IN SEARCH OF A UNIFIED THEORY: AN ATTEMPT TO RECONCILE GRAVITY AND QUANTUM

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ABSTRACT

Issues around geometry of the universe, density of the universe (Underweight), expansion of the universe and theories held-up by scientists such as Stephen Hawking, John Wheeler, Albert Einstein, etc have been looked into. The equations formulated by these people; that is $E = mc^2$, $E = h\nu$ and $PV = nRT$ were treated to give meaning under the general truth that the universe has only two entities; MATTER and ENERGY and HEAT and COLD to manipulate them. The Energy x Time ≡ Matter x Space relationships is suggested in this paper in place of, Energy.Matter = Space.Time, which was summarized by Albert Einstein. The three dimensionness of space were incorporated into $E = mc^2$ to give $E/N \Xi c^3$. $E = hc/\lambda$ which had the notion of space divided by space is re-related to space per time and $PV = nRT$ is revisited until it was modified to be in congruent with the above two fundamental formulations; that is $PV \Xi KT/N$. These new relationships (**THEORIES**) are in agreement with each other and could be pronounced as **"UNITED"**. *[AJCE, 1(2), July 2011]*

INTRODUCTION

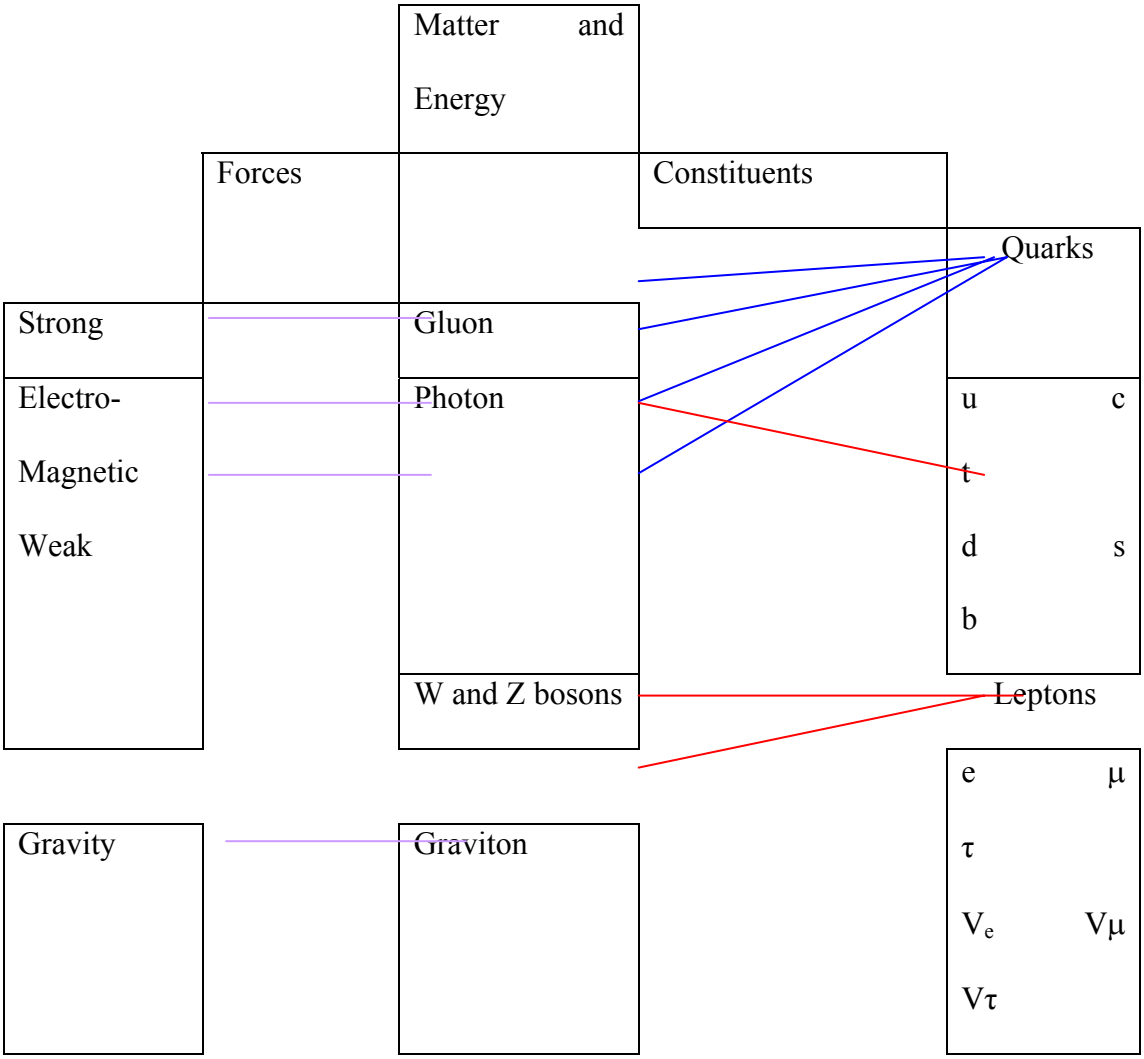
Issues of editing and then transferring knowledge in education have become increasingly important as new things unfold about concepts and outlooks of space/time. Chemistry textbooks currently used for education ought to take into account the need for tuning up with developments of contemporary science in general.

