complete shell, because its magnetic moment is not zero. Also the shell can not be spherically symmetric. The smallest number of electrons to be attracted to the nucleus to make a shell that has zero magnetic moment and is spherically symmetric is two electrons as shown in Figure 3. There is one great circle with two charges symmetrically placed. The magnetic moments are aligned with the radial direction. They are perpendicular to the surface of the shell.



The orientation of the magnetic moments can be understood in terms of symmetry and balance of forces. Electrons are attracted to the positively charged nucleus by their negative charge, since opposite charges attract. They are repulsed by the nucleus according to Lenz's law and conservation of energy, by the orientation of their magnetic

moments. Here, like magnetic poles repulse one another. The magnetic repulsion exactly balances the electric attraction at some value of the distance between the electron and the nucleus.

Now the second size of electron shell could have up to twelve electrons if the first shell had one electron. But, since the first shell has two electrons, the number could be even larger. What is the smallest number of electrons that could make a completely symmetric shell and have more than two electrons in it? In order to find the answer, one can attempt to construct symmetrical arrangements of 3, 4, 5, ... electrons until the next completely symmetrical shell is found. In this manner it is found to contain eight electrons as shown in Figure 4. Note that there are two symmetrical great circles. Each has four charges symmetrically placed. Any great circle drawn through any electron will always contain four electrons. The magnetic moments are aligned radially with the nucleus.

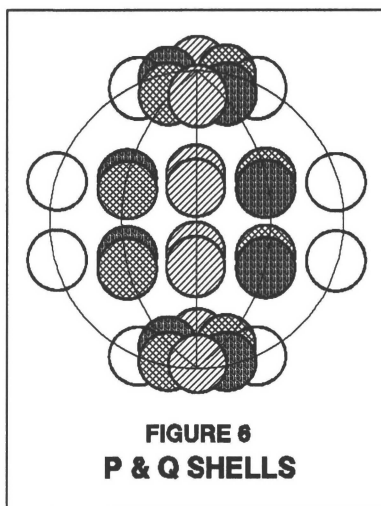


Consider the third size of shell. Again one may construct symmetrical arrangements of 9, 10, 11, ... electrons until one the next completely symmetrical shell is found to be eighteen as shown in Figure 5. Here there are three great circles. Each has six electrons symmetrically placed. The magnetic moments are aligned radially with the nucleus.

The result for each progressive layer size can now be predicted. By inspection each successive shell consists of one more great circle. The number of electrons in each circle is exactly twice the number of great circles due to symmetry requirements. The magnetic moments of the electrons each point radially away from the nucleus for the first layer of each shell size. The magnetic moment of the electrons in the second shell of each size point inward to balance the outward pointing shell.

Thus, by enumeration one notes that the successive shell sizes that satisfy the combinatorial geometry packing constraints are:

- Shell size #1 - 1 great circle of 2 electrons (Figure 3)
- Shell size #1 - 2 great circle of 4 electrons (Figure 4)
- Shell size #1 - 3 great circle of 6 electrons (Figure 5)
- Shell size #1 - 4 great circle of 8 electrons (Figure 6)
- Shell size #1 - 5 great circle of 10 electrons



These are the magic numbers or sizes of the shells in the periodic table of the elements. According to constraint #2 above there are two shells of each shell size. However the first shell size is paired with the nucleus itself as its partner. Table I below summarizes the periodic table information from the use of combinatorial geometry. Note the arrows showing the opposite orientation of the magnetic moments of each shell with another.

**TABLE 1
Distribution of Elements in Periodic Table Shells**

# Elements	Total # Electrons in	K	L	M	N	O	P	Q shell
2	2	N-><-2						
8	10	U-><-2	8->					
8	18	C-><-2	8-> <-8					
18	36	L-><-2	8-> <-8		18->			
18	54	E-><-2	8-> <-8		18-><-18			
32	86	U-><-2	8-> <-8		18-><-18		32->	
32	118	S-><-2	8-> <-8		18-><-18		32-><-32	
.								
.								
.								

Taking into account the third constraint for packing will alter the order of some of the shells in the table above to the revised form given below.

**TABLE 2
Revised Distribution of Elements in Periodic Table Shells**

# Elements	Total # Electrons in	K	L	M	N	O	P	Q shell
2	2	N-><-2						
8	10	U-><-2	8->					
8	18	C-><-2	8-> <-8					
18	36	L-><-2	8-><-18		8->			
18	54	E-><-2	8-><-18		18-><-8			
32	86	U-><-2	8-><-18		32-><-18		8->	
32	118	S-><-2	8-><-18		32-><-32		18-><-8	
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Figure 8 shows how these numbers correlate with the structure of the periodic table.

