The International Society of Unified Science

Periodicals Collection

Reciprocity

Volumes XI – XV
1981-1986

The Journal of the International Society of Unified Science
Notes on the Periodicals Collection

Bruce Peret, Editor

As an aid to locating a specific article, I have added a uniform page numbering system to the lower corners of each periodical. Each page number is composed of 4 components, the Collection “Set” letter, the Volume and Number of the issue, and the page number as it appears in that issue.

Reciprocity Format

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ISUS News Format

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This numbering system allows you to flip through the bottom corner of the set to locate a specific article, without having to locate the cover and then locate the page. ISUS News issues, being published much later but having the same Volume-Number-Page format, are preceded with an “I:” to distinguish them from a Reciprocity issue.

Some issues of Reciprocity began page numbering starting with the cover page, while others began with the first article page. The latter will not have page numbers on the cover pages. Also, the last page was usually a short catalog of books. These have been replaced with a blank page, to avoid confusion with the current catalog.

There is also quite a variety of type styles and sizes. Many of the early issues were printed on 8½ x 11 paper, and folded in half, making the text very difficult to read because of the small size. These smaller issues were enlarged with a photocopier and I did the best I could to fill in many of the blurred and missing words and letters.

There are a number of places where there are handwritten corrections, which were sent to me by the authors. I corrected as many of these errors as I could, but there are undoubtedly many more—and many more yet to be made. As the former Editor, I have noticed that mistakes are invisible until you get several hundred copies made—then they stand right out. If you would like to report any errors you find, please report them via the ISUS website, www.rstheory.com.

Bruce Peret
Editor, Secretary, Webmaster
The International Society of Unified Science, Inc.
May 15, 1998; revised February 10, 2008
This Collection is dedicated to the Memory of

Dewey B. Larson

for having the courage and determination to conceptually “go where no man has gone before,” and

Dorothy E. Larson

for her patience, understanding and steadfast support.
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SIXTH ANNUAL NSA CONVENTION

DEI ROOM
ROCKWELL INTERNATIONAL DOWNEY FACILITY
12214 Lakewood Boulevard
Los Angeles, CA 90241
Friday & Saturday
August 14 & 15, 1981
9:00 a.m. - 5:00 p.m.

DEI denotes Design, Engineering and Inspection

DESIGN FOR A COHERENT UNIFIED ENGINEERING SCIENCE, the RECIPROCAL SYSTEM OF PHYSICAL THEORY, CREATED BY MR. D. B. LARSON, will be the best reason for being at the 1981 Annual Meeting of the non-profit educational corporation, presently known as New Science Advocates (NSA, INC). (Name change for the corporation will be considered at this Convention).

A preview of the scientific and philosophic quality of the discussion that will pervade the 1981 Corporation Convention can be discovered by inspecting and perusing the variety of original and pertinent essays in the present issue of RECIPROCITY, news organ of the Corporation. (Change of RECIPROCITY from an eleven-year young newsletter to a full-size journal will be considered at this Convention).

Arrangements have been made with Tahitian Village Manager, Mr. Bob Burns, 13535 Lakewood Boulevard at Rosecrans, Downey, CA 90242 to reserve 20 rooms for these two nights and these can be reserved for Thursday (August 13) arrivals. Cost for NSA attendees will be $28.00 and $32.00 per night, depending on single or double occupancy. Final arrangements must be made with Mr. Burns by the middle of July. His telephone number is (213) 634-4444.

Our California hosts, Hal Norris and Richard Long, have arranged for use of the Kona Kai room at the Tahitian Village for the corporation’s main public meeting and Dewey B. Larson’s Principal Lecture on Friday evening. Social hour with no-host bar will start at 6:00 p.m. with dinner at 7:00 p.m. and the meeting to start at 8:00 p.m.

The dinner will be a sit-down affair with prime rib (Menu No. 8, $8.25 plus Tax and Tip) as the main course. The Arrangements Committee also chose strawberry shortcake for the dessert and asparagus for the vegetable.

More about 1981 Convention and CALL FOR PAPERS ON page 27.
Dr. W. R. Lucas
Director, Marshall Space Flight Center
Huntsville, ALA 35812

Dear Bill,

In this letter I will try to bring a new theory in focus concerning especially the far out areas of natural science and to stimulate early assessment of its consequences.

My work in utilizing zero g for processing led me to find out more about gravitation. Now, after 20 years of follow-up, it has become clear that all the answers are available through Dewey B. Larson's Reciprocal System of Theory. All observed physical and chemical features in our real universe coincide with Larson's theoretical universe of motion and which has many more not yet observed features, but since first published in 59, some of these theoretical features like quasars and pulsars, cosmic elements known as mesons and hyperons, neutral currents and atomic interactions, have been observed, while others still must be discovered. In the late sixties, I often referred to the gravity dominating all our processes as being a property of earth and we now can control this terrestrial environment by simply going away in a rocket. Some of my colleagues told me that I talked like Larson. I started to read his books, but his radical departure from present theories and his development of thought from such a drastic reconstruction of fundamentals made it extremely hard and time-consuming to comprehend, at least part of it. The reason, as I know now, was that he worked for 30 years intensively, ending up with that one fundamental postulate which determines the whole physical universe, and the reader must start with it and work his way backward until he finds an interface with his established experience and starts to trust the strange new thing.

Later I asked Larson how he could have invented such a thing without God's help and he said it was definitely not a revelation and more so, not an invention, but hard and often frustrating work of exploration. He started 50 years ago relating properties of the chemical elements from their position in the Periodic Table. Following the prevailing scientific thought, he was accounting as well for the variations of number and arrangement of subatomic particles. Success of his formulation started from introducing differences in the motions of the constituent subatomic particles rather than composition. Finally only the motion terms had to be retained arriving at a mathematical expression for the interatomic distance in the solid state in terms of just three variables clearly related to the Periodic Table. He told me
that the proper conceptual interpretation of the physical meaning of
such a surprisingly simple result was a rather discouraging phase
within the first 20 years of his work. Eventually it became clear
that the atom could consist of nothing more but a combination of
motions itself, oriented about three axes, and a general reciprocal
relationship within the space and time components of these motions
related to the atomic number of each element.

The understanding emerged that the atom is formed from units of mo-
tion in linear vibration and rotating, forming a disc, which rotates
forming a sphere, which can carry rotational vibrations which are
the charges.

He successfully extended his inter-atomic force equation and calcula-
ted thousands of examples for chemical compounds; including distances
between atoms in complex crystals, specific volumes, cohesion, melting
points, compressibility, and deduced a liquid state theory deri-
ving density, viscosity, surface tension, valences and so on from
the chemical compositions. Application of this knowledge will yield
the capability of analyzing theoretically zero-q effects on super-
cooling, stability of immiscible liquid systems, crystal formation,
amorphous solidification, wetting and so on.

While the concept of a universe of motion is by no means new, Larson's
break through to a usable theory comes from an absolutely consequent
and phantasyless development of motion as being nothing more but the
reciprocal relation between progression in space and progression in
time. There exists nothing more but

- **vectorial motion**, like Translation away or towards each other,
  Rotation clock-or counterclockwise
  Linear Vibrations
  Rotational Vibrations

- **scalar motion**, outward or inward

Space and time are consequences of motion and nothing more, no pre-
conceived space and time in which the old science has placed the uni-
verse, making them a nonphysical background and unrelated to each
other.

The result is a purely theoretical, completely inflexible structure,
having particular properties like matter, radiation, gravitation,
electric and magnetic phenomena and so on through a complete material
and cosmic-material cycle that must exist and must follow specific
physical and chemical behavior patterns.

The astounding thing is only that this fits our real universe so good.
It turns out that the physical constants like Boltzmann's constant,
Planck's constant, gravitational constant and so on are all conversion
factors from the natural space and time units to the arbitrary c.g.s.
units.

The simplest entity is radiation, there linear vibrating motion units
(photons) are stationary in the natural reference system, but the re-
ference system moves with one unit of space progression per one unit
of time progression. Thus unit velocity is the speed of light. From this the two sectors of the universe extend, the material sector into the below unit speed region, the cosmic material sector into the above unit speed region. Matter forms by rotation of vibrating units (photons) about three axes. While the reference motion is away from each other in all directions (scalar) as seen at the photons emitted from a light bulb, the rotation moves matter towards each other (scalar). This is gravitation. The gravitational speed is a square function of the distance to the other matter. The net gravitational motion is the sum of the natural outward and gravitational inward motions. There are three cases: first, the net motion is toward each other as observed by Newton; secondly, the net motion is zero, (Gravitational Limit), as observed in star clusters; thirdly, the net motion is away from each other as observed at the recession of galaxies. This extended Newton's Law tells us also about the distance requirement between stars and the size limits of galaxies, but it is basically not different from the inter-atomic-force equation.

This example shows that Larson arrives at the same conclusion as conventional theory plus extension into heretofore inaccessible ranges. Present theory is mathematically fitting each department separately but contradicting each other in the fringe areas because the common denominator is not there and which Larson obviously has discovered. No more than five percent of conventional thought has to undergo significant change and these reconstructions are confined to the far out regions: the very small; the very large; the very fast; and the very far. It is therefore of NASA's concern to look at it not in a defensive way like once the church towards Copernicus, but quickly check out with the right people whether they really have something.

Since 1971 a loosely knit group of interested people has formed, discussing the Reciprocal System and reporting advances in the paper, RECIPROCITY of their organization, the New Science Advocates (NSA). With their help, Larson is rewriting and extending his first book "The Structure of the Physical Universe", which was sold out since sometime. The first volume "Nothing But Motion", is usable as a text-book, it was released last month. I had 20 copies but not many left ($9.50). Annual meetings of the NSA have been held - 1976 at the University of Minnesota, 77 at U of Mississippi, 78 at U of Utah, 79 at U of Wisconsin-Superior. Now, Dr. Frank Anderson, Chairman, Dept. of Chemical Engineering, U Miss and Prof. Frank Meyer, Physics Dept, U Wisconsin, have asked me whether the meeting could be next year in Huntsville. It was always an over-the-weekend affair, because it is all voluntary. This would be a good chance to get specific answers in areas of interest from the right people. For instance, even if the results of space mission experiments are without any doubt mathematically correct, the meaning and consequence might be open. If the investigators can list such areas, I could forward this to NSA members and they can address it at the meeting here. Also Larson could be a speaker at one of your seminars. He is eighty years old, son of Norwegian immigrants from Dakota, now living in Portland, Oregon. I have never before seen anybody with such an independent and absolute logic.

There should be many more significant answers in the experimental results that presently nobody is asking for. The Reciprocal System
tells us as much about the cosmic sector as we know about the material sector we are living in. We know that exploding star material is partly disappearing (black holes?), appearing as "Material Rays" in the cosmic sector, rearranging itself into the cosmic elements (inversed space and time units distribution of our Periodic Table).

Then, the cosmic galaxies reach their destructive limit and explode, appearing as "Cosmic Material Rays" in our sector, rearranging itself into the material elements... and so on, a steady state universe. After all of the material does not leave only the heavy elements, there should be a classification by the old recycled and the newly formed material possible. A different look at the Skylab solar experiments might reveal a much different process as presently anticipated. For instance Prof. Meyer with a group of grad. students recalculate the magnitude of Mercury's perihelion precession requiring a mathematically very simple correction for the coordinate time change by Larson's theory. Einstein assumed an increase in mass of the planet at the higher orbital velocity at perihelion, needing 75 rather complicated equations. Both results are close to the measurements, only a variation of mass contradicts Einstein's E=mc², while the coordinate time applies in any field of physics and chemistry.

As already mentioned, the liquid state theory offers much.

Giving the Reciprocal System of Theory a fair chance requires a change in thinking, something that the human mind almost automatically resists and generally resents. It is evident that any activity must be slowly and carefully brought under way. Needed in first place is your acceptance and blessing. One can naturally in a letter give little to find your ear and I am happy to try to answer any more questions, just call or involve me in a discussion with colleagues. Larson has been with high interest discussed by many coworkers in the past, I remember Reinfurth, Wilhold and Jess Jones, they also have the new textbook.

Cordially yours,

Hans

P.S. A philosophically interesting point is that the Reciprocal Theory limits the physical universe clearly to a specific mechanical capacity. There is no open end for eventually explaining our total existence if the computers get big enough. Interesting interfaces also emerge with respect to life systems.

HANS WUENSCHER, NSA LEADER

Every person is a whole world in himself or herself. When a person dies, the whole world does not die with his death. Hans Wuenscher, a valued leader of our movement, has died in the flesh. Our corporation shall sorely miss his living council. His spirit is not destroyed and will continue to serve us and humankind.

Hans did the best work of his life in the Marshall Space Flight Center under the leadership of his friend and teacher, Wernher von Braun. Let Dr. Braun write Hans's epitaph:

"Nature does not know extinction; all it knows is transformation. Everything science has taught me strengthens my belief in the continuity of our spiritual existence after death."

(Clough) "It fortifies my soul to know
That, though I wander, Truth is so".
SOME COMMENTS ON SATZ'S PAPER

by K.V.K. Nehru

I am setting down below some issues requiring clarification that arose on reading the excellent paper on 'Further Mathematics of the Reciprocal System' by R. W. Satz (RECIROCITY, p. 4-15, Vol. X, No. 3). Such type of difficulties may well be experienced by other lone amateurs like me. (I will refer to NOTHING BUT MOTION as NBM and QUASARS AND PULSARS as QP.)

1. One of the most serious difficulties that besets a beginner is the occurrence of uncorrected typographical errors, especially in the mathematical expressions. The reader who has been following the development thus far, racks his brain to comprehend this pseudo-difficulty, as he is treading an utterly unfamiliar ground. A veteran may not feel this, however. Some such errors of omission and commission I find are:

1.1. A general confusion resulting from the use of 1/2R to mean (1/2)R at some places and 1/(2R) at other places (as in line 16, p. 8).

1.2. Lines 12-13, p. 5: Instead of "...natural unit velocity..." it must be "...natural unit of velocity..."

1.3. Line 9, p. 6: In the equation "s'nat = 2 x s'nat x f'os nat" the L.H.S. should be "s'nat/t'nat".

1.4. Line 4, p. 7: 'x' is missing inside the parentheses in the R.H.S. of the equation.

1.5. Line 3 below the Table, p. 9: Instead of the words "1 or more," it should be "more than 1."

1.6. Line 2 from bottom, p. 9: Instead of "1/2 - 1/2 - 2," it must be "1/3 - 1/2 - 2."

1.7. Line 1 in the Table, p. 10: Under 'Rot. Freq.' it should be 2R/3π instead of 2R/π.

1.8. Line 2 in the Table, p. 10: Under 'Photon Frequency' it must be 2R and not 2R.

1.9. 2nd Table, p. 10: Under 'Rot. Displ.' for Deuterium, it must be "(1)" and not "1" in the electric dimension.

2. The next type of difficulty arises out of the failure to define new symbols, terms or ways of representation when used the first time in the text. Examples are:

2.1. Use of letter R to represent the Rydberg frequency in p. 7, without priorly defining. R should have been defined in p. 6 itself where Rydberg frequency is first mentioned: instead, it is done later, on p. 8.
2.2. **Line 3, p. 11**: What is meant by the 'relative rotations' is not clear.

2.3. A new notation, differing from that adopted in NBM, is used to represent the rotational displacements of the double rotating systems of the atoms. Especially the discrepancy in the number of electric displacement units among the two notations is not made clear. For example, lithium is represented by $2^{-1} 1^{-1}$ whereas it should be $2^{-1} 2^{-1}$ or $2^{-1} 2^{-2}$ from NBM.

2.4. **Lines 1-2, p. 13**: How this bond gives rise to an electric speed of $1/10$ for vibration one ... etc. is not clear. What is meant by the 'Active Dimension' in the Tables in p. 13 and 14 (which even takes on a value of $1\frac{1}{4}$ etc.)? These gaps in the explanation could not be made good by referring to NBM either (as the author suggests at the outset).

3. The last type of difficulty is conceptual:

3.1. "... the oscillation takes place over one natural space unit" (line 6 from bottom, p. 5). Does the oscillation take place over a space unit in all cases? In the case of high frequency radiation, say of frequency $n$ (where $n$ is an integer), the greater than 1 space-time ratio is accomplished by the periodic scalar reversal of the time component. What is oscillating, therefore, is the time component, while the space component is progressing unidirectionally. Hence what we have to consider here is a sine curve in three-dimensional time. (See lines 8-5 from bottom, p. 29, OP.) As such, the Eq. (18) in p. 7 is applicable only to low frequency radiation (with frequency $= 1/n$).

   The equation for a simple harmonic oscillation in one dimension (say the T direction) of time is

   $$ T = \frac{1}{2} t_{nat} \cdot \sin \left[ -\pi t / t_{nat} \right] $$

   which can be derived like the Eq. (18).

3.2. "The diameter of all the particles is one natural space unit, reduced by the interregional ratio, or 2.914 Å." (lines 4-5, below the Table, p. 9).

   But to me it appears that the interregional ratio applicable here is not 156.44. For, see for example, "... each of the rotating systems of the atom has an initial unit of vibrational displacement with three possible orientations, one in each dimension. For the two-dimensional basic rotation this means nine possible positions, of which two are occupied." (p. 154, NBM) Hence the additional $2/9$ factor in $128(1 + 2/9)$. But in the case of subatomic particles, since they are only single rotating systems, of the nine possible vibrational positions, only one is occupied and so the interregional ratio ought to be $128(1 + 1/9) = 142.22$. This gives the diameter of the particle as 3.2054 Å while that of an atom is 2.914 Å.
SOME THOUGHTS ON THE RECIPROCAL SYSTEM OF THEORY

Under this heading Professor K.V.K. Nehru has raised some interesting questions and made some perceptive comments about D. B. Larson's NOTHING BUT MOTION, referred to by Dr. Nehru as NBM and NEW LIGHT ON SPACE AND TIME, referred to by Dr. Nehru as NLOSAT. These questions and comments are reproduced below, interspersed with responses by the creator of the Reciprocal System, who refers to the second book by ST and the first book by M.

(1) K.V.K.: p. 156, 13th line from bottom, NLOSAT: Instead of the words 'basic vibrating unit' it must be 'rotational base.'

p. 123, 10th line from bottom, NBM: in 'However, the rotational displacement...,' the word 'rotational' should be replaced by 'vibrational.'

(1) D.B.L.: You are right on both of these items. I have expressed the first one in the correct manner on page 140 M.

(2) K.V.K.: There is a difference in the notations used for representing the rotations of atoms (e.g.: 2-1-0, p. 236, NLOSAT) and of the sub-atomic particles (e.g.: 1-0-{1}). In the former the numbers represent double natural units whereas in the latter they represent single natural units. This divergence is a source of confusion as no attempt was made to clarify it, and both modes of notation were used at the same places, as in p. 236, NLOSAT.

(2) D.B.L.: I gave a brief explanation on page 231 ST, but this book is, as I said in the preface, a "bird's eye view," and I could not go into much detail on anything. There is a more extended explanation on page 140 M, including setting up a new system of notation to avoid the difficulty that you point out. I do not believe it advisable to try to use the same notation for both atoms and sub-atomic particles, as this would lead to complications in the development of theory.

(3) K.V.K.: p. 170, last but one para, NLOSAT: It is not clear how a proton, M 1-1-{1}, can acquire a positive electric charge (see p. 145, NBM). From what has been explained in the para cited above and elsewhere, as its electric rotational displacement is space-like, the proton can only acquire a negative electric charge--like the electron.

(3) D.B.L.: An electric charge is a one-dimensional rotational vibration. In order to be stable and identifiable as a separate entity it must oppose the rotation with which it is associated, but this does not have to be the rotation in the electric dimension. The charge can oppose the rotation in one of the magnetic dimensions. Since the magnetic rotation is always positive in the material sector, this means that all material elements can take positive electric charges under appropriate conditions. In fact, at high temperatures, such as those in the stars, all elements are positively charged.

(4) K.V.K.: In p. 155-6, NLOSAT, the apparent reduction in the velocity of light in a material medium is attributed to the additional space involved due to the rotational space-like displacements included in the structure of most atoms of matter. On this score, the apparent velocity of light in a material medium with only positive rotational displacements should be greater than c!
(4) D.B.L.: I am not quite clear as to the point of your comment. I will say, however, that ordinary matter is a time structure; that is, one in which n units of time are associated with each unit of space (as we see the situation in the context of the conventional fixed system of reference). When the photon passes through this matter, the total time involved in the motion is increased by the addition of the time component of this matter. The photon speed, the ratio of space to time, therefore decreases. Conversely, in the cosmic sector, where matter is a space structure, the speed of light is increased in passing through cosmic matter.