My experiences in teaching chemistry to Ethiopian students consistently indicated that students, and teachers to a lesser extent, have always found learning chemistry difficult. To most of them, it is very frustrating to the extent of jeopardizing individual's career in chemistry and in other natural (physical) science fields. Thus, looking into what core problem(s) could these be based on is a worthwhile effort.

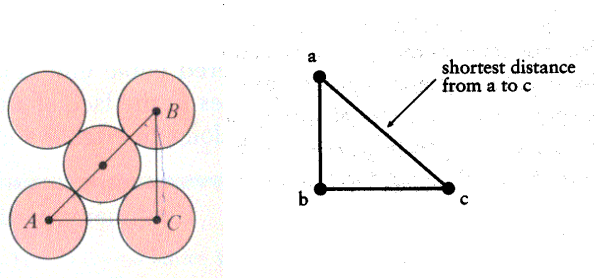
One could start picking three chemistry textbooks of the time, three theoretical physicists', and astrophysicists' deliberations on space/time, geometry of the universe and on other related concepts for comparisons and for points of departure from what is taken as accepted and absolute theories in the three chemistry books, and citing some of the issues here below.

In his book Out of My Later Years, Einstein (1, p.48) gave hints about how he saw the future, and why he had been unable to develop a unified theory of everything. He wrote: The general theory of relativity is as yet incomplete in so far as it has been able to apply the general principle of relativity satisfactorily only to gravitational fields, but not to the total field. We do not yet know with certainty by what mathematical mechanism the total field in space is to be described and what the general invariant laws are to which this total field is subject. One thing, however, seems certain: namely, that the general principle of relativity will prove a necessary and effective tool for the solution of the problem of the total field.

According to the standard model of particle physics (2) there are four forces that physics so far adhered to while some other scientists came to believe that there is a Fifth in the arena, unknown to physics to date, which is counteracting the four and pushing the universe into unprecedented accelerated expansion!!!