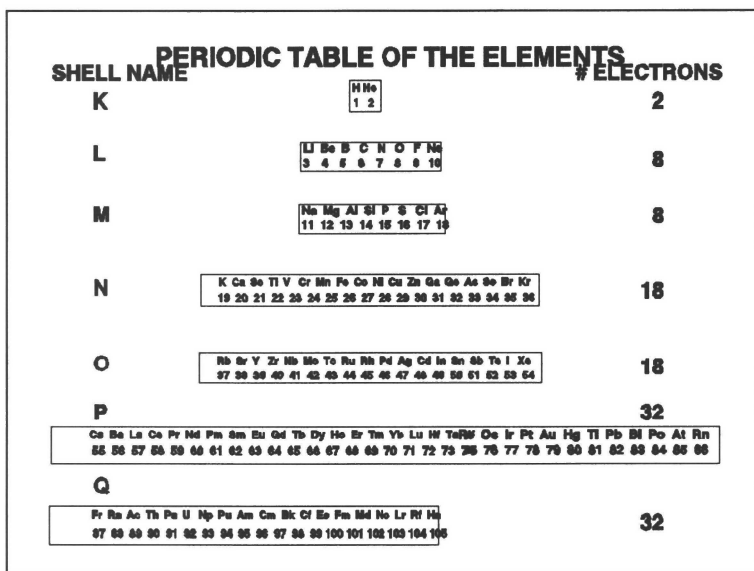


Figure 8

Table 3 below shows empirically how the 4th shell displaces the third shell.

**TABLE 3
STEP BY STEP BUILDUP OF THE FOURTH SHELL**

ATOMIC SYMBOL	ATOMIC NUMBER	TOTAL NUMBER OF ELECTRONS			
		1st SHELL	2nd SHELL	3rd SHELL	4th SHELL
Ar	18	2	8	8	
K	19	2	8	8	1
Ca	20	2	8	8	2
Sc	21	2	8	9	2
Ti	22	2	8	10	2
V	23	2	8	11	2
Cr	24	2	8	13	1
Mn	25	2	8	13	2
Fe	26	2	8	14	2
Co	27	2	8	15	2
Ni	28	2	8	16	2
Cu	29	2	8	18	1
Zn	30	2	8	18	2
Ga	31	2	8	18	3
Ge	32	2	8	18	4
As	33	2	8	18	5
Se	34	2	8	18	6
Br	35	2	8	18	7
Kr	36	2	8	18	8

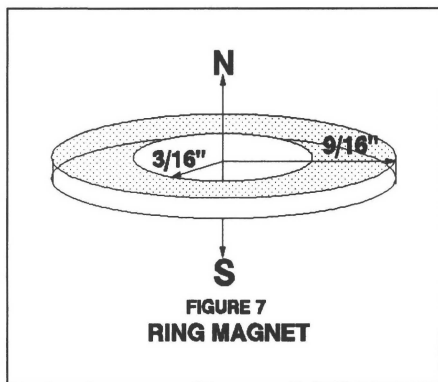
Magnetic Experiments on Packing

Combinatorial geometry is able to correctly predict the size of the seven shells or periods of the periodic table. However, like quantum mechanics, it predicts the size of many more periods than actually exist. This is a defect of both approaches.

This defect was removed from the combinatorial approach by performing a series of magnetic binding experiments. In a purely magnetic experiment it is not possible to completely represent the electrical forces, however an apparatus was constructed that attempted to simulate the electrical forces. The apparatus consisted of a nonmagnetic wooden board with sets of 2, 4, 6, 8, and 10 holes drilled in it in a circular symmetrical pattern that would be made by the electron magnets in a great circle of a packing shell. The balance of electrical and magnetic forces on the electrons in the great circle is approximated in a rudimentary way by inserting pegs in the holes to hold the simple dipole ring magnets just touching in their equilibrium position. One of the magnets may be released by removing its peg. Then its binding to the rest of the configuration of magnets may be measured.

In this way it is possible to measure the relative binding force per magnet in a great circle of magnets as a function of the number of magnets in the circle. This can indicate the natural tendency of dipole magnets to group in particular configurations.