(5) K.V.K.: Speaking of the progression of the photon in the free dimension it is remarked that "...the combination of a vibratory motion and a linear motion perpendicular to the line of vibration results in a path which has the form of a sine curve." (p. 51, NBM) In the case of HF radiation, the space component of the vibration progresses unidirectionally while it is the time component that oscillates back and forth. As such "the linear motion perpendicular to the line of vibration referred to above cannot be the scalar progression of the space component of the general space-time progression. Is the sine curve form, then, taken to be pertaining to the three-dimensional time?

(5) D.B.L.: The frequency of the radiation is irrelevant. In either case, HF or LF, the progression of the natural reference system in the dimension of the vibration is neutralized by the reversals. This permits a progression to take place in a perpendicular dimension. The scalar motion (progression) in this second dimension is totally independent of that in the first, as scalar quantities cannot be combined vectorially.

(6) K.V.K.: Explaining the effect of adding rotation to the vibrational units of a photon, it is said that the "remaining vibrational units of the original photon continue as a photon of lower displacement" (p. 123, 3rd para, NBM). But it is not clear how the detachment of one of the vibrational units (which are any way discrete) reduce the displacement of the original photon?

(6) D.B.L.: The units that I am talking about here are units of displacement -- that is, units of speed. (See explanation of the use of the term "displacement" on pages 119-121 M.) When one unit is detached to join the rotational motion, the photon continues on its way with one less unit of speed (a lower frequency).

(7) K.V.K.: The liquid state is the result of vanishing of the force of cohesion in one dimension (and the gaseous state in three dimensions). However, whether the vanishing of the cohesion in two dimensions results in any specifically observable distinction is not made clear. Is it to be equated to the vapor state?

(7) D.B.L.: Probably. I had not covered this subject fully twenty years ago when I interrupted my research work in order to start publication of my results, and I have not been able to get back to it since. My conclusions in this area are therefore somewhat tentative.

(8) K.V.K.: p. 173, top para, NLOSAT: Not only this--if the hypothesis of the tendency of atoms to assume a stabler structure like that of inert gases by gaining an electron is true, should not the atoms, say, of chlorine, tend to transform to those of argon, if placed in an environment of negative electrons, by absorbing single electrons?
(8) D.B.L.: It looks that way to me, too, but I suppose we will have to let the supporters of conventional theory answer this question.

(9) K.V.K.: p. 50, bottom para, NBM: It is not clear why do the inward/outward scalar reversals result in vectorial direction reversal in only one dimension? Why they do not produce a three- or two-dimensional vibrating unit?

(9) D.B.L.: We are dealing with a scalar motion, and the only latitude that we have, at this stage of the step-by-step development, is to change from + to −, and vice versa. This does not necessarily preclude introducing additional dimensions of motion later in the development, but multi-dimensional scalar motion has some unfamiliar features. I intend to discuss this type of motion at considerable length in Volume II.

(10) K.V.K.: p. 185-6, NLOSAT: In view of the dimensional differences in the origin of electrical, magnetic and gravitational forces which are actually motions of the same general nature, it is shown that the force exerted by an electric charge on an uncharged mass is only $1/c^2$ as great as the force on an object with a charge of comparable magnitude. However, no mention is made of the force exerted by the electric charge on a magnetic charge, which, though it must be less than the force of an electric charge on electric charge, must, nonetheless, be greater than the force exerted by electric charge on uncharged mass. Hence this must be within the possibility of detection, like the weak force exerted by a magnetic charge (referred to in the para cited) on a (magnetically uncharged) mass unit.

(10) D.B.L.: I have not arrived at a firm conclusion on this point as yet. It had occurred to me, and I have given it some consideration. So far, I am inclined to believe that it will be ruled out by the directional orientation of the electric and magnetic forces.

(11) K.V.K.: Within the gravitational limit of a material aggregate there is net inward scalar motion. As such, what would happen to a photon emitted from the object, within the gravitational limit? As the photon has no independent motion but is only carried away by the general space-time progression and since the net motion now is inward, how can we account for the velocity, $c$, of the photon and its eventual emergence from the domain of the gravitational limit?

I think, the argument that the above net inward motion within the gravitational limit belongs only to the material aggregate and does affect the photon is not valid. Even if such an argument is preferred, it raises another difficulty: how to account for the bending of light rays in a gravitational field gradient.

(11) D.B.L.:

Diagram (a) shows how the photon motion $P$ and gravitation $G$, without any modifying influences, would look relative to the natural reference system. The photon is motionless, while
gravitation has an inward speed $1-x$. Diagram (b) shows the same situation relative to the conventional fixed reference system. Now the photon has an outward speed 1, while the inward gravitational speed has been reduced to $x$. Diagram (c) shows the usual situation encountered in practice. The gravitational speed $x$ has been modified slightly by random motion, and now has a magnitude $y$, still very small compared to 1. A photon emitted from the gravitating object moves outward from that object at unit speed.

(12) K.V.K.: The mass-less sub-atomic particles do not have net time-like displacement in three-dimensions like the atoms. As such why are they not carried away by the general space-time progression since inward gravitational motion is not present to counteract the outward scalar progression? Doubtless, they differ from the photons thus carried away by the space-time progression in having additionally rotational displacements. But so long as the net rotational displacement is in less than three dimensions, the space-time progression should carry it off in the free dimension. Perhaps this could be the reason that this class of sub-atomic particles is not observed (p. 142, NBM).

It is put forward that the uncharged electron, for example, cannot move through space as its net displacement is space-like and the relation of space to space is not motion. However, since the one unit of two-dimensional rotation is balanced by the unit of negative vibration, and the net space-like rotation is only in electric dimension, is there no dimension effectively free so that the scalar space-time progression applies in that dimension?

(12) D.B.L.: These massless particles undoubtedly move at the speed of light, as you suggest. Our inability to observe them is not due to their speed, but to the fact that, except in the case of the neutrino, we have not, thus far, identified processes in which they take part. Experience with the neutrino suggests that some of the effects of the other massless particles may also be detectable is we look in the right places.

(13) K.V.K.: Instead of a RV displacement being added to an existing rotational displacement as in the case of atoms, is it possible to have a rotational vibration (of opposite space-time character) directly added to the linear vibrating unit that is photon? For example, a negative electric charge, $RV_{1-}$, can be imposed on a photon, $LV_{1+}$?

(13) D.B.L.: No. A charge is a rotational vibration. As such, it can only exist as a modifier of a rotation. Otherwise there would be nothing to constrain it into the rotational path, and it would revert to the status of a linear vibration.

(14) K.V.K.: Chapter 13, NLOSAT: The discussion does not bring out some important aspects of the difference in the characteristics of electric and magnetic charges compared to those of gravitation.

Firstly: Like electric charges repel each other and unlike charges attract. In order to explain this, should it be taken that the scalar effect of the charge is both inward and outward in space-time at the same time?

Secondly: The gravitational force, unlike that due to charges cannot be screened off (p. 60, line 3, NBM) because
gravitational motion is inward scalar motion with respect to the general structure of space-time. Now if, the motion which gives rise to the electric or magnetic forces is a motion of the same general nature as that of gravitation, being the motion of the individual atom or particle with respect to the general structure of space-time (p. 186, NLOSA). It is difficult to see how these forces can be screened off as is possible actually.

As regards the first point the following line of explanation may be considered. The negative electric charge, being a time-like RV displacement, must have an attendant scalar translational motion in space (just like the gravitational motion of a positive rotation). Like the positive rotation, it may appear, that this RV displacement should therefore involve a scalar inward motion in space. However, "... because of its vibrational character each unit of this charge is only half as effective as a unit of unidirectional rotation." (p. 190, NLOSA) Consequently, this accompanying scalar translational motion is midway between the general outward space-time progression and the inward scalar translational motion of a rotational unit. Thus it appears as a scalar outward motion in space from the point of view of the gravitationally-bound stationary reference system. This manifests as mutual repulsion between the negative electric charges.

On the other hand, the rotational vibration that is a positive electric charge, is a space-like RV displacement. Hence it involves a scalar translational effect similar to that of a unidirectional rotation that is space-like (motion in time). But the scalar translational motion of space-like rotational displacement units (i.e., rotation in time) is the gravitation in time. As such the space-like RV displacement too involves a scalar inward motion in time. Once again, as in the previous case, because of the fact that the vibrational rotation is only half as effective as a unidirectional rotation, this attendant scalar inward motion in time of a positive electric charge falls midway between the general outward space-time progression and the inward gravitational motion in time. Now, in order to understand how this appears from the point of view of the stationary spatial reference system, we must recall that in the context of such a reference system, the progression of the time component is the same as that in the natural reference system. Consequently, the scalar translational motion of the positive electric charge is apparent as inward in time. This manifests itself to us as mutual repulsion of the positive charges, since the inward scalar motion in time is tantamount to outward scalar motion in space.

Finally, the relationship of negative to positive electric charges is that of scalar outward motion in space to scalar inward motion in time and manifests to us as mutual attraction of the positive and negative electric charges.

Regarding the possibility of screening off the electrical charge effects: once we see them as basically scalar motions of the individual charges, screening becomes impossible, like in the case of gravitation. The following interpretation may be relevant. The screening is a balancing of the inward (or outward, as the case may be) scalar motion by a vectorial motion (i.e., 'co-ordinate' as versus 'clock' motion) in the dimension (or dimensions) concerned, by the screening object. This characteristic of the screen, the generation of motion oppositely directed to that of the scalar translational effect of the charge is not unlike the process of acquisition of gravitational charges due to captured charged neutrinos.
As given, since "... the natural unit equivalent of a magnetic (2-dimensional) displacement n is $4n^2$, " i.e.,

$(2n)^2$, the natural unit equivalent of a magnetic displacement unit of 1 is $2^2 = 4$, and in equivalent electric units is $4/2 = 2$ (in view of the double units we are working with). On the other hand, the natural unit equivalent of the magnetic displacement unit of $\sqrt{2}$ is $(\sqrt{2})^2 = 2$, and in equivalent electric units is $2/2 = 1$. Thus, while it does not seem to matter, at unit level, whether we consider the first unit of magnetic displacement as 1 or $\sqrt{2}$, only the latter is actually relevant, since this alone gives us the correct atomic number sequence.

This important point is not brought out in the discussion and the whole issue is glossed over with nothing more than one sentence, "At the unit level dimensional differences have no numerical effect, i.e., $1^3 = 1^2 = 1."$ (p. 128, NBM)

Indeed, the role of unity, as a natural datum, is of far-reaching significance. The requirement of the first effective unit of the 2-dimensional displacement being $\sqrt{2}$ instead of 1 can be seen to be arising out of the following. The first unit of displacement, from the rotational base, has a unique and distinguishing characteristic in that it marks the emergence of "something physical compared to the prevenient "nothingness."

Inasmuch as this is so, the difference between the first unit and the rest is not only one of degree--but something else too. The adding of the first displacement unit involves a transit from the region inside the unit displacement to that outside. Hence the dictum that "... all of the physical phenomena of the inside region ... are ... second power expressions of the corresponding quantities of the outside region" (p. 155, NBM) applies here. Consequently, the 1 unit displacement, when looked from the viewpoint of physical manifestation--i.e., from the "something's" side of the unit boundary as against the "nothings's" side--is to be regarded as $\sqrt{2}$.

It must be noted that the setting up of units and measurement procedures from the standpoint of natural reference system, in terms of speed displacements, results in the relation between the algebra of displacements and the algebra of the conventional speed units being exponential in nature. This is to say that the adding of displacements is equivalent to the multiplying of the corresponding speeds.

Suppose we define the speed displacement $d$, of a speed $v$, as $d = \lg c - \lg v$, since it is a deviation from the unit speed, $c$; all speeds like $1/n$ give positive displacements, $\lg n$, while speeds like $n$ give negative displacements, $-\lg n$, and unit speed $c$ gives zero displacement, $\lg 1$. Though this definition does not exactly tie in with the treatment in the book, it, nonetheless, serves to demonstrate the general exponential nature of the relationship mentioned above. It also illustrates how the adding of a motion of $(n-1)$ positive displacement units to another of $(n-1)$ negative displacement units produces zero displacement (p. 121, NBM), since in dealing with the corresponding speeds we need to multiply the speed $n$ (represented by $(n-1)$ negative displacement units) by speed $1/n$ ($(n-1)$ positive displacement units) to obtain the unit speed (zero displacement).
(14) D.B.L.: Your criticism of the lack of coverage of electricity and magnetism is valid, but here again you should bear in mind that a "bird's eye view" does not see everything. I will give you a much broader view of these subjects in Volume II of the new edition.

As brought out in Volume I (particularly in Chapter 18), linear motion is limited to two full units, from +1 to -1, as seen in our fixed reference system. In terms of the natural reference system both +1 and -1 are zero, the + zero and the - zero, we may say, if we look at the situation from the standpoint of what is happening in the region between the two. The motion of an electric charge is always outward, but the motion of a positive charge is outward from the positive zero, while that of a negative charge is outward from the negative zero. Two positive charges move away from each other, as shown in the upper line of the diagram below. Two negative charges also move outward away from each other, as shown in the lower line. But a positive charge and a negative charge move toward each other, as indicated by the middle line, even though they are both moving outward from their respective zero points.

[Diagram showing motion of charges]

Screening is simply a matter of mathematics. A+B is always greater than A, but A-B can take any value. Since all gravitational motion is in the same direction, the effect of introducing matter between objects X and Y is to increase the original gravitational motion A to A+B. But since the motion of charges can take either direction, the introduction of matter between charges X and Y may have a resultant A-B.

(15) K.V.K.: Regarding the lifetimes of the cosmic decay particles (Ch. 15, NBM) the following points may be considered. The spatial extension of the cosmic atom is the analog of the lifetime of the atom in the material sector. As such the lifetimes of the decaying c-atoms must bear a relation to their spatial extensions before the decay.

The correlation of lifetimes with the dimensions shown in p. 192, (NBM), can be arrived at by tying together some loose/ends as below (with appropriate interchange of the words 'space' and 'time'):

(i) The limiting spatial extension of the incoming atom in each dimension is one natural unit (i.e., s in conventional units). Thus the extension space involved in two dimensions becomes \( s^2 \), and in three dimensions, \( s^3 \).

(ii) The temporal equivalent of this spatial extension \( s \) is \( s/c \).

(iii) "...If the motion is one-dimensional, all of the effects can be transmitted. If it is two-dimensional, the fraction transmitted ... is \( 1/c \) of the total ... The transmitted fraction is only \( 1/c^2 \) in the case of three-dimensional rotation." (p. 185, NLOSAT)
(iv) "...The time region speed, and all quantities derived therefrom, which means all of the physical phenomena of the inside region .. are .. second power expressions of the corresponding quantities of the outside region." (p. 155, NBM)

The Table below shows the result of applying these criteria (i) to (iv) above to the various dimensional motions.

<table>
<thead>
<tr>
<th>Criterion No.</th>
<th>Number of dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>(i) s</td>
<td>s^2</td>
</tr>
<tr>
<td>(ii) s/c</td>
<td>s^2/c</td>
</tr>
<tr>
<td>(iii) (s/c)</td>
<td>(s^2/c)(1/e)</td>
</tr>
<tr>
<td>(iv) \sqrt(s/c)</td>
<td>\sqrt(s^2/c)(1/c)</td>
</tr>
<tr>
<td>Result converted to secs.</td>
<td>1.233148 x 10^-8</td>
</tr>
</tbody>
</table>

On the other hand, if the extension space involved in the two- and three-dimensional cases are respectively \( \frac{s^2}{c} \) and \( \frac{s^3}{c} \) (based on statistical circular and spherical symmetry in co-ordinate space) instead of \( s^2 \) and \( s^3 \), we have the calculated values of the lifetimes in the two- and three-dimensional situations as respectively 1.347645 x 10^-16 and 1.356892 x 10^-24 seconds.

(15) D.B.L.: You may have something here. I do not have time to make a full evaluation of your proposal now. In fact, I have a general policy of not making a quick decision on any new idea, whether it is my own or comes from someone else. But it appears to me that this may be the kind of a thing that I was looking for (unsuccessfully) at the time I wrote Chapter 15. I suggest that you prepare a paper on this subject and send it to Professor Meyer for publication in Reciprocity, so that the NSA members can take a look at it.

(16) K.V.K.: The general space-time progression of our universe is an outward scalar progression. How is this to be distinguished from one with both space and time progressing inward? The universe of motion with both space and time progressing outward is indistinguishable from that with both space and time progressing inward. In addition, both these cases are indistinguishable from a third case where for one unit both space and time progress outward and in the next unit both of them progress inward, alternately. It is not clear how this indistinguishability is built into the conceptual framework of the Theory. Moreover, how (or whether) our consciousness has come to regard it as an outward progression is not evident.

(16) D.B.L.: The existence of a physical universe is possible only if gravitation is inward, so that the originally widely dispersed units of matter move closer together and eventually reach positions in which they can interact. This means that the arbitrary fixed reference system that we set up on the basis of such interactions is moving inward relative to the natural reference system. The apparent progression of the natural reference system is therefore outward.

B 11.1-17
(17) K.V.K.: "... deviations from unit speed .. are accomplished by means of reversals of the direction of the progression of either space or time." (p. 75, NBM) What about the case of conjoint reversals of both space and time, like: \( \frac{t}{+}, \frac{t}{-}, \frac{t}{+} \) etc.? That is, for one unit space progresses inward while time progresses outward. In the next unit space progresses outward and time progresses inward. Such a basic motion has a speed of 1 that is unvarying and must be both an independent and a stable motion. Can we identify the above 'coupled-vibration' with any physical entity? The above may even result in rotation. At any rate, the motion is similar to the inward translational aspect of the material gravitation.

(17) D.B.L.: A speed of unity, 1/1, is no motion at all relative to the natural system. We cannot distinguish between no motion in space and no motion in time.

(18) K.V.K.: I find that the following concepts are not explained adequately, with the result the reader (who is being exposed the first time) is left with many nagging why and hows:

(a) the inter-regional ratio (p. 154, NBM)
(b) secondary mass (p. 161, NBM)
(c) electric mass and mass of electric charge (p. 163, NBM)
(d) secondary neutral valence

(18) D.B.L.: I am not sure just what you have in mind here. Are you merely suggesting that I should explain these points more fully in later publications? (in which case, I thank you for the suggestion), or do you have some questions that you want answered? (in which case I would like to have something more specific).

(19) K.V.K.: p. 100, NBM: Continuing the line of argument (in the text), if we substitute an object with a speed less than \( c \) for each of the photons, instead of for only one (as suggested in the last-but-one para), we arrive at the true relative \( v \) speed of the two objects as \( \frac{v_1 - v_2}{v_1 + v_2} = 1 \) always. Thus the true relative speed always turns out to be unity for any objects--not necessarily only for photons.

(19) D.B.L.: The time component of speed always includes the time of the progression (clock time), regardless of whether the moving objects are, like the photons, moving at the unit speed of the progression, or at some different rate. Thus the denominator is always \( 1 \pm v \), never \( v \) alone.

(20) K.V.K.: p. 128-9, NBM: It is not clear why the relation that "..a magnetic displacement \( n \) is equivalent to \( 2n^2 \) electric displacement units" does not hold good for \( n=1 \). For \( n=1 \), the equivalent electric displacement works out to be 2, by this formula. However, in the development of the series of elements, the magnetic displacement \( l \) is counted as an equivalent electric displacement of 1 unit and not 2. There is definitely a hiatus in the reasoning here, an examination of which may lead to some important insight and clarify, among others, the case of half units represented in \( M \frac{3}{2} - \frac{3}{2} - 0 \), for example.
Under these circumstances, it is not difficult to see that halving the displacement unit amounts to taking the square-root of the corresponding speed and does not involve any half unit of speed (i.e., if \( d = 1g\ n \), then \( \frac{1}{2}d = \frac{1}{2}1g\ n = 1g\ \sqrt{n} \)). Unit level, as in the case of sub-atomic particles, this gives rise to the unique possibility of positing \( \frac{1}{2} \) unit displacement (p. 141, NBH) because of the idempotent nature of unity (i.e., \( 1 = 1 \)), without involving anything less than unit speed.