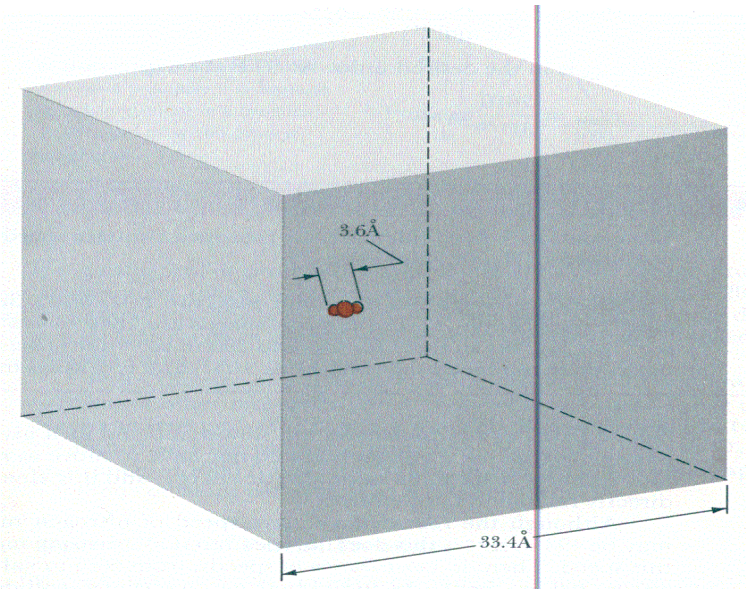


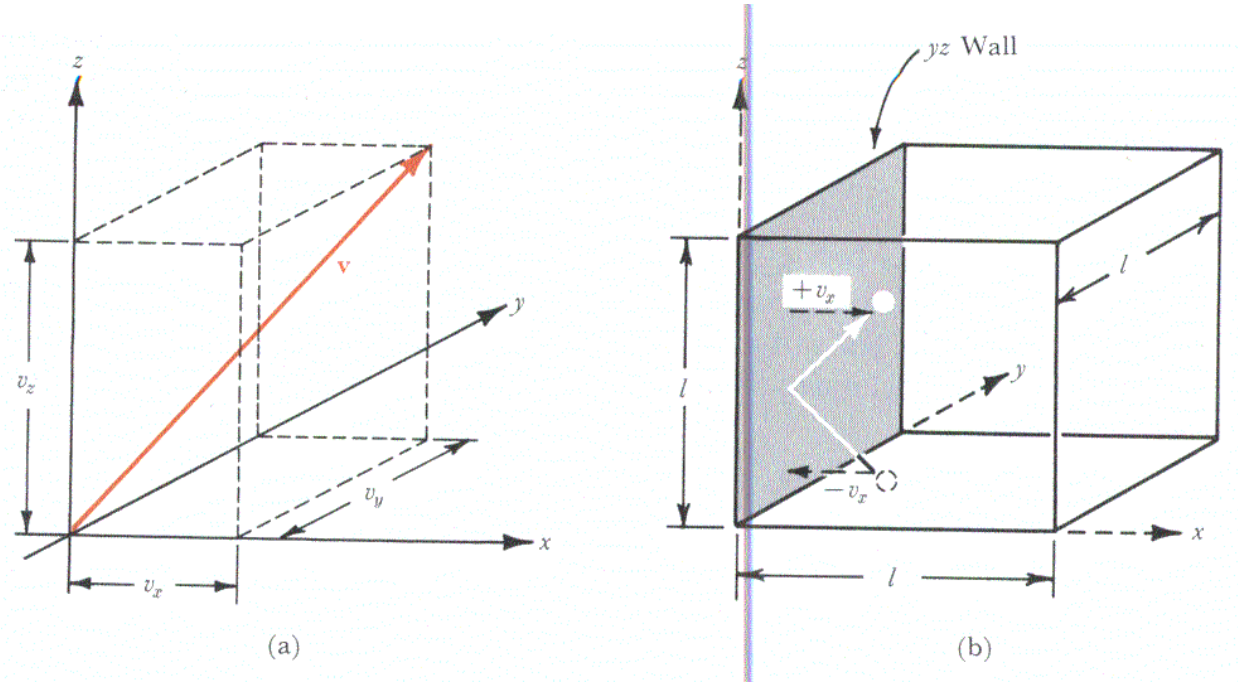
In describing the structure of a crystal it is convenient to view it as being composed of a huge number of simple, basic units called unit cells. For example, the simplest and most symmetrical unit cell of all, called the *simple cubic unit cell,* shown in the diagram below (3), is derived using a plane (2D model). The question is: Why restrict space into two (Euclidean) when it is actually three dimensional?



Virtually every scientist would agree that the most significant theoretical model of nature ever formulated is the atomic theory. The same theory that tells us of the energies of atomic orbitals also describes their shapes, the simplest and most symmetrical unit cell of all being called the simple cubic unit cell. The theory also provides a physical model for the behavior of gases that is in agreement with the gas laws as in $\left(P+\frac{n^2a}{V^2}\right)(V-nb)=nRT$ and offers a basis for the explanation of other kinds of molecular behavior. The layers of closely packed particles in a crystal lattice constitute planes as demonstrated in 1848 by Bravais that 14 different geometrical systems could describe all space lattices (4).

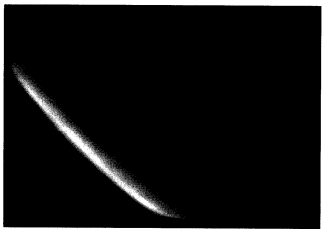
The velocity of a molecule of gas is resolved into components as in the diagrams below:





From "Kinetic Theory" Maxwell-Boltzmann distribution for a gas of non-interacting molecules,