In order to represent the electron in Bergman's model as closely as possible, ceramic ring magnets were purchased from Radio Shack as shown in Figure 7. Note that the north-south poles of the magnet are oriented perpendicular to the smallest dimension of the magnet in order to be similar to Bergman's thin ring of current. Fifty magnets of equal strength were selected to perform the experiments.



In order to eliminate the effects of friction between the magnet and the board, it was found necessary to measure the vertical force necessary to separate a magnet from the rest of the configuration. The same magnet was used for all configurations.

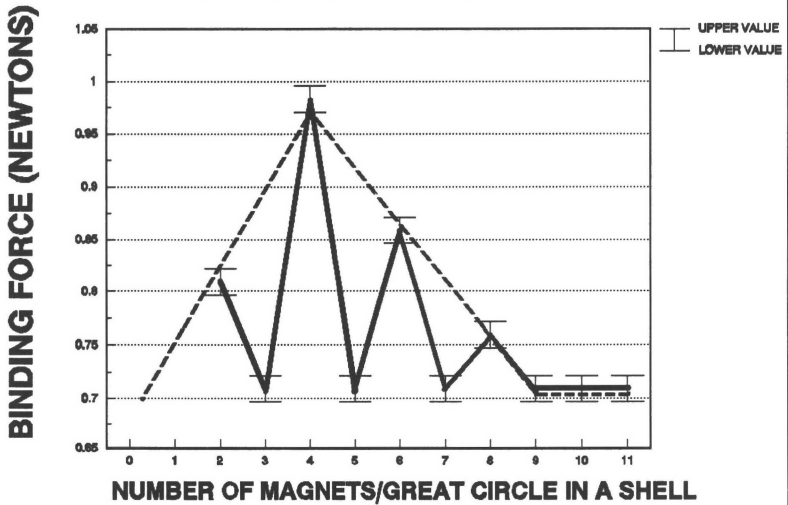
The results of the measurements are shown in Graph 1. Notice that odd numbers of magnets in a circle are weakly bound. Also great circles with 10 or more electron magnets are so weakly bound that they will not form shells. Thus if this data is used as a fourth constraint on the combinatorial geometry approach to the packing of electrons in shells, there will only be 7 periods in the periodic table, because the great circles of magnets in the eight and higher periods have insufficient magnetic binding to form a shell.

Also note from Graph 1 that great circles with 8 electron magnets are the most strongly bound configurations. These are too strongly bound to interact with the electrons of a neighboring atom. Thus in the outermost shell of an atom only groups of electrons smaller than eight will participate in the magnetic bond with another atom. This appears to be the origin of the chemical valence. Also this indicates that the mechanism for chemical binding of the elements is largely magnetic in agreement with long standing observations.[13]

CONCLUSIONS

The quantum theories describing matter and the atom were found to be unsatisfactory theories for science, because they incorporated many assumptions and postulates known to be in disagreement with reality. These assumptions include the use of point-particle action-at-a-distance Hamiltonian formulations of mechanics. Also the quantum theories of the atom assume that the magnetic moment and spin of particles do not have their origin in the finite size and structure of the particles. Furthermore these theories involve planetary motion of the electron about the nucleus with angular momentum l without the continuous emission of radiation that the empirical laws of electrodynamics demand. The logical rules for developing scientific theories, known as Mach's logical criteria for scientific propositions, indicate that quantum mechanics and quantum electrodynamics(QED) are not eligible and never were eligible to be called theories in science. It is these theories that describe the universe as governed by random statistical processes or chance in opposition to the biblical view that the universe is orderly being governed by the laws of cause and effect.

BINDING FORCE BY GREAT CIRCLE



A rudimentary model for a new theory of the atom was developed using combinatorial geometry for finite size electrons with a physical magnetic moment that predicts all the properties of the periodic table. Using the constraints from the magnetic binding experiments for ring magnets in symmetric circular configurations, the model explains why there are only seven periods in the periodic table. The quantum theories predict an infinite series of periods.

This new model of the atom is based entirely on classical electrodynamics. It represents an orderly universe governed by the laws of cause and effect instead of random processes.

This new model of the atom incorporates in a fundamental way the finite size of the electron and its physical magnetic moment. The areas in which the quantum models err is precisely the real origin of the so-called "quantum effects". This is exactly the same sort of result found by Barnes[1] and Lucas[10,11] when they proved that the finite size of elementary particles was responsible for all the so-called "relativistic effects".

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* This work is based on Joseph's 1992-93 science fair project at Oxon Hill High School, Science and Technology program. For his 1993-94 science fair project he extended this work to cover the nucleus as well.

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