(20) D.B.L.: I don't believe that I get the point of your argument on this item. So far as I can see, we are applying the same relation all the way through the series of elements. The sequence of magnetic additions is this:

<table>
<thead>
<tr>
<th>Rotational base (2)</th>
<th>Rotation</th>
<th>Net Speed</th>
<th>Electric Equiv.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective zero (unity)</td>
<td>1-0-0</td>
<td>0-0-0</td>
<td>0</td>
</tr>
<tr>
<td>Helium</td>
<td>1-1-0</td>
<td>1-0-0</td>
<td>2 n = .1</td>
</tr>
<tr>
<td>Neon</td>
<td>2-1-0</td>
<td>1-1-0</td>
<td>10 n = 2</td>
</tr>
<tr>
<td>Argon</td>
<td>3-2-0</td>
<td>2-2-0</td>
<td>18</td>
</tr>
</tbody>
</table>

We start with a rotational base for each of the two rotating systems of the atom, with net speed zero in all dimensions. Then we add one magnetic rotational unit to bring the effective speed to unity, the natural zero level. (The language that I used in the book may have been somewhat misleading, although I did say specifically that the purpose of this first magnetic unit is to bring the scalar speed to zero on the natural basis.) Since this non-effective unit uses up one of the \( n = 1 \) spots, there is only \( 2 \times 12 \) group of elements, and a \( 2 \times 22 \) group follows, as shown in the tabulation.

(21) K.V.K.: p. 154, NBH: The inter-regional ratio is calculated on the basis that """"... for each of the 128 possible rotational positions there is an additional 2/9 vibrational position."" The ratio is thus found to be \( 128(1+2/9) = 156.44 \). However, in the case of sub-atomic particles, which are single rotating systems, only one, and not two, of the possible nine vibrational positions are occupied. Thus the inter-regional ratio must be \( 128(1+1/9) = 142.22 \) and not 156.44.

(21) D.B.L.: You are correct. The 142.22 ratio must be substituted for 156.44 in the appropriate applications. I said this on page 163 M.

This completes the items that I received from Professor Meyer. I have tried to be responsive to the questions that you have asked, but it cannot be expected that all of my answers will be satisfactory. So I want to assure you that I will be glad to discuss any of them at more length if there are issues that you want to raise. It is apparent from your comments that you have gained a good deal of insight into the structure of the theory already, and I would like to help clear away any obstacles that still remain in the way of a full understanding.

It has become quite clear since publication of Nothing But Motion that the scientific community in general has.
very little comprehension of the scalar type of motion that plays such a large part in my theoretical development, although scalar motion is not something that is peculiar to my theoretical system. It is something that exists as one of the phenomena of the physical universe, and any physical theory should be prepared to deal with it. Since it is a very important factor in my theoretical structure, and so generally neglected in current practice, I am planning on including an extended discussion of this type of motion in Volume II. I put a part of this discussion into a memorandum that I used at the recent NSA conference at Huntsville, Alabama. I believe that this should be of some interest to you, and I am therefore enclosing a copy.

FURTHER COMMENT

K.V.K.: While printing my questions + DBL's answers, please consider the following additional remarks. The numbers I attached to these remarks below are those corresponding to my question numbers. The paragraphs numbered 5, 17 and 19 below may be printed in parentheses after the corresponding answers of DBL.

(5) Apparently, my question was not clear here. What I meant was: a progressing sine wave has two components--(i) the oscillation in the lateral dimension and (ii) the uniform forward progression. Now my point is, that both these components must be of the same nature--either spatial or temporal. Thus, if the oscillation component is in time, the progression component in the perpendicular dimension to be compounded with this has to be in time also; and the sine wave must be envisaged as occurring in three-dimensional time and not in three-dimensional space.

(15) My query No. (15) becomes partly redundant if my paper on c-atom lifetimes appears in RECIPROCITY. As such, only the first para of my query No. (15) may be retained--in order to give continuity Larson's answer No. (15)--and the rest could be omitted. (See p. )

(17) But reply No. (17) does not answer the point I raised here. I was asking whether this "coupled vibration," with speed of -1 like the gravitational motion, could be realized in some physical entity?

(19) Does the answer here mean that the relative speed of two objects with speeds \( v_1 \) and \( v_2 \) (in natural units) is given by \( \frac{v_1 + v_2}{1 + v_1 + v_2} \) since the total time involved would be \( 1 + v_1 + v_2 \)?
THE LEVELS OF EXISTENTS: A REVIEW OF DOUGLAS HOFSTADTER'S BOOK 
GÖDEL, ESCHER, BACH: AN ETERNAL GOLDEN BRAID

by
Ronald W. Satz

Introduction

The major topics of Hofstadter's book are metamathematics, human brain operation, and artificial intelligence. The first part of the book is called GEB (Gödel, Escher, Bach) and the second part of the book is called EGB (an Eternal Golden Braid). The book is 777 pages long, including an 18 page index. There are 152 figures. As might be expected of a best-seller and Pulitzer Prize winner, the book is written in a very popular, even jocular, style. Though huge and sprawling, it is very entertaining and stimulating.

Douglas Hofstadter (hereafter abbreviated to D.H.) is Assistant Professor of Computer Science at Indiana University and is apparently going to take over Martin Gardner's column in Scientific American. D.H. describes himself as a "tortoise": "an ingenious, persistent, and humorous being, with a fondness for paradox and contradiction." His humor comes through in the between-chapter metaphorical dialogues, which are roughly patterned after Bach's fugues. Paradoxes and self-references are discussed in all the sciences. Even the title of the book is parodied to Copper, Silver, Gold: an Indestructible Metallic Alloy (a book on metal-logic). The end of the book includes its own self-reference.

To do justice in commenting on the book would itself require a book. But to keep this review short, I will be content only to mention briefly some of the hundreds of topics discussed and will point out where I disagree with D.H. Even though the book generally progresses from metamathematics to artificial intelligence it is not a systematic presentation of the levels of existents; individual chapters may have a complete mixing of levels. In this review, I will discuss one level at a time, starting at the lowest and ending with the highest.

I. Logic and Mathematical Science

A. Formal systems

D.H. discusses formal systems of logic and mathematics. To specify a formal system requires the following: an alphabet of symbols, a set of finite strings of these symbols (called well-formed formulas), a set of axioms, and a finite set of rules of deduction. First, D.H. gives some very elementary examples of formal systems of his own invention: the MIU system, the pq-system, and the TQ-system. Then he goes on to discuss a non-axiomatic version of the Propositional Calculus (I prefer the axiomatic version; see Ref. 2 by A. G. Hamilton). Topics discussed include the alphabet, rule of joining, well-formed strings, atoms, formation rules, rule of separation, double-tilde rule, deduction theorem (called, oddly, by D.H., "the fantasy rule"), carry over rule, intended interpretation, rule
of detachment, contra-positive rule, De Morgan's rule, "switeroo" rule, and decision procedure for theorems (truth tables). D.H. does not discuss the Predicate Calculus.

Next, D.H. addresses formal systems in mathematics, specifically geometry and number theory. He recites the history and postulates of Euclidean and non-Euclidean geometry. Then he presents a formal system of number theory, called "Typographical Number Theory" (abbreviated to TNT). This includes numerals, variables, terms, atoms, negations, compounds, quantifications, open formulas, closed formulas, 5 axioms, rule of specification, rule of generalization, rules of equality and successorship, and the rule of mathematical induction. There is mention of recursive and primitive recursive functions and graphs, but here is no mention of non-recursive functions. I think that this is a profound omission, as shown next.

B. Results about formal systems

A consistent formal system is one in which every theorem, upon interpretation, comes out true (in some imaginable world); a complete formal system is one in which all true statements can be expressed as theorems. Now Ref. 2 shows that the Propositional Calculus, pure first order Predicate Calculus, first order theory of Abelian groups, and first order arithmetic without multiplication are all consistent and complete. The major question handled by D.H. is whether Typographical Number Theory is consistent and complete—and many pages are devoted to showing that if it is consistent, then it is incomplete. D.H. gives many variants of Gödel's Incompleteness theorem, one of which is

All consistent axiomatic formulations of number theory include undecidable propositions.

Perhaps most readers will accept this at face value and may even revel in this impotence as D.H. seems to. However, the statement is wrong! TNT and similar systems are incomplete, but it is wrong to say that no consistent formal system of arithmetic can be complete. In fact, to quote from Ref. 2, p. 151, "If we allow our sets of proper axioms to be non-recursive, we can have a first order system of arithmetic which is consistent and complete." The problem with TNT is that it represents only recursive functions and not non-recursive functions.

But how useful is a formal system of number theory based on a set of axioms which are not recursive? If Church's thesis is correct, the answer is: not useful. D.H. gives 8 different versions of the thesis, none of which I particularly care for. A version I like is given in Ref. 2, p. 155:

Church's thesis is equivalent to the conjunction of

(i) Every partial function computable by algorithm is a recursive partial function.

(ii) Every recursive partial function is computable by algorithm.
II. *Meta-physical Science*

A. Holism vs. reductionism

D.H. excellently presents the arguments for and against holism and reductionism. As I see it, there are three stages to knowledge. Most people remain in the first stage, which I call "naive holism," in which they view practically all objects in their environment as "wholes"; they know the inputs and outputs of a given existent, but they do not know the in-between steps of processing. D.H. spends quite a few pages on Zen Buddhists--people I consider to be naive holists. The second stage of knowledge is "scientific reductionism." Here, a scientist studies a given existent, breaking it down into lower-level existents. Ad hoc theories are formulated for the given existent. The overall result of scientific reductionism is a collection of theories--most of which do not fit together well--for all the different disciplines. The third and final stage of knowledge is reached upon the development and understanding of a unified, general theory covering all levels of existents. I call this "sophisticated holism." This is the sort of theoretical system that Larson, I, and other members of our group are working on. Whereas D.H. maintains that a formal system cannot lead to all truths, I believe that a sufficiently powerful one could.

B. Supernaturalism, atheistic materialism, transnaturalism

Most people are supernaturalists: they believe that a being or realm exists which cannot be described by natural law and which is the origin of all natural phenomena. Most scientists--including D.H.--take the stand of agnostic or atheistic materialism: all that exists are matter particles in space-time; there is no ESP and no souls. Another position that Larson, I, and some others like, but which is not discussed by D.H., is that of transnaturalism: the belief that another natural (but non-physical) realm exists, which is the source of ethical law (and perhaps ESP). By no means is this a magical or occult realm. D.H. seems to think that animals, humans, and machines are very much alike--he ignores the ethical distinction of humans.

III. *Physical Science*

A. Non-chunked laws

D.H. only briefly mentions the theories of relativity and quantum mechanics; his main interest is in particle theory. Here he talks about quarks, electrons, positrons, photons, Feynman...
diagrams, phonons, polarons, nuclei, and virtual particles. He says that "Every real particle's existence involves the existence of infinitely many other particles, contained in a virtual 'cloud' which surrounds it as it propagates." I totally disagree! Needless to say, D.H. is unaware of the Reciprocal System.

B. Chunked laws

However, D.H. excellently discusses macroscopic laws of physics, such as the gas laws, Ohm's law, and the principles of meteorology. These laws are extremely useful to us since a description at the molecular level would be tremendously difficult; for example, have you ever tried to explain the weather in terms of the positions and motions of individual molecules of the gases in the air?

IV. Biological Science

A. Sub-cells

D.H. maintains (without going into detail) that life arose by some "bootstrapping" process from physical matter. He discusses self-assembling viruses and non-self-assembling viruses. And he humorously describes how a T4 bacteriophage "rapes" an E. Coli. bacterium.

B. Cells

There isn't much discussion of how the organelles of the cell came together. But D.H. goes through the usual identification of the nucleus and the cytoplasm and presents the central dogma of molecular biology: DNA → RNA → proteins.

D.H.'s main interest here is in cellular reproduction. Among the topics discussed: DNA strands, bases, enzymes, copy modes, amino acids, translation, the structure of enzymes (primary, secondary, tertiary, and quaternary), punctuation, genes, ribosomes, purines, pyrimidines, and levels of meaning in DNA. He presents a very clever "formal" system for replication, called "Typogenetics."

Multi-cellular organisms and populations of organisms are only briefly alluded to. But there is a good discussion of morphogenesis, feedback and feedforward loops, repressors and inducers, and the theory that differentiation is due to different sets of "working" proteins in different cells of a multicellular organism. D.H. does make the point that "cracking" the genetic code is only the beginning. We must eventually be able to look at the genotype and be able to deduce all manner of details of the phenotype.

One appropriate biological topic missing is the origin and evolution of nervous systems and brains.
V. Human Science

What is the nature of a human being? There seem to be three different views in the literature. One is that man is merely an animal, a member of the biological kingdom Animalia. The second view is that man is distinct enough from the animals, by reason of language and technology, to be placed in a separate kingdom. The third view goes even further; it maintains that man, by reason of his code of ethics, is as distinct from biological existents as biological existents are from physical existents. D.H. definitely takes the first view.

A. Psychology and brain physiology

There are 25 trillion cells in a human being, of which 10 billion are neurons. D.H. explains dendrites, axons, and synapses. He likens the collection of neurons to the collection of ants in an ant colony. He gives the operation of the neurons by paraphrasing Descartes' famous remark, "I think therefore I sum." The organization of the brain is shown: the cerebellum, the cerebrum, and the cerebral cortex. The two hemispheres of the cortex are only briefly described, and D.H. does not even allude to the verification of the psychological theory Transactional Analysis. (The rational, analytical, logical, reality-oriented Adult ego state of TA is generated from the left cerebral cortex; the fun-loving, intuitive, holistic, creative Child ego state of TA is generated from the right cerebral cortex; and the nurturing or critical Parent ego state of TA is generated by the remainder of the brain.)

D.H. next examines the location of memory. Lashley's experiments indicated that memory is not localized, whereas Penfield's experiments indicated that it was. D.H. resolves this contradiction by postulating that a particular memory is stored in a number of brain areas.

More complex cells than ordinary neurons may be involved in visual processing, such as "complex" cells, "hypercomplex" cells, and "ultrasuper-hyper-complex" cells ("Grandmother" cells—is he kidding?). The next level of complexity comes with a grouping of neurons, called a neural "module" or a "symbol." D.H. states the intriguing idea that a symbol is roughly something for which one knows a word or stock phrase. (He says, though, it may be difficult to disentangle symbols and identify which group of neurons is responsible for which word.) There is a symbol of the self, the "self-symbol" or "I." D.H. gives a non-soulist explanation of mind and seems to lean toward determinism instead of free will. The problem with a non-soulist explanation is that it has to account for the ethical code, which is difficult to do; on the other hand, a soulist has to explain exactly how a non-physical existent can interact with a biological existent, an equally difficult task. In any case, self-awareness and consciousness are an epiphenomena.
B. Music and art

D.H. believes that there are algorithms in the brain which give rise to creativity, including the making of art and music. He even says that there is an algorithm for the appreciation of beauty. At any rate, the book is heavily illustrated with the paintings of M.C. Escher, a Dutch graphic artist, noted for paradox, illusion, double-meaning, and strange loops—a perfect match for Gödel and Bach.

C. Language and various paradoxes

D.H. takes very seriously the paradoxes in language. His favorite is the Epimenides paradox. (Epimenides was a Cretan who made one immortal remark: "All Cretans are liars.") Now some philosophers, particularly the logical positivists, think that such paradoxes are silly and meaningless; D.H. thinks that these philosophers are silly and meaningless. According to the logical positivists, any significant statement is a statement of form or a statement of content. Essentially all of the paradoxes listed by D.H. are statements of both form and content. D.H. seems to relish such paradoxical statements. He does not relish the resolution of these paradoxes. I do.

D. Sociology, economics, political science

Not much is said on these topics (but the ideological battle between libertarianism and communism is alluded to). D.H. does find "strange loops" in government, for example, the FBI investigating its own wrong-doings. However, proper interpretation of the Constitution should resolve such problems.

By the way, D.H. points out, changes or advances in number theory will have no affect on the calculations of bankers!

E. Technology

Technology is the result of purposeful interaction between human existents and physical existents (engineering) and between human existents and biological existents (genetic engineering, agriculture, and medicine). D.H.'s main interest in this area is in computer systems and artificial intelligence.

1. Computer systems

D.H. gives the usual description of computer systems, including the following: memory, central processing unit, input-output devices, bits, micro-programming, machine language, assembly language, high-level languages, compilers, and interpreters. He discusses his three computer programs: Bloop, Flop, and the mystical Gloup and discusses modularity, loops, and procedures in programming.

2. Artificial intelligence

The goal of the AI community is to construct a machine which will have self-modifiable software or the base of
inviolate hardware. D.H. lists the achievements of AI to date: mechanical translation, game playing, proving mathematical theorems, symbolic manipulation of mathematical expressions, pattern recognition, hearing, understanding natural language, producing natural language, and learning (in a small way). D.H. may be pessimistic about formal systems but he is certainly optimistic about the future potential of AI. He says that future AI products could have superintelligence, a will, creativity, and appreciation of beauty. Of course, with each new advance we humans are likely to become blase (Tesler's theorem on AI). Well, I do hope that AI workers come up with a super-intelligent theorem deducer, one that, say, could take the axioms of the Reciprocal System and continuously print out in English their step-by-step consequences (theorems). But many decades could pass before we have such a machine.

References:


** MORE ABOUT 1981 NSA CONVENTION **

The DEI Room, where our 1981 CONVENTION will be held, contains a full scale mock-up of the Shuttle, Columbia. One of the original Apollo capsules is also kept there as well as many other displays associated with space exploration. This should provide a good environment for the CONVENTION.

It is possible that a Rockwell Public Relations speaker will be sent to our meeting to describe the Shuttle program and its associated future projections. The time of this presentation has not been established, but is tentatively scheduled after lunch Friday.

Access arrangements to the DEI Room for attendees who are not Rockwell employees will be detailed to you later. A request has been submitted to allow attendees to eat lunch at the Rockwell cafeteria at noon on Friday. This will give attendees a choice of food and help to keep cost at a minimum. No special lunch time program is being planned.

CALL FOR PAPERS. An NSA member or a person who becomes an NSA member (annual membership dues $10 payable to NSA Treasurer Rainer Huck, address on page 2) is eligible to submit a paper to be considered for presentation to the 1981 CONVENTION. Anyone eligible who wishes to present evidence supporting and/or critically analyzing some aspect of the Reciprocal System of Physical Theory is invited and encouraged to apply to present a paper to the August meeting by submitting abstract, including author's name and address, title of paper, time requested and aids, if any, needed by July 8th to Dr. Rainer Huck, Program Organizer. Notice of acceptance of submitted paper will be sent to author by July 22.
GRAVITATIONAL DEFLECTION OF LIGHT
BEAM IN THE RECIPROCAL SYSTEM
by
K. V. K. Nehru

The gravitational deflection of light beam owes its origin to the
same factor as that causing the excess perihelion precession of the
planets--namely, the coordinate time component associated with inde-
dependent motion \([1]\). But there is a significant difference between
the movement of a planet and the movement of a photon in the sun's gravita-
tional field. In the former case, the motion of the planet is an inde-
dependent motion. On the other hand, the motion of the photon is due to
the background space-time progression and is introduced by our use of
the stationary reference system. This has an important bearing on the
manner in which the spatial effect of the coordinate time manifests
itself in the motion, in the two cases, as will be explained below.

Gravitational Motion and the Gravitational Potential

The gravitational motion of a material atom is inward in space.
But in a celestial object like a star, which is a spatial aggregate of
such units, the inward motion of each unit is counterbalanced by the
interaction with the contiguous neighbors. The scalar space-time
direction of this counterbalancing force is in opposition to that of
gravity and has the same magnitude as the gravitational motion and is
equal to the escape velocity, \(v\), at that location. The escape velocity
can be evaluated by noting that the centrifugal force on a mass \(m\) situ-
ated at a radial distance \(r\) will be equal to the gravitational force on
it by the central mass \(M\). Thus

\[
m \frac{v^2}{r} = G \frac{Mm}{r^2} \quad \text{or} \quad v^2 = \frac{GM}{r}
\]

where \(G\) is the gravitational constant.