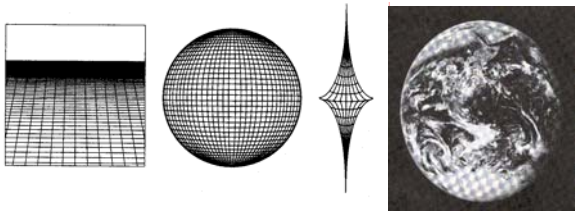
$N_i = \frac{N}{q} g_i \exp(-\beta \in_i)$ gives the number fraction $\frac{N_i}{N}$ of molecules in the gas (at equilibrium at temperature T) in the energy level i with energy ∈I and degeneracy gi. In this regard, chemistry books have not given rooms for alternative explanations or for any other theories or views possibly to exist. In addition, disclose that such alternative theories or explanations do crop up from time to time. The big question is: Why is squaring the velocity of what you measure such an accurate way te describe what happens in nature? (5)



Evolution of the Universe
Illustration ©Shigemi Numazawa

The Geometry of the Universe

We know that locally, near a star or another massive object, space is curved. Space curves around the object spherically, as demonstrated by the eclipse experiments. But what is the overall shape of the universe? (6). The three constant-curvature models in two dimensions are shown below. In the four dimensions of space-time, the special metric of relativity theory is used to define distances. With this metric, the hyperbolic space of negative curvature is often approximated by a saddle.



The earth as seen from space (courtesy of Technology Application Center)

The introduction in the last pages was intended to give background information about existing scientific theories and how they are limited in their attempts to do so particularly in an educational context. The basic issue in this paper is therefore what and how to do in the future when writers want to present chemistry books to their audiences and/or while learners should use these books in transferring science to their users.

DISCUSSION

Frome the atomic theory described above, the force of the interaction between charged particles is directly proportional to the sizes of the charges e and inversely proportional to the square of the distance r between them (7). The van der Waals Equation is also given as . $\left(P + \frac{n^2 a}{V^2}\right)(V - nb) = nRT$ According to Einstein, $E=mc^2$. The big question, though, is why is squaring the velocity of what you measure such an accurate way to describe what happens in nature?

The interesting thing is that almost anything that steadily accumulates will turn out to grow in terms of simple squared numbers, as shown above. Over time, physicists became used to multiplying an object's mass by the square of its velocity (mv^2) to come up with such a useful indicator of its energy. It is almost as if the ultimate energy an object will contain reveals when you look at its mass times c squared, or its mc^2. This is not a proof, of course, but it seemed so natural, so "fitting", when the expression mc^2 did suddenly appear. (For the reader interested in Einstein's actual derivations, the Web site for this book, davidbodanis.com, goes through some of his reasoning.)" (5)

The last century was a revolution in science that changed the modern perception of the natural world. Einstein's theories of relativity and quantum theory are two of the most radical—and irreconcilable—breakthroughs that form the foundation of much of modern theoretical physics. Where once theoretical physics was an obscure subject, it is now a major focus of study, showing a change in the outlook of the scientific community. In all, twentieth century science was a change in outlook: in the nineteenth century, science was thought to be nearly complete; but that belief was shattered by discoveries of the twentieth century such as Gödel's Incompleteness Theorem, atomic physics, and relativity. Once again, scientists are seeking to bring theories together into a coherent system. Quantum gravity is a theory that would combine Einstein's relativity with quantum theory, which explains the subatomic world.

It was in 1905 that Einstein published his special theory of relativity, famous as the equation $E=mc^2$. Work by mathematician Hermann Minkowski several years later translating Einstein's equations revealed a unity of space and time, a four-dimensional continuum (8). Shortly thereafter, Einstein began trying to find a general

theory for non-uniform motion (special relativity only applied to uniform or linear motion). This work evolved into his general theory of relativity, which Cline (8) explains, "space and time are inseparable, and in the regions of the universe where matter is present the space-time unity possesses a curvature".

The search for unity between relativity and quantum mechanics might lead to an understanding of our universe's creation: a singularity is a point of infinite density, the beginning or end of time (9). Hawking (10) points out that at such a point, space-time and quantum effects would become comparable because of scale. Thus, an understanding of these two things together would lead to the knowledge of the universe's birth. In that sense, quantum gravity is not a very practical study in science, for it has few direct applications to daily life. Quantum gravity could explain *life*, though. It would answer such pure questions of human existence as how the universe was born. By studying this area of science, scientists are working to complete the human history.

John Wheeler proposed in the 1960's that the quantum world could be described as a swirling quantum foam, whereas space-time is smooth (Peterson "Loops"). A theory of quantum gravity, loop quantum gravity, does show this proposed quantum foam. It also says that space is divided into discrete units—quanta—and that the "physical measurement of an area or volume will necessarily yield quantized results" (Peterson "Loops").