Coordinate Time

The coordinate time increase associated with a speed \(v\) is given by

\[
\frac{v^2}{c^2} \text{ fraction of unit/unit}
\]

This is in the radial direction of the counterbalancing force explained
in the para above \([2]\).

Let the radial distance of the photon at its closest approach to
the sun be \(r_0\). Since \(v^2\) is a point function of the radial distance
given by eq. (1), the increase in the coordinate time for a change of
radial distance from the 'outer gravitational limit' \([3]\) to \(r_0\) will be
given by

\[
\tau_{g-o} = (\frac{v_o^2}{c^2} - 0) = \frac{v_o^2}{c^2}
\]
where \( v_0^2 = \frac{GM}{r_0} \). The circumferential space equivalent [2] of this coordinate time increase is \( \pi v_0^2/c^2 \). But the photon is already moving at unit speed--one unit of space per unit of time--in the forward dimension. As such no further spatial shift is possible in the direction of its motion (unlike in the case of the planetary motion). However, in view of its scalar nature, the spatial effect of this coordinate time increase will manifest in a spatial dimension other than the one in which the photon is already progressing at unit speed. Thus the photon gets displaced in the inward radial direction coinciding with the direction of gravity.

Now the question arises why this effect should manifest radially inward instead of radially outward direction. The situation here can be easily understood if we look to an analogy from the motor/generation principle in electrical engineering. Current flowing in a particular direction, in the conductor of a motor armature situated in a magnetic field forces the armature to rotate. But the rotation of the conductor (in the same magnetic field) now generates what we call the 'back e.m.f.' and causes a current flow in the conductor in the opposite direction (opposing the original current), establishing a natural equilibrium. Analogously, in the present case, the coordinate time increase resulting from a radially outward equilibrium motion manifests as a circumferential spatial shift. While this gives rise to the excess perihelion motion in the case of orbiting planets, in the case of the photon such motion not being possible, the spatial shift, \( \pi v_0^2/c^2 \), shows up in the radial direction opposite to that of the originating motion: that is, it manifests in the radially inward direction.

We have so far considered the increase in coordinate time only during half of the transit, from the outer gravitational limit to \( r_0 \). The coordinate time change associated with the remaining journey, from \( r_0 \) onwards to the outer gravitational limit on the other side, will similarly be

\[
\tau_{0-g} = \left( 1 - \frac{v_0^2}{c^2} \right) = -\frac{v_0^2}{c^2}
\]

(4)

This will again manifest as a spatial shift of magnitude \( \pi v_0^2/c^2 \). It must be noted that the negative sign of the coordinate time increase, in eq. (4) above, has no relevance in deciding the direction of its spatial effect. The spatial effect is always additive, irrespective of the sign of the coordinate time because of the scalar nature of the relation between the dimensions of time and the dimensions of space. Thus the total spatial shift in the direction perpendicular to that of progression is given by

\[
\delta_0 = 2\pi v_0^2/c^2
\]

(5)

in fraction of unit/unit or simply the deflection in radians.

**Interaction Cross-section**

However, this deflection, given by eq. (5) is not necessarily effective in its entirety. This requires the consideration of the way in which an independent motion, as against the fictitious motion of the space-time progression, can be brought to bear on a photon or a material particle. An independent motion can be imparted to a
material atom, for example, because it can offer a resistance in the
direction of the motion being applied. The resistance to motion is
due to the speed displacement in that dimension. For instance, why
we don't find sub-atomic particles participating in the scalar inver-
sion from the cosmic-sector to the material sector, giving us the
cosmic rays, is because they are unable to build up speed in the vacant
dimension in which they do not have any displacement. In contradistin-
tinction, the motion of the space-time progression applies in the
vacant dimension, as in the case of a photon, for example.

As such, in the present case, the full force of the deflection
motion is applicable to the photon only if the plane of vibration of
the photon is parallel to the deflection motion: that is, if it is
in the direction of the gravity.

Let us take a look at the
photon in the direction of its
progression. Referring to the
figure, let the direction per-
pendicular to the plane of the
diameter of the circle is one
plane represent the direction
natural unit of space represent-
of the photon progression. The
ing the amplitude of the photon
vibration. Any diameter of the
circle, like PP, now repre-
circle, like PP, now repre-

diameter of the circle, like PP, now repre-

diameter of the circle, like PP, now repre-

diameter of the circle, like PP, now repre-

Suppose the photon
vibration happens to be in the
YD direction, the full impact
of the deflection motion, \( \delta \),
can be imparted to it. On the
other hand, if the plane of
vibration is XB, since the photon does not carry any displacement in
the YD direction, none of the deflection motion can be imparted to
the photon. In fact, when the plane is tilted at an angle \( \phi \) to YD,
the fraction of the deflection motion that can be transferred to the
photon is proportional to \( \cos \phi \).

In an unpolarized beam all orientations are equally existent and
the average value of the resistance—which I will call the 'interaction
cross-section'—that makes the motion transfer possible can be obtained
by

\[
\sigma = \frac{\frac{1}{2\pi} \int_{-\frac{1}{2}\pi}^{\frac{1}{2}\pi} \cos \phi \, d\phi}{\left(\frac{1}{2\pi} - \left(-\frac{1}{2\pi}\right)\right)} = \frac{2}{\pi}
\]  

So finally, from eqs. (5) & (6), the total effective deflection is

\[
\delta = (2\pi v_0^2/c^2) \cdot (2/\pi) = 4v_0^2/c^2
\]
Or, using eq. (1), we have

\[ \delta = 4 \frac{GM}{r_0 c^2} \]  

(8)

**Polarized Beam**

It may be noted that the above result is identical to what General Relativity predicts. However, the result differs from the Relativity value in the case of polarized beam of radiation. Consider the case of a fully polarized beam. Let the plane of polarization be represented by PP (fig. 1), inclined at angle \( \phi \) to the direction of gravity, YD. From what has been said above, the total effective gravitational deflection will be

\[ \delta_p = 2 \pi \frac{v^2}{c^2} \cos \phi = 2 \pi \frac{GM}{r_0 c^2} \cos \phi \]  

(9)

In the more general case where the degree of polarization in each direction varies, we proceed as follows. Let the power \( p \) in any plane (of polarization) be a function of the tilt angle \( \phi \):

\[ p = p(\phi). \]

Then the average interaction cross-section is given by

\[ \sigma_p = \frac{\int_{-\pi}^{\pi} p(\phi) \cos \phi \, d\phi}{\int_{-\pi}^{\pi} p(\phi) \, d\phi} \]  

(10)

The total effective deflection, then, is

\[ \delta_p = \delta_o \cdot \sigma_p \]

This aspect of the theory, namely, the dependence of the gravitational deflection on the polarization characteristics of the traversing beam provides a possibility to observationally test it in comparison with the theory of Relativity.

+ + + + + + +

**REFERENCES**


GRAVITATIONAL REDSHIFT ACCORDING TO THE RECIPROCAL SYSTEM
by
Dr. K. V. K. Nehru

If the frequency of a photon is \( f' \), at a location where the gravitational potential is \( GM/r \), then according to Relativity the gravitational redshift is given by

\[
z_g = \frac{f' - f}{f} = -\frac{GM}{rc^2}
\]  

(1)

where \( f \) = frequency of the radiation in its inertial rest frame,
\( G \) = gravitational constant,
\( M \) = mass of the object,
\( r \) = radial distance of the photon,
and \( c \) = speed of light.

The account of the gravitational redshift in the Reciprocal System may be given as follows:

The gravitational motion of any material particle is inward in space, toward all other space-time locations. In a celestial object such as a star, which is an aggregate of such material units, this scalar inward motion of the individual units is counterbalanced by the physical contiguity of the neighboring units. This counterbalancing force is in the scalar direction of the space-time progression, being opposite to gravity and has the same magnitude as that of the gravitational motion at that location. Thus its measure is equal to the escape velocity, \( v \). Now, we can identify the coordinate time increase at a particular location to be \( v^2/c^2 \) (in fraction of units/unit), just like in the case of excess perihelion shift. This means that the total time involved per unit of clock-time is \( [1 + (v^2/c^2)] \) units. The frequency, \( f' \), denotes the number of oscillations per unit of time in a gravity-free situation. In the location under gravity, then, this frequency becomes \( f \) number of oscillations per \( [1 + (v^2/c^2)] \) units of time. Thus

\[
f' = \frac{f}{1 + v^2/c^2}, \text{ or } \frac{f'}{f} = \frac{1}{[1 + (v^2/c^2)]}
\]  

(2)

Therefore, the redshift is

\[
z_g = \frac{f'}{f} - 1 = -(v^2/c^2)/[1 + (v^2/c^2)]
\]  

(3)

Comparison of the Results of the Two Theories

The escape velocity, \( v \), is evaluated as follows: The centrifugal force on a mass \( m \) rotating at the orbital speed of \( v \) at radius \( r \) is equal to the gravitational force by the central mass \( M \), under equilibrium situation. Thus

\[m \frac{v^2}{r} = G \frac{M m}{r^2}, \text{ i.e., } v^2 = \frac{GM}{r}
\]  

(4)

Substituting this in eq (1) and rearranging, we have, according to Relativity,
Comparing this with eq (2) we can see that \( 1 - \frac{v^2}{c^2} \approx (1 + \frac{v^2}{c^2})^{-\frac{1}{2}} \) for small values of \( v \). The divergence between them can be detected only (i) if the present experimental accuracies can be improved by many orders of magnitude, or (ii) if the test could be carried out for extremely large gravitational potentials such as encountered in the white dwarfs etc.

PRESIDENT'S COLUMN

Friends of the Reciprocal System know that it is in the mainstream of physics and science. There is some reason to think that this fact is somewhat obscured by action of our corporation. If so, the action contradicts our main overt purpose, which is to promote the Reciprocal System as effectively as we can. The action consists of retention hitherto of the name of our corporation, NEW SCIENCE ADVOCATES, adopted from its beginning. The term 'NEW' is easily misinterpreted. Do we advocate replacing the developed science of physics with the Reciprocal System? Of course NOT! The Reciprocal System is the developed science of physics, revalued and unified. To consider corporation name change I appointed a Committee, headed by Phil Porter, at our 1980 Huntsville Convention. The question of a better name for our corporation should be examined further by all of us at the 1981 Los Angeles Convention. Please send your thoughts to Phil Porter, P. O. Box 382, Loveland, CO 80537.

The most potent influence bringing and keeping us together in our incorporated existence is RECIPROCITY, our news organ. Improvement of its format and content, increase of its circulation and subsidizing its production are matters requiring our best intelligence at the coming 1981 Los Angeles Convention. To initiate consideration of these matters I appointed a committee, headed by Brad Elkin, at our 1980 Huntsville Convention. Please send your thoughts to Brad Elkin, 311 A Town Building, University of Pennsylvania, PA 19104. Toward transforming RECIPROCITY from an 11 year-young science newsletter to a full-size journal or combination of newsletter and journal, I have appointed two lively recent recruits, Mr. Jan Samer of Princeton, N.J. and Dr. K.V.K. Nehru of Hyderabad, India, to enlarge the RECIPROCITY editorial staff.

Members and friends of the non-profit corporation to promote the Reciprocal System should know that all of us owe much to some facilities of the University of Wisconsin-Superior, which aided the publication of RECIPROCITY and my own studies of the Reciprocal System of physical theory during the past decade. Since I am retiring from my teaching position at this University May, 1981, I wish publicly to thank particularly Mary Jo Gangnon and Barbara Johnson, excellent transcribers of past and present issues of RECIPROCITY, Katherine Munson for aid with label preparation, Marcella Typpo for aid with mailing, Dean Egal Feldman and Dr. Ronald Roubal for moral and material support.

I look forward again to seeing many of you in Los Angeles in August.
LIFETIMES OF C-ATOM DECAYS

by K.V.K. Nehru
Dept. of Mech. Eng.
N.S. Engineering College
Hyderabad - 500 488, India

[All references from 'Nothing But Motion' are designated as NBM, and from 'New Light on Space and Time' as NST.]

The phenomenon of the entry of c-matter into the material sector or the analogous entry of matter into the cosmic sector, involving the passage from space-time domain to time-space domain, may be called ‘scalar inversion' to emphasize the nature of the alteration of the reference frame. Scalar inversion involves two things: firstly, a transformation of motion in time (or space) to motion in space (or time), through the unit speed boundary, in all the three dimensions. Secondly, the emergence of a c-atom, for example, into the material sector can take place only from inside a single unit, since the three dimensions of time have nothing in common with the three dimensions of space--both having not more than a point contact, as it were (p. 154, NBM).

Therefore, in following up the calculation of various quantities across the boundary in scalar inversion, from the cosmic sector to the material sector, for example, consideration must be given to: (i) the loss of dimensional 'information' during the alteration of the viewpoint from the temporal reference frame to the spatial reference frame and (ii) the space equivalent of time occurring within a single unit.

As a result of the first point above, it is known that the full influence of spatial (or temporal) effects does not get transmitted across the boundary except when it involves only one dimension. On the other hand, only a fraction 1/c in the case of two-dimensional effects, and a fraction 1/c^2 in the case of three-dimensional effects gets transmitted. (See p. 185, NST.) I will refer to this as criterion No. II in the sequel.

Regarding the second point above, namely, concerning the relation between quantities within outside single unit, "...The time region speed, and all quantities derived therefrom, which means all of the physical phenomena of the inside region...are ... second power expressions of the corresponding quantities of the outside region." (p. 155, NBM) I will refer to this as criterion No. IV. In order to find the lifetimes of the cosmic atoms in the material environment it is necessary to apply both the above criteria.

The first step in deriving the lifetimes is to recognize that, in view of the scalar inversion, the spatial extension of the c-atom, being the analog of the lifetime in material sector, bears a relationship to the latter. As such we start with the consideration of the spatial extension of the incoming c-atom. Now, scalar inversion is not possible with anything more than one unit in each dimension. Depending on the number of dimensions of the motion eventually acquired during the inversion process, the amount of space involved in the one, two and three-dimensional cases is respectively s, s^2
and \( s^3 \) (where \( s \) is the unit space expressed in the c.g.s. system). Let us refer to this as criterion No. I.

The remaining criterion, No. III, necessary for our calculation is the recognition of the fact that the temporal equivalent of a spatial extension \( s \) across the inversion boundary is \( s/c \) (where \( c \), the unit speed, is expressed in the c.g.s. system). The result of applying the above four criteria to the one, two and three-dimensional situations is given in the following table.

<table>
<thead>
<tr>
<th>Criterion No.</th>
<th>Number of Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>I</td>
<td>( s )</td>
</tr>
<tr>
<td>II</td>
<td>( s )</td>
</tr>
<tr>
<td>III</td>
<td>( s/c )</td>
</tr>
<tr>
<td>IV</td>
<td>((s/c)^{1/4})</td>
</tr>
</tbody>
</table>

Result

Converted to secs. \( 1.233 \times 10^{-8} \) \( 1.521 \times 10^{-16} \) \( 1.875 \times 10^{-24} \)

The same result could have been obtained more simply though showing less details of the underlying process by directly noting that the clock-time involved in the one, two and three-dimensional cases of the decay is \( t \), \( t^2 \) and \( t^3 \) respectively (where \( t \) is the unit time expressed in the c.g.s. system). The measured values of the lifetimes could then be obtained by applying the criterion No. IV, as \( t^{1/4} \), \( (t^2)^{1/4} \) and \( (t^3)^{1/4} \) respectively.

Further, in the calculations above if the extension space involved is taken as \( \pi s^2 \) and \( \pi s^3 \) respectively in the two and three-dimensional cases, basing on symmetrical probability, instead of \( s^2 \) and \( s^3 \), we have the computed values of the lifetimes in the respective situations as \( 1.348 \times 10^{-16} \) and \( 1.357 \times 10^{-24} \) secs.

The acquisition of gravitational charges by the incoming c-atoms has an effect on the above lifetimes which can be evaluated in the following manner. In view of the scalar inversion, it must be noted that the gravitational charge of the material sector, being a two-dimensional rotational vibratory time displacement, is foreign to the space-time character of the basic rotational displacement of the c-atom. In the analogous case of a material atom, for example, a gravitational charge of the cosmic sector is tantamount to a magnetic charge in the material environment. Consequently, the calculation of the influence of a rotational vibration of space-time direction opposite to that of the basic rotation, on various quantities requires the consideration of the appropriate inter-regional ratio.
For example, "... the motion that constitutes the charge is on the far side of another regional boundary--another unit level--and is subject to ... inter-regional transmission factors." (p. 163, NBM). Further, "... inter-regional ratio ... accounts for the small "size" of atoms. According to the theory ..., there can be no physical distance less than one natural unit ... But ... the measured inter-atomic distance is reduced by the inter-regional ratio, and this measured value is therefore in the neighborhood of 10^-8 cm." (p. 154-5, NBM). In exactly the same manner, the acquisition of a gravitational charge by the c-atom, in view of the inter-regional ratio, has the effect of shortening the measured lifetime by a factor of 1/156.44. (While it is clear that the inter-regional ratio operates here, I am not certain that its value is 156.44 in this case.)

An atom is a double rotating system. The rotational vibration that is a gravitational charge establishes a coupling with one of these two rotational systems. In the case of an acquisition of one more gravitational charge, the second rotational vibratory displacement acquired acts on the second rotational system of the c-atom rather than adding to the previous system already modified by the first gravitational charge. As such, the computation of the lifetime in this case involves the application of the inter-regional ratio once more. Thus the measured lifetime in the case of two gravitational charges acquired is shortened by a factor of 1/156.44^2

The lifetimes, with or without the gravitational charges, in the one, two and three-dimensional situations are, therefore, as follows:

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Charges</th>
<th>Lifetime (sec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>1.233148 x 10^-8</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0.788234 x 10^-10</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>1.520655 x 10^-16</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>0.621313 x 10^-20</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>1.875193 x 10^-24</td>
</tr>
</tbody>
</table>
Reciprocity

Volume XI  Number 2

Summer, 1981
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Summer, 1981

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4. A NOTE BY R.W. SATZ ON PROF. K.V.K. NEHRU'S COMMENTS  
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PROSPECTS for promoting the Reciprocal System of physical theory at our 1981 Convention are bright, if we supporters of Dewey B. Larson's creation work for it to survive and prevail. In the existing world of our earth, where a Space Shuttle has just been launched, new and unending avenues of exploration and inquiry are opening, even as happened before.

The SIXTH NSA CONVENTION intends to honor Dewey Larson for initiating and greatly contributing to the contemporary Renaissance in the physical sciences. We shall do this by tendering him and his lovely wife, Dorothy, an honorarium at our meeting. Every NSA member and supporter of our movement is asked to contribute $10 or more to this purpose. Please send your contribution to Dr. Rainer Huck, NSA Treasurer, address on RECIPROCITY masthead.

D. B. Larson's creation and development of the Reciprocal System is the basis of seeing the physical universe clearly as an unbroken WHOLE, a unity of motion. This rational conception of our world of space and time makes an end of the existing order of physical theory that fragments and fractures the oneness of the physical universe, portraying it as a realm of altogether self-existent, unconnected and completed things & elementary particles of static and inertial matter.

Nature's Frame of Reference, discovered by D. B. Larson and adopted by his Reciprocal System of theory, is the three-dimensional space-time progression. For simplifying physics this frame is preferable to and should replace the reference frame which has been for centuries the basic frame used in physics, the Cartesian rectilinear grid (slightly modified in the Einsteinian theory of relativity to a curvilinear grid).

As pointed out by Prof. David Bohm, "The Cartesian order is suitable for analysis of the world into separately existent parts (e.g. particles or field elements)...... we look into the nature of order with greater generality and depth and discover that both in relativity and quantum theory, the Cartesian order is leading to serious contradictions and confusions." (D. Bohm, 'Wholeness and the Implicate Order', p. xv, Routledge & Kegan Paul, 1980)

CONVENTION NOTE

Dr. Rainer Huck did so fine a job as Program Chairman at the 1980 Huntsville Convention that he had to be requested to serve again in 1981 and he has kindly consented.

If you wish to present a paper on your recent exploration of the Reciprocal System at the Downey Convention, and have not notified Rainer, you may still have a chance for time on the program, provided that you send notice of title to him promptly.

As RECIPROCITY goes to press, Editors may not have up-to-date list of papers to be presented. Some papers, we have learned, that have been entered and accepted are scheduled to be presented are:
Dr. K.V.K. Nehru, India, "Neutron Lifetime"
David Halprin, Australia, "Intrinsicality"
Ronald W. Sats, "Photoinization and Photomagnetization"
Dr. Elizabeth A. Rauscher, "Physical Models of Remote Connections"
Dr. Ron Blackburn, "Some Allies of the Reciprocal System"

Mr. Larson's Principal Address will be delivered in the Kona Kai Room of the Tahitian Village Hotel, Friday, August 14, 8:00 P.M., after dinner. Price of dinner is $10, including tax and tip. Please make your dinner reservations with Mark Weissman, Convention Host, see below.

NSA has reserved over-night accommodations for those who will need them at Tahitian Village Hotel, 13535 Lakewood Boulevard at Rosecrans, Downey, CA 90242, single occupancy, $28/night and double occupancy, $32/night. If you intend to stay at Tahitian Village, please make reservations with Tahitian Village Manager, Bob Burns, at above address.

CONVENTION HOSTS
Names and work telephone numbers of some local personnel who will be available to help you find your way around, if you plan to attend the 1981 NSA Downey Convention and may require such aid, include:

- Hal Norris (213) 594-3289
- Dick Long (213) 594-3974
- George Frey (213) 594-3901
- Mark Weissman (213) 594-3901
- Alan LeFever (213) 594-2976

CONVENTION SCHEDULE
Friday, August 14th
DEI Room, Rockwell International Downey Facility

9:00 A.M.-11 A.M.: Registration
9:30 A.M. Opening of Convention - Prof. Frank Meyer
10:00 A.M. Session I: Dr. Rainer Huck, Chairman
- 11:50 A.M. Presentation of Papers about the Reciprocal System
12 Noon Lunch

1:00 P.M. Rockwell Public Relations Welcoming Speaker
Shuttle Program and Future Projections
2:00 P.M. Session II: Dr. Rainer Huck, Chairman
- Presentation of papers about the Reciprocal System
- 3:00 P.M.

6:00 P.M. NSA Annual Dinner, Social Hour with no-host bar
Kona Kai Room, Tahitian Village Hotel
7:00 P.M. Dinner
8:00 P.M. Dewey B. Larson: Principal Address
"Renaissance in the Physical Sciences"

Saturday, August 15
DEI Room, Rockwell International Downey Facility
9:00 A.M.-11:50 A.M. Session III: Dr. Rainer Huck, Chairman
- Presentation of Papers about the Reciprocal System
Noon Lunch

1:00 P.M.-5:00 P.M. or sooner
NSA, INC. Annual Business Meeting
Officer and Committee Reports
Elections.

B 11.2-4
The attached letter replying to a series of questions from Homer Ballard may be of some general interest. These inquiries were prompted by a news item reporting "direct and unambiguous evidence" of speeds greater than that of light in the quasar 3C 273. Ballard's questions were as follows:

a. On the basis of your theory, what would happen physically to an object such as a spaceship if it were to exceed the velocity of light. Would its occupants survive?

b. Assuming that the occupants of a superlight spaceship did survive the transition, what would the physical effect of return to sublight speeds be?

c. You have stated that antimatter (your "C matter") will probably not be used as a fuel in future spacecrafts because of our inability to keep it together in a space location, however it has apparently been produced and collected for several days in storage rings for colliding beam experiments. How do you explain this?

d. Assuming "C matter" could not be collected, what form of matter might serve as a fuel for superlight propulsion? You state that matter in old galaxies reaches a point in ageing where it explodes driving some of the galactic mass above light velocity. Would this form of matter serve? What is it?

e. I believe that you have stated in one of your publications that the idea of superlight drives and so called "space warps" is unlikely to become reality, yet your theory does predict the possibility of superlight communication via gravitational, electromagnetic and static-electrical physical vibrations does it not? If superluminal communication is possible and everything ultimately can be converted into information, then it would seem that eventually we may be able to reduce a physical object to information and communicate it wherever we desire on an appropiate superluminal vibration. What are your thoughts on this?
Dear Mr. Ballard:

Since I am a science fiction fan myself, and enjoy reading about space travel, exotic energy sources, etc., I do not like to have to throw cold water on the possibility that some of these things might be brought within the realm of reality. Unfortunately, however, the picture that emerges from the development of the concept of a universe of motion has no place for these products of the imagination. Nor can it accommodate the equally imaginative products of the modern astronomer, such as the black holes and the big bang. Perhaps this makes the universe rather dull, but we have to take it as it comes.

Speeds greater than that of light are possible in that universe, to be sure, but it is not possible to change position in space at a rate exceeding the speed of light. The higher speeds result in a change of position in time. Consequently, they are of no use to the would-be space traveler. The "superluminal" speeds reported in the article in Science News are fictitious. They are based on the cosmological hypothesis as to the location of the quasars, which greatly overstates the distance. The actual distance of 3C 273, according to my calculations, is close to the 0.0031 distance of M 87, the giant galaxy from which it was probably ejected, rather than the 0.158 "cosmological" distance assumed for purposes of the astronomers' speed calculation. When the 9.6 c speed is reduced by this ratio, it becomes 0.19 c, or about 5600 km/s, which is fast, but not remarkable.

Answering your last question first, the theory does not allow communication at a speed exceeding that of light in space, nor does it allow communication at a speed less than that of light in time. It follows that neither sector can utilize the speeds of the other for communication purposes. The answers to your other questions follow:

a. The matter of which the occupants are composed would survive, providing that the internal speeds within the ship (the temperatures) remained low. But life processes could not survive the required acceleration.

b. If the effects of the acceleration could be avoided, there would be no adverse result from the high speed of the ship. The critical speeds are the internal speeds. There is nothing to prevent a low temperature aggregate from moving at a high speed.

c. Some sub-atomic particles of the inverse (cosmic) type have a degree of stability in the material environment, and any cosmic particle or atom is stable at the speed of light. As I pointed out in NBM, the true nature of
the "antiparticles" produced in the accelerators is still uncertain. In any event, the experimental results show that contact of these particles with their "anti" forms does not result in the annihilation required by the antimatter hypothesis, except in the one case of the electron and the positron.

d. It is not possible to reach speeds in excess of that of light by any kind of a "propulsion" process; that is, one in which the speed is added incrementally. Fractional units do not exist in the universe of motion. Speeds less than unity (the speed of light) are therefore possible only by utilizing units of the inverse quantity to modify one speed unit. The resulting speed is \( 1 - (1/n) \), where \( n \) is the number of units of inverse speed, which I have identified as energy, \( \text{t/s} \), or speed of a mass, \( v = t/s \times s/\text{t}^2 = t/s \). As you can see, the net speed, \( 1 - (1/n) \) never exceeds 1, no matter how many units of \( n \) are applied. In order to reach speeds above unity, a full speed unit must be applied, increasing \( 1 - (1/n) \) to \( 2 - (1/n) \). The only process energetic enough for this purpose, so far as I have been able to determine, is an extremely violent explosion. It follows that speeds in excess of that of light, originating in the material sector, are confined to the products of explosions of large astronomical objects: stars or aggregates of stars.

Sincerely yours,

D. B. Larson

A NOTE by R.W. SATZ on Prof. K.V.K. NEHRU'S COMMENTS

I am delighted that Prof. Nehru made such a careful study of my paper "Further Mathematics of the Reciprocal System". Typographical errors are a source of vexation to both authors and readers. All of those cited except for that in comment 1.8 were the responsibility of the Reciprocity staff. As for comment 2.1, I was defined in Eq. (14) in manuscript, but left out in the printed version. The queries in comments 2.2 and 2.4 can be answered by reference either to Structure or to the second volume of the revised edition (I referenced implicitly all of Larson's books at the beginning of the paper, giving only one, NBH, explicitly). The new notation for atoms and intermediate particles makes clear the 3 rotations taking place. I now think that the total speed notation for the neutron should be \( \frac{1}{2} - \frac{1}{2} - 1 \).

As for comment 3.1, the cosmic radiation, like our radiation, covers the entire spectrum of wavelengths but in reverse order (p. 204, Structure); photons, whether of high or low frequency, are stationary in space-time and thus Eq. (18) and its cosmic equivalent apply to all frequencies. The last comment (3.2) is accepted, even though it means that sub-atoms would be "perceived" as being larger than atoms; all particles (photons, sub-atoms or atoms, whether material or cosmic, are natural unit of space (or time) in diameter, reduced by the appropriate interregional ratio.
Some Myths of Modern Physics

FRANK H. MEYER and RONALD W. SATZ

ABSTRACT—Questions are raised as to four principles of modern physics: solar fusion, the nuclear atom, light as a measure of maximum speed and gravitational collapse through the argument that a single contradiction between the theory and fact is enough to discredit any fashionable theory, no matter how mathematical and popular.

Questions for physicists and physics teachers as to myths in contemporary thought within our discipline may be raised, identified and distinguished from physical truth by findings which the authors of this report have drawn from both classical and modern writings, particularly from the works of D. B. Larson of seeing the world as a whole. (Larson, 1959 and 1979). Our concern focuses on four myths of contemporary physics:

**MYTH of solar fusion**
**MYTH of the nuclear atom**
**MYTH of “nothing faster than light”**
**MYTH of gravitational collapse**

Myth-making is an old human custom and entertainment. Physicists have not been immunized from it.

Some additional examples of modern myth-making are: the 4-dimensional infinitely divisible space-time continuum; the quark; the neutron star; and the black hole, etc.

Myths of modern physics, being of scientific rather than religious foundation, are more subtle than popular myths of the past.

Hardly anyone in the U.S.A. or U.S.S.R. believes that the sun and moon are a god and goddess. Probably no academician alive believes, as once Plato did, that the planets, Mercury, Venus, Mars, Jupiter and Saturn are divinities. The Viking gods, Odin and Thor, no longer are widely believed to preside, respectively, over Wednesday and Thursday, not even in Scandinavia.

Myths of modern physics are much more difficult to refute than the myths of the past, because the modern myths are more finely invented and intricately interwoven. The modern scientific myths also are backed by articulate advocacy of many leading modern scientists—a profession better organized than the priesthood of ancient Greece, Rome, Scandinavia or medieval Europe.

**MYTH of solar fusion**

The myth of solar fusion is the unfounded theory that the sun’s energy derives primarily from the fusion of four hydrogen nuclei to a helium nucleus with neutrino formation as a by-product.

One has only to look into almost any college astronomy textbook, be it Fredrick and Baker, 10th Edition (1976); George Abell, 3rd Edition (1975); Saschoff and Kutner (1978); or Michael Zelik, Astronomy (1979); to realize that the nuclear fusion model of solar energy generation has had its day. This is because Ray Davis’ neutrino experiment has not confirmed the fusion model. It is regrettable that many competent physicists and astronomers accepted the Hans Bethe solar fusion models as proved before the experimental results were in. As recently as 1965, no well-known physicist or astronomer doubted that the sun was emitting copious amounts of neutrinos. They agreed uncritically and complacently that the Bethe models must be correct and the Davis experiment must prove it to be so.

In 1981 the nuclear fusion myth can only be maintained by denying that it matters at all whether the theory can be confirmed experimentally.
More than 20 years ago, D.B. Larson (1959) doubted the solar fusion concept and proposed an alternative radioactive explanation of solar energy generation. From the postulates of his Reciprocal System of Theory he has inferred that the energy generation is achieved by the fission of the heavy elements instead of fusion of the light elements in the sun. The Larson fission theory of solar energy generation has the merit that it does not require the sun to emit an abundance of neutrinos, as does the fusion theory. Fission, nevertheless, does account for solar energy as well as fusion and should have been considered equally with fusion as a principal cause of the sun's energy from the beginning. Though by not examining it, no one has either proved or disproved it, this theory has a distinct advantage over the fusion theory of also offering a credible physical explanation of Type I supernova explosions (Larson, 1971).

MYTH of the nuclear atom

The solar fusion myth is a conspicuous by-product of the theory of nuclear physics. The mythical character of the by-product raises a question: How free of myth is nuclear physics itself?

The principal reason why the nuclear atom model, apart from the question of its truth, has remained firmly in command of physical and chemical research is that it has seemed to work. However, the nuclear atom model seems not to work for explaining how the sun's energy is generated. Thus, the nuclear atom is itself brought into question, because it has failed to work for the important case of solar energy generation.

Besides, analysis of atomic structure in the light of D.B. Larson's (1961) Reciprocal System discloses that the nuclear atom model is itself a myth.

No nucleus can be seen in any atom, simply because there is none to be seen, not because the atom and nucleus are too small to be seen.

So-called elementary particles, such as protons, neutrons and electrons, are not included in actual atomic structure, because an atom is really a unity of discrete motions rather than a system of distinct substances.

The interesting finding of the Reciprocal System is that matter presupposes light. Matter is a form of motion, specifically a superposition of discrete motions, rotational motions, upon the vibrational and translational motions of one or two photons of light.

Shrader-Frechette (1977) in an extended review of the nuclear atom concluded that there is no more evidence that an atom is composed of elementary particles than that it is not.

MYTH of nothing faster than light

It is evidently true that no material object moves faster than 186,000 miles/second. It is not true that material objects are the only physical objects to be found in the physical universe. The material sector is one-half of the physical universe, not the whole of it. Larson (1959 and 1979) refers to the other half as the cosmic sector, because the principal evidence for its existence is found in the existence of cosmic radiation.

The cosmic sector contains as many kinds of physical objects as does the material sector. A cosmic object can be identified and distinguished from a material object by the fact that it can only exist as such by having a finite rate of motion exceeding 186,000 miles/second.

Hence it is a myth that 186,000 miles/second is the maximum speed allowable in the physical universe. The absolute constancy and isotropy of the 186,000 miles/second speed in empty space-time should have alerted physicists before now to the fact...
that this cannot be the characteristic speed of a particle of light. Photons are peculiar immaterial physical objects in that they have two speeds, two rates of motion—a translation rate and a vibration rate, called frequency. What distinguishes one photon from another is frequency. A photon is a compound motion, which explains why it behaves as particle and wave. The speed which photons have in common is the speed of the specific space-time location in which each photon originates. Larson calls this speed of light the unit speed of the space-time progression at the uniform clock rate of one unit of space per one time unit. The postulated discreteness of the space-time continuum is due to Larson's discovery (1959 and 1979) that neither space nor time is infinitely divisible and that they are reciprocally related as motion.

It is because space and time are the reciprocals of each other, that for every physical entity or phenomena, there is an inverse, which is identical in all respects except that space and time are are interchanged. For instance, for every material chemical element in the Periodical Table, its inverse exists in the form of a chemical element. This inverse is not an additive inverse (+ and -), which is a reason why Larson prefers to use not the term "anti-matter" (Alfven Hannes, 1966), to characterize the cosmic elements and particles. Material element and/or its basic element opposite are related as multiplicative inverses (x and /).

Unit speed, (the speed of light), is neither a maximum nor minimum (speed) finite physical. Its true physical significance, according to the Reciprocal System, is twofold. Unit speed is the uniform scalar rate of progression of empty and photon-filled space-time locations. As such it is the natural preferred inertial frame of reference, in which all physical measurement is most appropriately and simply performed. The mathematical number unity rather than zero is the true physical zero.

MYTH of gravitational collapse

Gravitational collapse is a scientific notion much employed by astrophysicists to explain a diversity of astronomical objects. The notion first was invoked to explain the ultradensity of the white dwarf stars. More extravagant forms of gravitational collapse, the neutron star and the black hole, are used to explain the ultradensity of stars even more dense than the white dwarf—the pulsar (Manchester, Taylor, 1977).

Gravitational collapse is a scientific myth because it is built upon three propositions each now known to be contrary to fact. These questionable premises about gravitation and space-time are: Gravitational force is the only universal force.

Space-time is an infinitely divisible continuum.

Gravitation always behaves as an attractive force.

If gravitational force were the only universal force, the large-scale structure of the physical universe would have a center at which the specific density of the stars and galaxies would be a maximum. Proceeding outwards from this putative center, the specific density should continuously decrease until finally at great distances it should be replaced by an infinite void.

In fact, the physical universe is not so constructed. If the physical universe has a center, it is everywhere and anytime, as Comenius (1658) proposed.

In fact, the space-time continuum is interrupted by finitely divisible units of space and time. In fact, motion is a reciprocal relation between space and time. More space and less time mean faster motion. Less space and more time mean slower motion.

As a consequence of the discrete and reciprocal character of space and time, gravitational force manifests a repulsive side inside a natural...
unit of space ($q = 0.45 \times 10^4 \text{ cm}$) as well as the familiar attractive side outside the discrete space unit. Gravitational motion is naturally always a scalar motion always tending towards unity.

The space-time progression is naturally always a scalar motion always tending away from unity. Outside a natural unit of space, the space-time progression moves things apart and is the cause of expansion (Hubble, 1936) and the openness (Pasachoff) of the physical universe. However, inside a unit of space, away from unity results in bringing physical objects closer to each other in space. Consequently, in the motion of solid cohesion the force of space-time progression plays the role of the attractive force.

Hence even in the solid phase of matter gravitational collapse can NOT be made to occur; atoms in solids have not been made to touch each other under maximum compression. Solid matter is a stable equilibrium product, a stable equilibrium between the attractive space-time progression force and the repulsive gravitational force.

When gravitational collapse is not found in the solid phase, it is not to be expected in the fluid phases of stellar and galactic matter. In short, gravitational collapse is a myth. Hence a different explanation must be sought for the ultradensity of certain astronomical compact objects, such as white dwarfs, pulsars, quasars, etc.

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* For "a different explanation" see article, "THE DENSITY GRADIENT IN WHITE DWARF STARS" by D.B. LARSON printed in this issue of RECIPROCITY.
THE DENSITY GRADIENT IN WHITE DWARF STARS

In connection with assembling the material for a new edition of the 1959 book in which I introduced the theory of a universe composed entirely of motion, I am reviewing the progress that has been made in the intervening 22 years, both in the development of the details of the theory itself and in the fields of observation and experiment, to make certain that the new work has the benefit of these advances. One item that came to my attention during this review is particularly important because it supplies a positive verification of the theoretical findings as to the structure and density of the white dwarf stars, a result that has far-reaching implications.

In order to appreciate the significance of the observed facts in relation to the theory, it is necessary to understand the general nature of the motion of which the theoretical universe of motion is composed. The most important direct consequence of the postulates that define this universe is the existence of a general reciprocal relation of a scalar nature between space and time. By reason of this reciprocal relationship, motion in such a universe can take place either on the basis of a space-time ratio of 1/n, a speed less than unity (which we can identify as the speed of light), in which case the change of position takes place in space, or on the basis of a space-time ratio of n/1, a speed greater than unity, in which case the change of position takes place in time. The first of these alternatives is the prevailing motion in our immediate environment. What I have shown in my previous publications is that the extremely compact astronomical objects discovered in recent years -- white dwarf stars,
pulsars, quasars, etc. -- are aggregates whose components are moving at
greater-than-unit speeds.

Of course, the idea of speeds in excess of the speed of light conflicts
with Einstein's dictum that such speeds are impossible, but to err is human,
and Einstein is no exception. As usually happens in such cases, the error
stems from the use of an invalid assumption. In his book *The Character of
Physical Law*, Richard Feynman points out that when we put all of our presumed
knowledge together, "we get inconsistency, because we get infinity for various
things when we calculate them, and if we get infinity how can we ever say that
this agrees with nature?" Feynman attributes this inconsistency to the use of
"a number of tacit assumptions...about which we are too prejudiced to under-
stand the real significance". What Einstein apparently did not realize is that
one of the assumptions on which he based his conclusions violates a universal

Strangely enough, this law, generally recognized in most other fields of
thought, is practically ignored in science. But we cannot repeal a law of
nature by ignoring it. This is the law that prohibits the infinities that
Feynman deplores. It tells us that the ratio of the output of any physical
process (such as the acceleration of a mass) to the input (in this case, the
applied force) does not remain constant indefinitely, but eventually decreases,
and ultimately reaches zero.

So the relation expressed in Newton's Second Law of Motion, \( F = ma \), cannot
remain constant. Recognition of this fact leads to an interpretation of the
experimental results that is quite different from Einstein's. Instead of his
conclusion that it is impossible to exceed the speed of light (which follows if, as he assumed, the relation $F = ma$ remains constant), the correct interpretation is that it is impossible to accelerate a mass to a speed greater than that of light by means of an electrical force. In other words, the limitation is not on the speed, but on the capabilities of the process. The significance of this is that it does not preclude acceleration to higher speeds by other means, such as the sudden release of large quantities of energy in violent explosions.