ANALYSIS/ARGUMENT

Any college physics book gives tables of the following sorts (2) and the way of understanding nature as we found them in many chemistry education materials base their initial point of argument around core- constants.

Quantity	**Symbol**	**Value**
Bohr radius	$a_0 = h^2/4\pi^2 m_e e^2$ (k_e)	0.529 177 249(24) X 10^{-10}m
Boltzmann's constant	$k_B = R/N_A$	1.380 658(12) X 10^{-23} J/K
Compton wavelength	$\lambda_C = h/m_e c$	2.426 310 58(22) X 10^{-12}m
Gas constant	R	8.314 510(70) J/K.mol
Gravitational constant	G	6.672 59(85) X 10^{-11} N.m^2 /kg^2
Hydrogen ground state	$E_0 = 4\pi^2 m_e e^4 k_e^2 / 2h^2 = e^2 k_e /2a_0$	13.605 698(40) eV
Magnetic flux quantum	$\Phi_0 = h/2e$	2.067 834 61(61) X 10^{-15} Wb
Permeability of free space	μ_0	4π X 10^{-7} N/A^2
Permittivity of free space	$\epsilon_o(\in_o) = 1/\mu_0 c^2$	8.854 187 817 X 10^{-12} C^2 /N.m^2
Planck's constant	h $\hbar = h/2\pi$	6.626 075(40) X 10^{-34} J.s 1.054 572 66(63) X 10^{-34} J.s
Rydberg constant	R_H	1.097 373 153 4(13) X $10^7$$m^{-1}$
Speed of light in vacuum	c	2.997 924 58 X 10^8 m/s

From the table above we could bring up the following issues. Let us have a look into the different constants. Bohr radius-$a_0 = h^2/4\pi^2 m_e e^2$ (k_e) , m; Boltzmann's constant-$k_B = R/N_A$, J/K; Compton wavelength-$\lambda_C = h/m_e c$, m; Gas constant-R, J/K.mol, Gravitational constant-G, N.m^2 /kg^2; Hydrogen ground state-$E_0 = 4\pi^2 m_e e^4 k_e^2 / 2h^2 = e^2 k_e /2a_0$, eV; Magnetic flux quantum-$\Phi_0 = h/2e$, Wb; Permeability of free space-μ_0, N/A^2; Permittivity of free space-$\epsilon_o(\in_o) = 1/\mu_0 c^2$, C^2 /N.m^2; Planck's constant-h, $\hbar = h/2\pi$, J.s; Rydberg constant-R_H, m^{-1}; and Speed of light in vacuum, c, m/s. If one examines the relationships of each constant and its unit, he/she is bound to

get to the following bottom line. That is, for example, a_0-m; R-J/K.mol; G- $N.m^2/kg^2$; μ_0 -/A^2; $\in_o$ - C^2 /$N.m^2$; h- J.s; c- m/s and on.

These when summed up result in that either space alone appeared, m, in the case of Bohr radius, or one over space, m^{-1}, in the case of Rydberg constant. In others, for example, in gas constant, energy per temperature per number of particles, that is, per matter appeared. In still others, energy per temperature, force per space squared, as in the case of permeability and charge squared per force per space squared did appear. In Planck constant, we find energy multiplied by time and in speed of light space divided by time is the relationship.

As one, who has gone through this paper, could possibly conclude we took over two centuries in learning-teaching chemical sciences to understand nature through only a less than ten percent window of opportunity. That window more than any thing pictured by almost all to date authors of the science books, as the ultimate, absolute, and comprehensive avenues to help understand the universe. Moreover, that was not the easy way for many students and teachers particularly in Ethiopia to comprehend the sciences first. The information in the books apart from being very incomprehensive, the authors' environments that helped them observe, gather data and arrive at generalizations were in many aspects foreign to Ethiopians. Secondly, as these books did not include other outlooks and findings of contrary to theirs, there were no chance for Ethiopians to dare contribute from their experiences. Hence, chemical education in Ethiopian universities using such books did not help the learners so far as much as it should have to.

One could confidently say that the different authors of science books, all of them used matter-energy-space-time interrelated differently to describe phenomena in

nature. We all followed suit to learn and some of us then after to teach science without any significant input of views that were similar or on the contrary.