One of the reasons why Einstein's interpretation of the observed facts has been so widely accepted in spite of its unsound foundation involves another of the "tacit assumptions" mentioned by Feynman. It has been assumed that a speed in excess of that of light would result in a corresponding increase in the rate of change of spatial position. The absence of any observed changes of position at higher rates (except for some observations of quasar components, whose true significance is still in doubt) has therefore been regarded as a confirmation of Einstein's conclusion. But here again, the conclusion that has been drawn goes beyond the evidence, which applies only to the rate of change of position in space, and has relevance to the speed only insofar as the change of position due to the motion takes place in space. In the universe of motion, the change of position is in space if the space-time ratio (speed) is $1/n$. It is thus impossible for a change of position in space to take place at a rate (speed) in excess of unity (the speed of light), because the limiting value of the quantity $1/n$ is $1/1$. But this does not mean that higher speeds are impossible; it merely means that motion at higher speeds, with space-time ratio $n/1$,
is motion in time rather than motion in space.

According to the theory of a universe of motion, the neutral condition is motion at unit speed, and the motions of the universe as a whole are symmetrical around this level, the true speed magnitude in each case being the deviation from unity. As a result of the space-time symmetry, the effect of any motion in time is the inverse of the effect of the corresponding motion in space. The particular motion with which we are concerned at the moment is the motion imparted to the products of the explosion of a star: a supernova. Some of the products of such an explosion are ejected at speeds less than that of light, and they take the form of a cloud of particles moving outward in space from the site of the explosion, but remaining in the original location (the moving location indicated by a clock) in time. Another portion of the explosion products is accelerated to speeds greater than that of light. These products take the form of a cloud of particles expanding into three-dimensional time, but remaining in the original location in space. This cloud of particles is the white dwarf star.

As I have shown in my publications, a development of the details of the properties and the evolutionary course of the white dwarfs on this theoretical basis leads to results that are in full accord with the observations. For present purposes, however, we are concerned only with the density relations. The expansion of the (relatively) slow-moving explosion products into space results in a large decrease in the density of the expanding aggregate. Because of the reciprocal relation between space and time, the expansion of the fast-moving product into time results in a large increase in the density of this
aggregate. The white dwarf star is therefore an object of abnormally high density, compared to a normal star. Furthermore, the density gradient is the inverse of that which prevails in the normal stars; that is, the center of the white dwarf is the region of greatest compression in time (equivalent to expansion in space), and it is therefore the region of minimum density.

This picture of the white dwarf derived from the theory of a universe of motion is, of course, quite different from the currently popular view, and it is possible that many individuals will find it little short of outrageous. But the reason for writing this article is that in the course of my review of the progress in the white dwarf field that has taken place in recent years, it became evident that some of the information about these objects that is now available supplies a positive confirmation of the upside down nature of the white dwarf structure.

As pointed out by James Liebert in a review article in the 1980 Annual Review of Astronomy and Astrophysics, it is generally conceded that the apparently normal matter in the outside layers (atmosphere) of the white dwarf stars must have been accreted from the environment. (The development of the theory of a universe of motion arrives at the same conclusion.) This matter, then, is mainly a mixture of hydrogen and helium, with hydrogen as the major constituent. If conventional theory is correct, the heavier element, helium, will preferentially move downward, leaving the outer layers of the star enriched in hydrogen. On the other hand, if the inverse density gradient required by the theory of a universe of motion actually exists, the hydrogen will preferentially move downward, and the outer layers will be enriched in helium. The
verdict from observation is unequivocally in favor of the universe of motion. Liebert reports that the "cooler helium-rich stars" are "the most numerous kind of white dwarf", and that some have almost pure helium atmospheres. "The existence of nearly pure helium atmosphere degenerates over a wide range of temperatures has long been a puzzle", he says. But it need not continue to be a puzzle. The helium accumulates in the outer layers because these are the regions of greatest density in the white dwarf.

This theoretical conclusion, strange as it may seem in the light of current thought, is further confirmed by an examination of the behavior of the elements heavier than helium, commonly lumped together as "metals" in discussions of stellar composition. The metals, too, should preferentially accumulate in the regions of greatest density: the center of the star, according to current astronomical theory; the outer layers, according to the theory of a universe of motion. Liebert describes the observed situation in this manner:

The metals in the accreted material should diffuse downward, while hydrogen should remain in the convective layer. Thus the predicted metals-to-hydrogen ratio would be at or below solar (interstellar) values, yet real DF-DC-DK stars have calcium-to-hydrogen abundance ratios ranging from about solar to well above solar.

Here again, as in the helium distribution, the verdict is unequivocal. The larger concentration of the heavier elements in the outer regions definitely identifies these as the regions of greatest density, a result that is inexplicable on the basis of conventional theory, but is specifically required by the theory of a universe of motion. Liebert admits that no plausible
explanation on the basis of current astronomical theory is known. The only suggestion that he mentions is that the accretion of hydrogen must be blocked by some kind of a mechanism, a far-fetched idea without the least support from observation.

When it is viewed in conjunction with the gradual decrease in component speeds that takes place as energy is lost to the environment, the inverse density relation also supplies an explanation of the occurrence of novae. The continued energy losses eventually result in the speeds of some of the constituent particles dropping below the unit level, and into the region of motion in space. These particles then occupy more space because of their spatial speed, and they form "bubbles" that move to the region of least density, the center of the star. Accumulation of this material with high spatial speeds builds up a gas pressure. Eventually the pressure reaches a level at which it breaks through the overlying matter, resulting in a flare-up of the star, as the hot material from the interior is exposed briefly. The outburst relieves the internal pressure, the star resumes its normal condition, and a new pressure build-up begins.

The explanation of the origin, the extreme density, the novae, and other properties of the white dwarfs that I derived originally by deduction from the properties of space and time as they exist in a universe composed entirely of motion requires some significant conceptual reorientation, and most astronomers have been reluctant to entertain the possibility that current ideas may have to be altered to such an extent. However, more and more of those who examine the existing problems carefully are recognizing that something will have to undergo
a drastic change, and are assessing the situation in a manner similar to the following from Martin Harwit:

The fundamental nature of astrophysical discoveries being made -- or remaining to be made -- leaves little room for doubt but that a large part of current theory will have to be drastically revised over the next decades. Much of what is known today must be regarded as tentative and all parts of the field have to be viewed with healthy skepticism. (Astrophysical Concepts, Wiley, New York, 1973, page 9)

The big problem, of course, is to determine just what has to be changed, and what to put in its place. The inverse density gradient that we find in the white dwarfs now identifies one of the requirements that must be met by the "drastically revised" theory. It must provide a new explanation of the white dwarf structure that incorporates this upside down density relation. Perhaps there are alternative ways in which this requirement can be met, but it seems rather obvious that the first step in exploring the situation ought to be to take a good look at the theory already in existence that anticipated this requirement.

D. B. Larson
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PROSPECTS FOR MODERN PHYSICS
by Frank H. Meyer

In evaluating the prospects for modern physics we should look to the historical development of science. By learning from the past we may perchance avoid the fate of those who, as Santayana remarked, are condemned to repeat it.

In the recent past physics — particularly astrophysics and nuclear physics — has been dominated by inventive theories such as relativity theory and quantum mechanics. Although flawed in some one or more essential respects, they have held sway in the absence of correct theoretical representations of observed phenomena. Most modern physicists have an aversion to confronting error in our invented theories, building on the assumption that currently accepted science is fundamentally correct. We readily perceive the shortcomings of the theories invented by our predecessors, the medieval and ancient physicists; in the latter case we have learned that even widely held scientific convictions may be in error. Such error is, however, the inevitable shortcoming of all invented theories. The failure of the medieval and ancient physicists to confront the error in the geocentric world view invented by Aristotle and codified by Ptolemy was due to a dogmatic adherence to this amalgam of ancient Greek science and medieval Biblical exegesis. The fundamentals of this invented science were not open to question.
How then did the error of the geocentric theory come to light and how did the understanding of the true world system emerge? The geocentric theory became overloaded with epicycles when confronted with increasingly accurate observations. Then, new advances in inductive science overturned the former science based upon invention.

Copernicus realized that the Ptolemaic epicycles could be dispensed with if the Earth along with the other planets were to be placed in an orbit around the Sun. Yet he remained attached to the Aristotelian doctrine of perfect circular motion, and did not depart from the crystal spheres of Ptolemy, assigning to the last one the fixed stars and making it the boundary of the universe. It was Bruno who proclaimed the infinity of the cosmos and the innumerable number of worlds revolving about the stars, which he recognized as suns. Later Johannes Kepler, using data gathered by Tycho de Brahe, concluded that planetary orbits are elliptical and formulated his three laws of planetary motion. Finally Newton, standing on the shoulders of these giants, deduced from the motion of the Moon about the Earth a single set of laws to govern both celestial and terrestrial phenomena.

As distinguished from the prevailing notions in nuclear physics and astrophysics, from relativity theory and quantum mechanics, all of which are invented theories, the Reciprocal System, like Newtonian physics, is built on inductive reasoning. Originated by Dewey B. Larson, it is the culmination of the efforts of generations of physicists, including such men as Planck, Einstein, de Broglie, Rutherford, Bohr and Dirac. The International Society of Unified Science (formerly called New Science Advocates) since its founding almost twelve years ago has endeavored to advance the Reciprocal System of physical theory which has now reached the goal which eluded Einstein and others — a single set of laws to govern all physical phenomena. The failure of earlier scientists to reach this goal is due to the nature of invented physical theories which, no matter how sophisticated and mathematical, cannot arrive at correct conclusions. The realization that this physical universe, with its material and cosmic sectors, in reciprocal relation to one another, is a universe of motion had to be made by means of inductive reasoning.

In this issue of RECIPROCITY are published some of the papers presented to the Sixth Annual ISUS Conference. Larson indicates the essential role of scalar motion in the basic behavior of the physical universe, such as space-time progression and gravitational motion; Ronald Satz shows that the Rutherford scattering experiment does not physically demonstrate that the atom is essentially an electrical system with a nucleus; and K.V.K. Nehru applies the Reciprocal System to obtain a tentative calculation of the lifetime of the muon (i.e., cosmic argon).
SCALAR MOTION

by Dewey B. Larson

Whenever a new physical theory appears, one of the first objectives of the supporters of that theory is to find a crucial experiment, an experiment whose results agree with the new theory, but are definitely in conflict with its predecessors. This is a difficult undertaking, not only because it is hard to find an experiment of the right kind, but also because the results of that experiment, if an experiment is found, can usually be accommodated to existing theory by ad hoc assumptions of one kind or another. And the scientific community prefers to accept a modified theory of that kind, in preference to an entirely new theory, even if the modifications require such wild ideas as black holes or charmed quarks. Nevertheless, a crucial experiment occasionally does make its appearance.

Perhaps the most famous was the Michelson-Morley experiment. The constant speed of light disclosed by that experiment was devastating to the Newtonian system, and created a conceptual vacuum that cleared the way for the acceptance of Einstein's relativity theories. My associates and I have naturally been on a lookout for a crucial experiment of this kind, and many leads have been followed up. Dr. Huck has an electrical experiment underway. Dr. Cramer has been working with a project that involves measuring the positions of the moon, and many other ideas are in various stages of development.

Last year at Huntsville I gave a preliminary report on what will be my contribution to this project. I was not able to devise a crucial experiment, but what occurred to me was that we could reach exactly the same point by identifying some previously unrecognized result of some earlier experiment. After all, we are not interested in the crucial experiment itself. What we want is the crucial piece of information that is derived from that experiment, and it actually makes no difference whether we get that from a new experiment or an old one. The public library in my home city is currently featuring a sign that says, "A book is always new if you have never read it." The same is true of physical facts. A physical fact is always new if it has never before been recognized.

In the course of my investigations over the past forty or fifty years I have uncovered a great many hitherto

*This article is an edited transcript of the address given by Dewey Larson on August 15th, 1981 at Downey, California to the Sixth Annual ISUS Conference.
unrecognized or disregarded physical facts -- a surprisingly large number of them. But the one that fits our present requirements is a hitherto unrecognized property of scalar motion. Scalar motion itself is well known, although not by that name. For example, when the recession of the distant galaxies was first discovered some years ago, the astronomers needed an analogy to help explain the nature of that motion, and they knew right where to look for it. Almost every such explanation reads something like this one, which was taken from a current astronomical text:

The common analogy likens the galaxies to spots on the surface of a balloon that is being inflated. As the rubber stretches, all the spots move away from each other.

The widespread use of this analogy testifies to the general understanding that the motion of the spots on the expanding balloon and the motion of the distant galaxies is, in some way, different from ordinary motion; but the importance of that motion is not seen to be sufficient to justify any systematic exploration of its properties. After all, nobody is very much worried about the physics of expanding balloons. But that situation was changed very drastically by the development of the theory of the universe of motion, because scalar motion plays a very important part in that theoretical structure. So it was necessary for me to undertake the full-scale investigation of scalar motion that had not hitherto been attempted.

If we examine the motion of the spots on an expanding balloon in isolation, without placing the balloon in a reference system, or introducing a reference system into the balloon, or if we construct a similar mental picture of the recession of the distant galaxies, there is no way by which we can distinguish the motion of any one spot or of any one galaxy from the motion of any other. Each spot and each galaxy is simply moving outward away from all others at a constant rate of speed. That motion has only one property -- a scalar magnitude. Such a motion is, by definition, scalar. The scalar motions readily accessible to observation are not isolated in the manner of those I have mentioned, but are connected to a physical reference system in some manner, as for instance by placing the balloon on the floor of a room. That physical coupling to the reference system provides the directions that the motions themselves do not not have. If the coupling is fixed, so that the directions are likewise fixed, then the combination of a scalar motion and a coupling to the reference system behaves in most respects in the same way as an ordinary vectorial motion, and it is not currently distinguished from a vectorial motion.

Here is a place where a very important point has been overlooked. It is recognized that the balloon can be placed
anywhere in the room, and it follows that the motion of any particular spot can take any direction in the reference system. But what has not been recognized, or at least not clearly recognized, is that the ability to take any direction is not limited to a constant direction. For example, the balloon may be rotated. The effect of a continuous rotation of the coupling to the reference system is to distribute the scalar motion over all directions in the dimension or dimensions of rotation, thus producing a distributed scalar motion. The properties of that distributed scalar motion are quite different from the properties of combined vectorial motions in different directions. In vectorial motion the magnitude and the direction are interrelated. For example, if a vectorial motion of magnitude \( X \) in a specific direction is superimposed on a vectorial motion of equal magnitude in the opposite direction, the resultant is zero. Similarly, vectorial motions of equal magnitude in all directions add up to no motion at all. But the magnitude of a distributed scalar motion is not altered by the changes in direction.

The balloon example is a relatively unimportant motion, originated and maintained by human action. But the fact that such motions exist means that the same kind of motions may originate from natural causes. So we thus arrive at the conclusion that there probably exist somewhere in the physical universe a class of distributed scalar motions that are not currently recognized as motions.

As soon as we reach that conclusion, it is almost immediately apparent that the reason for the lack of recognition is the prevailing attitude toward the concept of force. Force is defined for scientific purposes as the product of mass and acceleration. Motion itself is measured, on an individual mass-unit basis, as speed or velocity. That is, each individual mass-unit moves at that rate. On a collective basis, it is measured as the product of mass and velocity, which is currently called momentum, but in earlier days was known by the more descriptive name of quantity of motion. The time rate of change of the motion is an acceleration on the individual mass-unit basis, and the product of mass and acceleration, or force, on the collective basis. This obviously means that force is specifically defined as a property of motion and it follows that force cannot be autonomous in the manner in which the so-called fundamental forces of nature are currently regarded. Every fundamental force is a property of a fundamental motion. But that creates problems for present-day science. For example, the electric charge produces an electrical force, and so far as we can tell it produces that force directly, with no sign of any intervening motion of the kind that is required by the definition of motion. Present day science handles that problem very simply — by ignoring it. But if we want to actually resolve the problem, what we need to do is to identify the electric charge as a distributed scalar motion.
The charge itself is the motion, so we don't need that intervening motion that we don't find.

This process of identification is a necessary part of all scientific work, because the entities with which we deal don't come equipped with labels. The process itself is simple enough. It operates on what is sometimes called the 'duck principle.' You are familiar with that, I presume? If it looks like a duck, and it swims like a duck, and it waddles like a duck, and it quacks like a duck, then it's a duck. We can illustrate the application of that principle by a simple example. Out in the depths of space we see certain objects that we call stars and planets. It is not obvious from visual observation what those stars and planets are -- at one time it was thought that they were simply holes in the sky that let the light shine through. Since then the properties of matter have been determined, where we are in direct contact with it, and some of the properties of the stars and planets have also been determined. The two have been correlated, and whenever a comparison has been made, they have been found to be identical. That justifies us, on the basis of the duck principle, in concluding that the stars and planets are aggregates of matter.

In exactly the same way we are identifying the electric charge as a distributed scalar motion. This is the same conclusion that I reached earlier in my theoretical works; but the situation is now entirely different. That theoretical conclusion had no meaning to anyone who was not willing to accept the premises on which it was based; and any scientist, or anybody else for that matter, had the option of accepting or rejecting it. That option is no longer open. We have now demonstrated that the identity of an electric charge as a distributed scalar motion is a necessary consequence of positively established facts, and the scientist has no option but to live with the facts.

What I have said so far covers essentially the same ground that I covered in the preliminary talk last year at Huntsville, and it may be that I have been imposing on those of you who heard the previous talk by subjecting you to the same thing twice. But there are two reasons for so doing. In the first place I wanted to emphasize the status of these findings with respect to distributed scalar motion as the equivalent of the result of a crucial experiment. The other reason is that it has been possible to extend those conclusions very materially during the intervening twelve months, and I wanted to talk to you a little about those extensions. My original intention, as I mentioned to some of those who were present at the conference at Huntsville, was to write an article for some appropriate scientific journal that would cover the scalar motion findings -- and as soon as I got home from the conference, I started work on that article. But, coincidentally, I continued the investigations.
And the results of those investigations accumulated so rapidly that it was very soon apparent that the idea of an article was impractical, and that the amount of material that I had could not be covered in anything less than a book-length presentation. So I proceeded with the preparation of the text of such a book, and in thinking over the subjects that might be of interest to you tonight, I decided that perhaps you might be interested in a sort of a preview of the contents of that volume.

Within the subject area that it covers, the conclusions reached in this new work will be identical with those reached in my previous theoretical works; but they will be reached by a totally different route. In the theoretical works I began with a set of postulates as to the properties of a universe of motion, and all conclusions in all areas were derived entirely by derivation of the consequences of those postulates, without introducing anything from observation or experiment. In this new work I am going to do exactly the opposite. I am going to start with a set of positively established facts, including those that have been derived from the scalar motion investigation; and all conclusions will be derived entirely by development of the consequences of those established facts, without introducing anything of a theoretical nature. That means that the entire book will be factual, without any tie-in to any physical theory. But since the conclusions will agree with the conclusions derived from the theory of a universe of motion, whereas they will disagree in many respects with current physical theories, the work as a whole will constitute a significant confirmation of the validity of the theory of the universe of motion.

The discovery and identification of distributed scalar motion was, in itself, an important advance in knowledge. But it also opens the door to a better understanding of the entities that are now identified as distributed scalar motions. One important point that has been clarified is the existence of multi-dimensional motion. Vectorial motion is one-dimensional. It may extend into three dimensions of space, but as motion it is confined to one dimension. Any such motion is described by a vector, which is one-dimensional; and any number of these vectors can be combined into a resultant vector, which is likewise one-dimensional. But scalar motions in different dimensions cannot be combined in any way analogous to the addition of vectors. It follows that scalar motions in different dimensions are independent. An n-dimensional motion, mathematically speaking, is simply one that requires n magnitudes for a complete definition. Thus a one-dimensional motion, or other physical quantity, can be defined by one magnitude; a three-dimensional scalar motion requires three magnitudes for its definition. One of those magnitudes, and only one, can be further subdivided by the introduction of directions relative to a spatial reference system. That motion can then be defined by a
vector, and it can be represented in the spatial reference system by a line.

Current scientific thought regards the whole of existence, physical existence at least, as being contained within the space and time of the spatial reference system. And that current thought denies the existence of what I have just been talking about; that is, multi-dimensional motion. But now that we have derived the existence of multi-dimensional motion from established physical facts, it is evident that this current scientific opinion, which was never anything but an assumption, is an erroneous assumption. What we now find is that the conventional three-dimensional spatial reference system is capable of representing only a limited portion of the total contents of the universe.

With the benefit of this information as to multi-dimensional motion, we can now complete the definition of the basic distributed scalar motions. A study of the properties of electric charges, which I will include in the new publication, but won't take the time to go into here, shows that the charge is a one-dimensional distributed scalar motion. A similar study of gravitation shows that gravitation is a three-dimensional distributed scalar motion. The situation with respect to magnetism is not as clear cut, because it is complicated by the existence of electromagnetism, which is a phenomenon of an entirely different kind. But we can identify the so-called permanent magnetism as a two-dimensional distributed scalar motion.

In present-day thought these phenomena are dealt with as fields, but just what constitutes a field has always been a matter of a considerable difference of opinion. From Marshall Walker we get this definition: "A field is a region of space where a test object experiences a specific force." But Einstein disagrees. Einstein says a field is something "physically real in space, "for the modern physicist as real as the chair on which he sits." This difference in opinion as to the nature of the field is further complicated by differences of opinion as to how the field theory ought to be applied and as matters now stand, the whole status of the theory is in considerable doubt. From David Park we get this assessment of the situation: "This does not mean that the ultimate explanation of everything is going to be in terms of fields, and indeed there are signs that the whole development of field theory may be nearer its end than its beginning." The clarification of the scalar motion situation shows that the field is neither a region of space as indicated by Walker, or something like the physicist's chair, as indicated by Einstein. It is simply a distributed force. The force aspect of a vectorial motion is a vector; the force aspect of a distributed scalar motion is a field.
The failure to recognize important facts, such as the existence of distributed scalar motion, has a double effect in that it encourages the development of erroneous theories, and then causes a disregard of the facts that disagree with those theories. The situation with respect to gravitation is a good example. The observed facts with respect to gravitation are well known, and they are almost entirely disregarded. As nearly as can be determined from observation, gravitation acts instantaneously, without an intervening medium, and in such a way that its effects cannot be screened off or modified in any way. But those properties are so difficult to explain on the basis present-day theory that the physicists have resorted to the unusual expedient of constructing a fictitious set of properties that they can explain, and substituting those fictitious properties for the observed properties. Notwithstanding all evidence to the contrary, present-day physical opinion insists that gravitation must be propagated at a finite velocity, through a medium, or something with the properties of a medium. Einstein, of course, made space a medium -- gave it the properties, as he said, of a medium. It is freely admitted that there is no evidence to support this present-day contention. As one prominent physicist puts it, "Nowadays we are also convinced that gravitation progresses with the speed of light. This conviction, however, does not stem from a new experiment or a new observation; it is a result solely of the theory of relativity." Once it is recognized that gravitation is a distributed scalar motion, all necessity for this defiance of the facts is removed, because the properties of a distributed scalar motion are exactly those properties of gravitation that have proved so difficult to understand.

The insistence on viewing gravitation as a transmission process also involves a wholesale disregard of the physical facts. That viewpoint likens gravitation to electromagnetic radiation, and we hear about gravitational waves in the same way that we hear about electromagnetic waves. But the two processes are entirely different, and it is very difficult to understand why anyone should ever connect the two. Electromagnetic radiation is an energy transmission process. A photon leaves an emitting object with a certain amount of energy. The energy of the emitting object is decreased by that amount. The photon travels through space and reaches an absorbing object, delivers the energy, and the energy of the absorbing object is increased by that amount. The intervening space, the distance, has nothing to do with the process, except in determining the time it takes for travel. The process is independent of the distance. In contrast to that process, the gravitational process is totally dependent on the distance. If there is no change in the distance, that is, if the two apparently interacting objects don't change their separation, then there is no change in the energy at all. And even if an energy change does take place, as happens in a case of an object falling towards the Earth, the
increase in the kinetic energy of the incoming falling object is not obtained at the expense of the Earth: it's derived from the potential energy, the energy of position, of the falling object itself. Much the same considerations apply to electricity and magnetism.

There are a number of other direct consequences of the scalar motion existence that have an important bearing on various physical problems, and I intend to cover them, that is, all those that I have so far identified, in this new book; but I don't want to take the time to talk about them here, because I want to leave time for adequate consideration of another very important finding, which, like the existence of distributed scalar motion, is significant enough to justify classifying it as the equivalent of the results of a crucial experiment.

This second important finding is a result of a well-known experiment, but it has not previously been recognized because a recognition of distributed scalar motion was a prerequisite for recognition of the new fact. As a preliminary, before starting to talk about that particular subject, I want to say a few things about speed limits. The present scientific view is that nothing physical can move faster than the speed of light. That belief is based on Einstein's interpretation of certain experiments in which an electric force was applied to the acceleration of light objects, such as electrons. It was found in those experiments that the acceleration did not continue at the same rate as might be expected from Newton's second law of motion, but decreased at high speeds at a rate which indicated it would reach zero at the speed of light. That indicated, of course, that either the force must decrease at high speeds, or the mass must increase. There is no physical evidence of any kind to indicate which is the correct alternative, so Einstein had to make a guess, and he guessed in favor of the mass alternative. According to his theory the mass increases at high speeds and becomes infinite at the speed of light. On this basis it is, of course, impossible for any higher speed to exist.

So far as present-day theory is concerned, it makes little difference which of these alternatives is correct, because there is obviously a limit on a one-dimensional basis in either case. Since present-day theory does not concede the existence of multi-dimensional motion, the existence of a one-dimensional limit is equivalent to the existence of a limit on speeds in total. But when we recognize the existence of multi-dimensional scalar motion, then it's equally evident that the limit on speed in one dimension can be reached in each of the three dimensions. That does not mean that it's possible to achieve a speed greater than light by electrical means, because, as I pointed out a little bit earlier, the electrical force is one-dimensional. That accounts for the fact that the electrical force was unable to
reach any higher speed. But it does not preclude acceleration to higher speeds by means of some other process, such as, for instance, the release of large quantities of energy in violent explosions.

This brings me down to that second important physical fact that I have been talking about. But I want to pause for a moment to emphasize the continuing factual nature of the development of thought. The reason I need to do that is that the conclusion that I am now ready to pull out of the hat appears in the theory of the universe of motion as a postulate, and it has some far-reaching consequences. Those who realize that both the conclusion itself and the consequences are a part of the theory of a universe of motion are likely to suspect that I may have smuggled some theoretical considerations into the development of thought at some point along the line. So I want to assure you that that's not the case. We're sticking entirely to the facts.

We know from observation that the electric charge occurs only in discrete units. We have identified the electric charge as a distributed scalar motion. Now there's no difference between this scalar motion and any other scalar motion so far as the motion itself is concerned: the difference is only in the nature of the coupling to the reference system. Once we have established that the electric charge, which is a scalar motion, is limited to discrete units, it then follows that scalar motion occurs only in discrete units.

Those of you who are encountering that conclusion for the first time may not be very much impressed by it. In fact, with all the build-up I have given it, it may come as somewhat of an anti-climax. But those of you who are familiar with the theory of a universe of motion will realize the great significance of deriving this conclusion from purely factual premises. At one stroke it raises a very substantial portion of the conclusions that have been reached with respect to a universe of motion from the status of theoretical conclusions to the status of established facts.

The only property of a scalar motion is magnitude; such a motion is a relation between a space magnitude and a time magnitude. Now we have further found that those are integral magnitudes, so that the properties of scalar motion are the properties of integral magnitudes. It then follows that we can derive the physical properties of scalar motion under any particular circumstances by translating the mathematical properties of reciprocal integers, which we already know, into the appropriate physical language. This, of course, is a general principle of extremely wide application.

In our ordinary view of motion the minimum amount of motion is zero; and zero is therefore the condition of rest,
the condition from which effective magnitudes are measured. In a reciprocal speed system, on the other hand, the minimum speed is unity, because anything less than unit speed is not speed: it's inverse speed. Similarly, the minimum inverse speed is unity. It follows that in such a system unit speed is the condition of rest, the condition from which all speed magnitudes are measured. Expressing that in another way, we can say that unit speed is the natural reference system. The natural reference system for scalar motion is not a fixed system; it is a moving system.

The motion of the time component is universally recognized. We all recognize that "now" is not something that stays put. It continually moves forward. The essence of the new finding is that "here" is an entity of the same kind: it likewise continually moves forward. What this means, then, is that all physical objects are continually being carried outward at unit speed relative to the fixed reference system.

In most cases that outward motion cannot be recognized; but where the gravitational effect is absent, as in the case of the photons of radiation, we can observe the outward motion: photons move outward at the speed of light. The same is true where the gravitational effect is practically negligible, as in the most distant galaxies, which are likewise moving outward at almost the speed of light. Another important consequence of the reciprocal relation that we have now established is the symmetry around unit speed which means that there is motion in time as well as in space. An increase in the time, while the space is constant, results in a decrease in space per unit time, and therefore causes a change of position in space. An increase in space with time remaining constant decreases time per unit space and causes a change of position in time. So here we arrive at the concept of a motion in time. This concept is perfectly familiar to those of you who have been dealing with the theory of a universe of motion; and a great deal of what I am saying now is very much the same as I was saying years ago when I was first explaining that theory. So it's old stuff to you. But it has a quite different significance in the present context. The extent to which we can now derive these conclusions from established facts greatly strengthens the position of the theory. Many individuals have rejected our conclusions without any serious consideration simply because they conflict with ideas of long standing that have had no basis other than assumptions to begin with. But now that we are able to show that these conclusions are consequences of positively established facts, that option, as I said with regard to another item, is no longer open. Scientists have no option but to accommodate themselves to the facts.

The system of scalar motions that we can represent in the spatial reference system, the one-dimensional motion that I
was talking about earlier, can be duplicated in time because of this space-time symmetry, so that we have another system equivalent to the scalar motion system that is represented in our reference frame. The derivation that I am giving you now deals only with scalar motion, and we'll have to leave vectorial motion for consideration at some other time, because I haven't brought that within the factual limits yet. But we can consider this point: that gravitation is a scalar motion, and that consequently all gravitating objects are included in the inverse system. This includes all material objects. It follows that the inverse system is at least co-extensive with the system that is open to observation, whether or not it is an exact duplicate. The inverse system that I have been talking about is a system of maximum speed. The system that we are well acquainted with, that we deal with on our ordinary reference system, is a region of minimum speed.

Now I want to take a brief look at some of the things that happen in the intervening area. First, we need to look at some of the primary processes that are involved. The progression of the natural reference system is outward, a plus or positive motion in our usual language. It is limited to one unit, because that is the maximum that we can have in a system of discrete units. Gravitation is capable of extending to two units before it reaches a net resultant of one negative unit; and to that one negative unit we can apply outward translational motion in one dimension. Here we again have a range of two units. The same is true in each of the three dimensions. That gives us then a total separation of six units of speed from one zero to the other.

So far I have been talking about full units. Of course, when we exclude fractional units, we don't have anything but full units, but we can produce the equivalent of a fractional unit by adding units of the opposite kind, that is, units of motion in time. N units of motion in time are equivalent to minus 1/n units of motion in space -- so that we accomplish a resultant of less than one unit by combining the one full unit with the oppositely directed fractional unit from the other direction. This is the first speed range, the range from zero to one unit. It is the range of our ordinary experience, the speed range that's represented in the spatial reference system. It's not possible, obviously, to exceed one unit by any kind of a subtraction from a single unit, which accounts for the limitation on the speed in one dimension. But there is nothing to prevent the addition of another full unit, so that in the next speed range, we have two units minus a fractional unit. The same is true in the third speed range.

It's necessary to keep in mind that the first of the two units is a unit of space and that there is a unit of time in the same dimension. There is a unit of space from zero space
to unity, which is the unit of both space and time, and another unit from this unit level to zero time. Thus, the second unit of motion is in time. Then, in order to add a third unit, we have to go to a second dimension, so that again we have a dimension of space. On this basis the speed from zero to one unit is in space. That's the ordinary motion that we are acquainted with. A speed from one unit to two units is in the same dimension, but it is in time. A speed from two units to three units continues that unit of speed in time, but adds a unit of speed in space, so that it's two-dimensional.

These are the major characteristics of high-speed motion as we derive them from the reciprocal relationship that we have just found. In order to give this a meaning in terms of our physical observations, we have to resort to the identification process again. The most energetic processes that we know of in the universe are explosions of stars and galaxies. If any objects with speeds in these intermediate ranges that I have been talking about actually exist, they must exist as objects of that kind. So let's look at them. All violent explosions generate some low-speed products, and we see those low-speed products expanding away from the site of the explosion, usually at high speeds. Those products are not of particular interest to us now because they are in the lower speed range, the ordinary speeds of our everyday experience. But in motion in the second speed range, the change of position is in time. So that the motion in that speed range produces the same kind of a cloud of expanding particles, but this time they are expanding into time. Because of the reciprocal relation between space and time that I have just been talking about, the cloud of particles expanding into time decreases in size as seen in the spatial reference system, so that we observe such a cloud of particles as a very small object of a very high density, which remains in essentially the original location. Such an object can, of course, be identified with the stars that we know as white dwarfs. So here, then, we can identify objects in which the speeds are in the second speed range — from unity to two units. This is another conclusion we reached theoretically, but now we find that we have sufficient evidence to establish it as a consequence of positively established facts.

We also have evidence that there are explosions of galaxies, and since these are very much larger objects — our own galaxy contains something like ten to the eleventh power solar masses, a hundred billion times the size of one star — the explosion of a galaxy is very much more violent, we can therefore deduce that some of the products of that explosion will probably enter the third speed range. As I pointed out a short time ago, that should have two consequences. Because it has a two-dimensional motion, one dimension of which is in time and another in space, that kind of an object will be
moving rapidly outward, as well as decreasing in size, like the white dwarf star. Such an object will therefore be the equivalent of what we might call a white dwarf galaxy; not a galaxy composed of white dwarf stars, but a galaxy that has the properties of white dwarfs. We can easily identify this as one of the objects known as quasars.

Now, to summarize what I said: I have not been able to find the kind of a crucial experiment that I and others have been looking for. But by means of a systematic analysis of previous experimental work, I have uncovered two hitherto unrecognized facts of a crucial nature — the kind of facts that would have been obtained from crucial experiments, if I had found such an experiment, or two of them. These new crucial facts are, first, the existence of distributed scalar motion, and, second, the limitation of all scalar motion to discrete units. With the benefit of these new crucial items of information, many of the unique features of a universe of motion, including multi-dimensional motion, motion in time, speeds greater than that of light, and a second half of the universe, can now be presented to the scientific community as established facts, rather than as theoretical speculations. This should aid very materially in the continuing effort to secure the serious consideration that has thus far been so difficult to obtain.
THE INTERACTION OF ALPHA PARTICLES AND GOLD ATOMS:  
A NEW EXPLANATION OF RUTHERFORD SCATTERING

by Ronald W. Satz

Introduction

Nearly all present-day physicists are convinced of the truth of the assertion in the following quotation from Weidner and Sells' Elementary Modern Physics [1]:

It was by the alpha-particle scattering experiments, suggested by Rutherford, that the existence of atomic nuclei was established.

However, when we study the literature of Rutherford's era, we find that he and his associates, Geiger and Marsden, did not in fact discover an atomic nucleus. Geiger and Marsden's paper, "The laws of Deflexion of Alpha Particles through Large Angles," [2] does present strong experimental evidence of a central repulsive force originating from atoms, but the paper does not prove that this force is electrical in nature. What their experiments did prove is that the number of particles scattered through an angle \( \theta \) is proportional to \( 1/\sin^4(\theta/2) \) and to the inverse of the square of the kinetic energy of the particles, \( 1/E_k^2 \). Of course, the experiments did disprove the Thomson "plum pudding" atom model, which did not predict a strong central repulsive force; but it is one thing to disprove a theory; it is quite another to prove one. If the Rutherford model were the only alternative left, we might have to conclude that it is correct -- but there are always other alternatives. This paper will present one such alternative: the Reciprocal System of physical theory. A new scattering equation will be derived and compared with the experimental facts as found in an up-to-date version of the original experiment, that conducted by Prof. Adrian C. Melissinos and his students [3]. The originator of the Reciprocal System is Dewey B. Larson; for full comprehension of this paper, the reader should first study Larson's books, particularly Refs. 4, 5, and 6.

I. THEORY

A. The Repulsion Force: \( F \)

1. Reciprocal System

In the Reciprocal System, non-ionized and non-magnetized matter is subject to only two primary forces: the space-time progression and gravitation. In the time-space region, the progression is outward and gravitation inward, whereas in the time region (inside unit space) the progression is inward and gravitation outward--a repulsion. Right at the boundary the
progression is zero, but the net gravitation is not zero. Compared with the repulsive gravitational force, the attractive gravitational force is negligible. Thus at the boundary only the repulsive gravitational force is effective. Now consider what happens when an atom A, which is moving towards an atom B, reaches this boundary. According to Larson [6],

When atom A reaches point X, one unit of space distant from B, it cannot move any closer to B in space. It is, however, free to change its position in time relative to the time location occupied by atom B. The reciprocal relation between space and time makes an increase in time separation equivalent to a decrease in space separation, and while atom A cannot move any closer to atom B in space, it can move to the equivalent of a spatial position that is closer to B by moving outward in coordinate time. . . . No matter what the spatial direction of the motion of the atom may have been before unit distance was reached, the temporal direction of the motion after it makes the transition to motion in time is determined purely by chance.

A previous paper of mine, "Time Region Particle Dynamics," [7] dealt with the situation in which atom A (say an alpha particle) is assumed to continue to move directly toward atom B (say a gold atom) in the time region. This paper will consider the general case in which no assumption is made as to the actual motion that takes place in the equivalent space of the time region. All that will be considered here is the equivalent motion that takes place at the boundary, i.e., in actual space. Here, with the atoms separated by \( s_0 \), the repulsive gravitational force \( F \) is (from Ref. 4)

\[
F = \frac{K_G}{s^4} = \frac{K_G}{s_0^4} \quad \text{(if } s = s_0) \tag{1}
\]

The repulsion coefficient \( K_G \) is expressed by

\[
K_G = \frac{[P_o s_0^4/(156.44)^4] * [\ln^4 t_{eff}/\ln^2 t'_{eff}]} \tag{2}
\]

where \( P_o \) is the natural unit of force and the number 156.44 is the inter-regional ratio. The dimensionless variables \( t_{eff} \) and \( t'_{eff} \) are material constants determined by the characteristics of the interacting particles, and will be discussed further later.

2. Conventional Theory

In present theory, the alpha particles somehow avoid interacting with the cloud of electrons supposedly surrounding each gold nucleus. The only force involved comes from the presumed nucleus. At low energies, this is a Coulombic force, given by
\[ F = \frac{zz e^2}{4 \pi \varepsilon_0 s^2} \]  \hspace{1cm} (3)

where \( z \) is the atomic number of the alpha particle (helium), \( Z \) is the atomic number of gold, \( e \) is the value of electric charge, \( \varepsilon_0 \) is the permittivity constant of free space, and \( s \) is the separation distance. This is an inverse square force, rather than an inverse quartic force as in the Reciprocal System. Why this Coulombic force should act between particles but not within nuclei is a question completely unanswered by current theory.

B. The Impact Parameter: \( b \)

MOTION IN ACTUAL SPACE: \( s_0 \) remains constant, but angle \( \phi \) changes from \( 0 \) to \( \pi - \theta \) where \( \theta \) is the deflection angle observed in the time-space region.

The figure shows a typical collision process. The impact parameter is the distance that the alpha particle would have passed the gold atom if there had been no force between them.