What has been so far tried was to bring up Aristotle's, then Newtonians' and then after to date the quantumeans' (Planck, Bohr, de Broglie, Heisenberg, Einstein) stipulations that fellow humans were presented with to follow in absolute sense of acceptance during the period of dominance of each scientist. These people could be grouped as those who had been following ''the continuum" and the other bigger group up-holding "the discontinued-quantum" as central themes to understand nature. With the help of those and with the current efforts like "Quantum gravity of Wheeler, Black hole issues of Hawking and the search for the soul of God of Schroeder" (6, 11, 12, 13, 14)

One could for example bring up, as here below, arguments like $E = - k/n^2$. The integer n is the same integer as in the angular momentum assumption, $mevr = n(h/2\pi)$; k is a constant that depends only on Planck's constant, h, the mass of an electron, me, and the charge on an electron, e: $k = 2\pi 2\ me\ e4\ /h2 = 1312$ kJ.mol-1

$c = 1/\sqrt{\epsilon_0 \mu_0}$ (Electromagnetic waves travel through empty space with the speed of Light.). The relative magnitudes of E and B in empty space are related by E/B = c.

E = mc2 ; E = hν; E = kg. (m/s) (m/s) = kg. (m/s2) .

mE = h. c/λ = J. s/photon . m/s . m-1 = {kg . (m/s2) . m .s /photon } .m/s . m-1.

Point One

To arrive at the de Broglei's relationship, the c in $E = mc^2$ must cancel with the c in $E = h\ c/\lambda$, as we could infer into the details c in Einstein's conservation equation is a constant and a variable in the second equation. We are as it seems canceling a variable with a constant.

Point Two

The squaring of a constant in the same equation closely links with the Euclidean principle of the shortest hypotenuse straight-line rule. For one the relationship between "Matter-Energy and Space-Time", as we now understand from our earlier discussion, is not yet a settled business. On the other hand, squaring in old physics is a convenience in search of accuracy and precision thing rather than a well founded mathematical and physic-chemical derivation.

RECOMMENDATIONS

$$Universe \equiv \frac{Space}{Time} \equiv \frac{Energy, E\left(P.E + K.E\right)}{Matter, \sum N}$$

Geometry, Structure of Space

Power $\mapsto$ Force $\mapsto$ Energy

$$PV \equiv k\frac{T}{N}$$

$$T \Rightarrow E \equiv NP\frac{V}{k} \equiv hc\lambda \Rightarrow \frac{E}{N \equiv M} \equiv \frac{Space\left(3D\right)}{Time} \Rightarrow$$

$$E \equiv mc^3 \Rightarrow \frac{E}{m} \equiv ccc \Rightarrow E \equiv \left(mc_{heat}\right)\left(c_{const\ ,light}\right)\left(c_{wind}\right)$$

Thank God for the Enlightenment!!!

REFERENCES

1. Einstein, A. (1950). *Out of My Later Years*, New York: Philosophical Library.
2. Serway, R. A. (1998). Principles of Physics, 2nd ed, Saunders College Publishing, Harcourt Brace and Company.
3. Brady, J. E, Russell, J. W, Holum, J. R (2000). Chemistry: Matter and Its Changes, 3rd ed, John Wiley and Sons, Inc.

4. Keenan, C. W, Kleinfelter, D. C, and Wood, J. H (1980). General College Chemistry, 6th ed, Harper and Row, Publishers, Inc.
5. Bodanis, D. (2000). $E = mc^2$. *A Biography of the World's Most Famous Equation*, Walker Publishing Company, Inc.
6. Aczel, A. D. (1999). *God's Equation: Einstein, Relativity, and the Expanding Universe*, Four Walls Eight Windows.
7. Huggert, S. A., et al. (1998). *The Geometric Universe*: *Science, Geometry, and the Work of Roger Penrose*, New York: Oxford University Press.
8. Cline, B. L.(1987). *Men Who Made a New Physics*. Chicago: University of Chicago Press.
9. Hawking, S. (1988). *A Brief History of Time*, New York: Bantam.
10. Hawking, S. (2001). *The Universe in a Nutshell*. Bantam Books: New York.
11. Bohm, D. (1979). *The Special Theory of Relativity*, Reading, MA: Addison-Wesley.
12. Ebbing, D.l D. (1996), General Chemistry, 5th ed, Houghton Miffin Company.
13. Halliday, D. and Resnick, R. (1988). *Fundamentals of Physics*, Vols. II, 3d ed., New York and I: Wiley.
14. Mortimer, C. E (1975). Chemistry: A Conceptual Approach, 3rd ed, D. van Nostrand Company.