1. Reciprocal System

Let \( m \) be the mass of the alpha particle and \( v_0 \) be its initial velocity. Referring to the figure, we have

\[
\text{impulse} = \Delta (mv)_y
\]

\[
\int F dt = mv_0 \sin(\theta)
\]

\[
\left(k_g/s_0^4\right) \int \sin(\phi) dt = mv_0 \sin(\theta)
\]  \hspace{1cm} (4)

The alpha particle passes from the time-space region, through the time region, and back into the time-space region. For the general case, we cannot write an equation for the actual motion in the equivalent space of the time region, but we can write an equation for the equivalent motion in the actual space of the time-space region. Throughout this motion, neither the angular momentum, nor the actual spatial separation changes. But the angle \( \phi \) does change. Therefore,
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\[ mv_0 b = ms_0^2 \frac{d\phi}{dt} \] \hspace{1cm} \langle 5 \rangle

Separating \( dt \) from \( d\phi \) in eq. \( \langle 5 \rangle \) and substituting in eq. \( \langle 4 \rangle \), we have

\[ \left( \frac{K_G}{s_o^4} \right) \sin(\phi) d(\phi) = \frac{mv_o^2}{s_o^2} \sin(\theta) \]

or

\[ \left( \frac{K_G}{s_o^2mv_o^2b} \right) \sin(\phi) d\phi = \sin(\theta) \] \hspace{1cm} \langle 6a \rangle

Since the kinetic energy, \( E_k \), is \( \frac{1}{2} mv_o^2 \), eq. \( \langle 6a \rangle \) can be rewritten as

\[ \left[ \frac{K_G}{s_o^2(2E_k b)} \right] \sin(\phi) d\phi = \sin(\theta) \] \hspace{1cm} \langle 6b \rangle

Before the collision, \( \phi = 0 \) and after the collision, \( \phi = \pi - \theta \) so these are the limits on the integral.

\[ \int_0^{\pi-\theta} \sin(\phi) d\phi = -\cos(\phi) \bigg|_0^{\pi-\theta} \]

\[ = -\cos(\pi - \theta) + \cos(\theta) \]

\[ = \cos(\theta) + 1 \]

Thus,

\[ \left[ \frac{K_G}{s_o^2(2E_k b)} \right] \sin(\theta) = \cos(\theta) + 1 \] \hspace{1cm} \langle 7a \rangle

But

\[ \frac{\sin(\theta)}{\cos(\theta) + 1} = \tan(\theta/2) \]

so

\[ \frac{K_G}{s_o^2(2E_k b)} = \tan(\theta/2) \] \hspace{1cm} \langle 7b \rangle

Solving for \( b \) we finally obtain

\[ b = \left[ \frac{K_G}{(2s_o^2E_k b)} \right] \cot(\theta/2) \] \hspace{1cm} \langle 7c \rangle

2. Conventional Theory

Refs. 1, 3, and 8 all have derivations for \( b \) in current theory. The result is

\[ b = \left[ \frac{zZe^2}{(8\pi s_o E_k)} \right] \cot(\theta/2) \] \hspace{1cm} \langle 8 \rangle

C. Target Cross-Section: \( \sigma \)

The target cross-section is defined as \( \sigma = \pi b^2 \).

1. The Reciprocal System

From eq. \( \langle 7c \rangle \), using the above, we obtain

\[ \sigma = \left[ \frac{zK_G^2}{(4s_o^4E_k^2)} \right] \cot^2(\theta/2) \] \hspace{1cm} \langle 9 \rangle

2. Conventional Theory
With \( b \) from eq. <8>,
\[
\sigma = \left[ \frac{z^2 Z^2 e^4}{64 \pi \varepsilon_o^2 E_k^2} \right] \times \cot^2(\theta/2) \quad \text{<10>}
\]

D. Differential Cross-Section: \( d\sigma \)

The differential cross-section is
\[
d\sigma = 2 \times bdb
\]

1. Reciprocal System

Here,
\[
db = \left[ -K_G/(s_o^2 \times 4 \times E_k) \right] \times \left[ d\theta/\sin^2(\theta/2) \right] \quad \text{<11>}
\]

Thus
\[
d\sigma = 2 \times \left[ -K_G/(2 \times s_o^2 \times E_k) \right] \times \cos(\theta/2)/\sin(\theta/2) \times \left[ d\theta/\sin^2(\theta/2) \right]
\]

\[
= \frac{-2 \times K_G \cos(\theta/2) d\theta}{8 \times s_o^4 \times E_k^2 \times \sin^3(\theta/2)}
\]

\[
= \frac{-2 \times K_G^2 \cos(\theta/2) d\theta}{4 \times s_o^4 \times E_k^2 \times \sin^3(\theta/2)} \quad \text{<12>}
\]

(with the minus sign dropped).

The angles \( \theta \) and \( \theta + d\theta \) define two cones with the horizontal line through the gold atom as their axis. The differential solid angle \( d\Omega \) between the two cones is
\[
d\Omega = 2 \times \sin(\theta) d\theta
\]

Since the cosine term in eq. <12> can be expressed as
\[
\cos(\theta/2) = \sin(\theta)/(2 \times \sin(\theta/2))
\]

eq. <12> becomes
\[
d\sigma = \left[ -K_G^2 (\sin(\theta)) d\theta \right]/\left[ 8 \times s_o^4 \times E_k^2 \times \sin^4(\theta/2) \right]
\]

\[
= \frac{K_G^2 d\Omega}{16 \times s_o^4 \times E_k^2 \times \sin^4(\theta/2)}
\]

or
\[
d\sigma/d\Omega = K_G^2/[16 \times s_o^4 \times E_k^2 \times \sin^4(\theta/2)] \quad \text{<13>}
\]

The units of \( d\sigma/d\Omega \) are meter squared per steradian, \( m^2/\text{sr} \).

2. Conventional Theory

Similarly, for conventional theory,
\[
d\sigma/d\Omega = z^2 Z^2 e^4/[256 \times x^2 \times \varepsilon_o^2 \times E_k^2 \times \sin^4(\theta/2)] \quad \text{<14>}
\]

E. The Scattering Constant: \( K_S \)

It is immediately seen from eqs. <13> and <14> that for both
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theories,

\[(d\sigma/d\Omega)\sin^4(\theta/2) = K_S\]

a constant.

1. Reciprocal System

Here,

\[K_S = \frac{K_G^2}{(16s_o^4E_k^2)}\]  \[<15\]

2. Conventional Theory

Here,

\[K_S = \frac{2\gamma^2e^4}{(256\pi^2\varepsilon_0^2E_k^2)}\]  \[<16\]

F. The Number of Particles Scattered per Minute at the angle \(\theta\): \(I_S\)

So far we have looked at the situation involving only one alpha particle and only one gold atom. For the situation in which a beam of alpha particles strikes a gold foil, we would like to compute the number of particles scattered through a certain angle \(\theta\). Let

\[I_o = \text{number of incident alpha particles/minute}\]

\[d\Omega = \text{detector solid angle}\]

\[N = \text{area density of scatterers (number of gold atoms/m}^2\)]

The value of \(N\) is determined from this equation:

\[N = \delta \cdot \rho \cdot \left(\frac{N_o}{A}\right) \cdot 10^4 \text{cm}^2/\text{m}^2\]  \[<17\]

where

\[\delta = \text{thickness of foil (cm)}\]

\[\rho = \text{density of scatterer (g/cm}^3\)]

\[N_o = 6.02 \times 10^{23}, \text{Avogadro's number}\]

\[A = \text{atomic weight of scatterer}\]

Then the number per minute, \(I_S\), of alpha particles scattered into the detector at angle \(\theta\) is

\[I_S = I_o \cdot N \cdot (d\sigma/d\Omega) \cdot d\Omega\]

\[= I_o \cdot \delta \cdot \rho \cdot \left(\frac{N_o}{A}\right) \cdot 10^4 \cdot (d\sigma/d\Omega) \cdot d\Omega\]
1. Reciprocal System

Here,

\[ I_S = I_0 \delta^* \rho^*(N_o/A) \times 10^4 \ast K_G^2 \ast d\Omega/[16 \ast s_o^4 \ast E_k^2 \ast \sin^4(\theta/2)] \tag{18} \]

2. Conventional Theory

Here,

\[ I_S = I_0 \delta^* \rho^* N_o/A \times 10^4 \ast (z^2 \ast e^4 \ast d\Omega)/[256 \ast K^2 \ast E_k^2 \ast \sin^4(\theta/2)] \tag{19} \]

Note: Both equations are based on the assumption that E is sufficiently low such that "relativistic" effects can be neglected and such that the gold atoms remain stationary during the interaction -- this would not be the case at very high alpha particle energies.

II. EXPERIMENT

A. The Experimental Set-Up

Prof. Adrian C. Melissinos carried out a modern version of the original Geiger-Marsden experiment and described his findings in Ref. 3. In this experiment

\[ I_0 = 1.1 \ast 10^5 \text{ incident alpha particles/minute} \]

\[ d\Omega = \Delta \Omega = da/l^2 = .8786/(6.67)^2 = 0.197 \text{ sr} \]

[da is differential area of detector and l is distance of detector from foil]

\[ \rho = 19.3 \text{ g/cm}^3 \text{ (gold)} \]

\[ \delta = .00025 \text{ cm} \]

\[ A = 197 \text{ (gold)} \]

Thus,

\[ N = \delta \rho^* (N_o/A) \times 10^4 \]

\[ = (.00025)(19.3)(6.02 \times 10^{23}/197) \times 10^4 \]

\[ N = 1.4744 \times 10^{23} \text{ gold atoms/m}^2 \]

So the equation for \( I_S \) is

\[ I_S = I_0 \ast N \ast (d\sigma/d\Omega) \ast d\Omega \]

\[ = 1.1 \times 10^5 \ast 1.4744 \times 10^{23} \ast (d\sigma/d\Omega) \ast .0197 \]
RECIPROCITY XI.3

\[ I_s = 3.1950 \times 10^{26} \frac{d\sigma}{dn} \]

\( I_s \) is measured, and then \( d\sigma/dn \) is computed. For each angle \( \theta \) the product \( (d\sigma/dn) \times \sin^4(\theta/2) \) can be found and the results plotted. From least-squares error analysis, the best fit experimental value of \( K_s \) can be obtained.

Melissinos states that the above value of \( I_o \), and hence also \( I_s \), is subject to at least a \( \pm 20 \) percent error in view of the approximations used and the non-uniformities in beam density and direction. One other uncertainty is the energy of the alpha particles. The incoming energy is 5.2 MeV, but since the particles lose a considerable amount of energy in traversing the target, Melissinos believes that it is more appropriate to use a mean value of \( E_k \) for the calculations. He calculates the mean value to be

\[ E_k = 4.39 \text{ MeV} = 7.03 \times 10^{-13} \text{ J} \]

B. Calculation of \( K_s \) for the Experimental Set-up

1. Reciprocal System

Here,

\[ K_s = K_g^2 / (16s_o^4 E_k^2) \]

\[ K_g = \left[ P \times s_o^4 / (156.44)^4 \right] \times [\ln^4 t_{eff} / \ln^2 t'_{eff}] \]

\[ P = 3.27223 \times 10^{-3} \text{ Newtons} \]

\[ s_o = 4.558816 \times 10^{-9} \text{ meters} \]

\( \ln^2 t'_{eff} = 1 \), since helium has no electric displacement -- it is "inert."

The difficult part in calculating \( K_g \) is the determination of the value of \( t_{eff} \) for gold and helium. The (tentative) method used here will be different from that used in my previous paper, Ref. 7. Gold has 3 active rotational dimensions with \( t = 4.5 \) in all (see Ref. 4 for more details). Helium has only 1 active dimension, with \( t = 3 \). The other two dimensions have \( t = 1 \). In the first dimension the mean value for gold and helium is

\[ t = (4.5 \times 3)^{1/2} = 3.67 \]

In the other two dimensions, the full rotational force of the gold atom is present, so instead of \( (4.5)^2 = 2.1 \), we simply have \( t = 4.5 \). The mean over all three dimensions is

\[ t_{eff} = (3.67 \times 4.5 \times 4.5)^{1/3} = 4.2 \]
Thus (tentatively),

\[ \text{K}_G = [3.27223 \times 10^{-3} \times (4.558816 \times 10^{-8})^4 / (156.44)^4] \times [\ln^4(4.2)] \]
\[ = 1.00 \times 10^{-40} \text{N-m}^4 \]

The (tentative) value of \( \text{K}_S \) is then

\[ \text{K}_S = (1.00 \times 10^{-40})^2 / [16 \times (4.558816 \times 10^{-8})^4 \times (7.03 \times 10^{-13})^2] \]
\[ \text{K}_S = 2.93 \times 10^{-28} \text{m}^2/\text{sr} \]

2. Conventional Theory

Here,

\[ \text{K}_S = z^2 \frac{e^4}{256 \pi^2 \varepsilon_0^2 E_k^2} \]
\[ z = 2 \]
\[ \varepsilon_0 = 8.85 \times 10^{-12} \text{ coulombs/N-m}^2 \]
\[ e = 1.602 \times 10^{-19} \text{ coulombs} \]
\[ E_k = 7.03 \times 10^{-13} \text{ J} \]

Thus,

\[ \text{K}_S = \frac{(2^2)(79^2)(1.602 \times 10^{-19})^4}{(256 \pi^2 \times (8.85 \times 10^{-12})^2 \times (7.03 \times 10^{-13})^2)} \]
\[ \text{K}_S = 1.68 \times 10^{-28} \text{m}^2/\text{sr} \]

3. Experiment

The best fit experimental value, according to Melissinos, is

\[ \text{K}_S = 2.70 \times 10^{-28} \text{m}^2/\text{sr} \]

Thus the theoretical and experimental results can be summarized as follows:
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\[ K_s (m^2/sr) \]

Experiment: \[ 2.70 \times 10^{-28} \]
Reciprocal System \[ 2.93 \times 10^{-28} \] (tentatively)
Conventional Theory \[ 1.68 \times 10^{-28} \]

Appraisal

It is well known that Rutherford's theory of scattering fails at high energy. On the basis of Melissinos's experiment, we must also reject this theory at low energy. Of course, given the present climate of thought, Melissinos himself could not come to this conclusion. He says (Ref. 3, p. 250):

The difference between the observed and theoretical constants, while at first sight large, can be traced to the limited sensitivity of the apparatus and mainly to
(a) Uncertainty in incoming flux
(b) Uncertainty in foil thickness and, to a lesser extent, to
(c) Extended size of the beam and lack of parallelism
(d) Extended angular size of the detector
(e) Plural scattering in the foil (for the data at small angles)
(f) Background (for the data at large angles)

However, given the close result of the Reciprocal system, it now appears that Melissinos is too modest. Even with some uncertainty in the theoretical value of \( K_G \) and the experimental values of \( I_0 \) and \( E_k \), it appears that the Reciprocal System is consistent with the observed result, whereas conventional theory is not.

Can an appeal to more sophisticated mathematics rescue the current theory? It cannot. From Ref. 1 (p. 223) we have this statement:

It is a remarkable fact that a thoroughgoing wave-mechanical treatment of scattering by an inverse-square force yields precisely the same result as that yielded by the strictly classical particle analysis discussed here.

Thus, despite the thousands of books, the thousands of papers, and the thousands of lectures on the nuclear theory of the atom, the physicists are going to have to discard their cherished concept.

The scattering equation of the Reciprocal System will next have to be applied to other pairs of incident and target particles and to other energy levels.
REFERENCES


LIFETIME OF C-ARGON, THE MUON

by K. V. K. Nehru

Larson states that the apparent lifetime of c-argon is the sum of its own proper lifetime and the time required for the conversion of the c-krypton rotations to massless neutrons [1]. This conversion of the cosmic type rotation, namely (3)-(3)-0 of c-Kr to the material type rotation, M 1/2-1/2-0 of the massless neutron, involves two distinct steps: firstly, there is the 'scalar inversion' resulting in the change of scalar direction, from the standpoint of the temporal zero (the initial level of negative rotation) to that of the spatial zero (the initial level of positive rotation), converting the (3)-(3)-0 rotations to the 1-1-0 rotation (along with the concomitant conversion of the rotational base). Secondly, there is the 'splitting' phenomenon which results in two single rotating systems of the massless neutrons, M 1/2-1/2-0, from the double rotating system of the above 1-1-0 rotation. Thus, the apparent lifetime of c-Ar comprises three components: (i) the proper decay time of the c-Ar, (ii) the inversion time, and (iii) the splitting time.

The Decay Time: The proper lifetime of the c-Ar, \( \tau_d \), in the material environment is the one-dimensional lifetime, \( t_{1D} \), which has been evaluated [2] as \( 1.233148 \times 10^{-8} \text{ sec} \).

Thus,

\[ \tau_d = t_{1D} \text{ sec.} \quad \langle 1 \rangle \]

\( t_{1D} \) is also the unit of time that is relevant in the computation of the inversion and splitting times.

The Inversion Time: It must be recalled that the two sectors of the physical universe -- the material and the cosmic -- are distinguished by the nature of the reference frames to which each belongs. The time-space region of our sector is reckoned from the standpoint of the stationary spatial frame of reference, while the space-time region of the cosmic sector is reckoned from the standpoint of the stationary temporal reference frame. The one-dimensional lifetime, \( t_{1D} \), was evaluated from a consideration of the kinetics of the entry from the space-time region to the time-space region.

However, in the inversion of the rotational units of the cosmic type to those of the material type, there is an additional factor to be taken into consideration. This is because, while the evanescent manifestation of a decaying c-atom in the material sector is analogous to the temporary sojourn of an alien visitor on a tourist visa, the scalar inversion amounts to nothing less than a complete
naturalization. The c-atom exists inside one natural unit of time, the 'space region' of the space-time sector, whereas the material atom (or particle) exists inside one natural unit of space, the 'time region' of the time-space sector. Consequently, the inversion of the c-atom involves the crossing of the unit time boundary as well as the unit space boundary. But since our observations and measurements are carried out in the time-space region, outside the unit space (time region), the additional factor we need to consider is that arising out of the crossing of the unit time boundary only.

The total number of possible directions -- the quantization of orientation, we may say -- in the time region that the scalar effect of the rotation can take is calculated by Larson [3] to be 156.44. Therefore, in the absence of any preferential direction, the probability, p, that the scalar inversion takes place in a unit of time (i.e., $t_{1D}$) would be $1/156.44$.

But this number, 156.44, is specifically applicable to the time region motion only in relation to our spatial zero point of view, or the analogous case of the space region motion in relation to the temporal zero point of view. As already mentioned, the inversion of the negative rotations (3)-(3)-0 to the positive rotations 1-1-0 is tantamount to switching the viewpoint from the negative zero to the positive zero. Although this entails no change from the natural standpoint, it amounts to a shifting of 8 displacement units from the standpoint of our stationary reference system [4]. In view of this 8-unit separation between the positive and negative zero points, the total number of positive orientations in the space region, namely 156.44 as reckoned from the negative zero standpoint, becomes $8 \times 156.44$, when reckoned from the positive zero standpoint. Consequently, the probability of inversion, p, becomes $1/(8 \times 156.44)$.

Over and above these, there is a numerical amplification arising out of the fact that x units measured from zero speed in time are equivalent to 8-x units measured from zero speed in space. Thus, one unit of motion in time "... the smallest amount that can exist, is equivalent to seven units measured from the spatial zero." [5]. Remembering that, whereas the previous factor 8 applies on the other side of the unit time boundary and therefore increases the total possibilities (i.e., reduces p), the factor 7 magnifies the motion on this side of the boundary and increases p. Thus we arrive at the value of the probability p as $7/(8 \times 156.44)$.

Since p is the probability that the inversion takes place in unit time, the mean time $\tau_i$, required for the completion of the inversion event is $1/p$. That is,

$$\tau_i = 8 \times (156.44/7) \times t_{1D} \text{ sec.}$$  \hspace{1cm} <2>
The Splitting Time: The splitting of the double rotating system 1-1-0 (three dimensions) to two of the two-dimensional rotations M 1/2-1/2-0 (four dimensions in all), involves one unit of time modified by the 4/3 dimensional factor, that is, $4/3 t_{1D}$. Here it may be argued that since after the inversion from (3)-(-3)-0 to 1-1-0 the motion has already crossed the unit speed boundary and arrived in the material sector proper, the time unit relevant is no longer the one-dimensional lifetime, $t_{1D}$ (which is applicable during the transition only), but the natural unit of time, $t_{nat}$. However, why this is not correct will be apparent in a moment.

It must be realized that the 1-1-0 combination is inherently unstable from the probability considerations [6], whereas the massless neutron, M 1/2-1/2-0, is a stable structure. Insofar as the scalar inversion from (3)-(-3)-0 leads to the improbable pattern 1-1-0, the splitting time, $T_s$, is negative. This is the same thing as saying, in common parlance, that a more probable condition is realized earlier than a less probable one. This clarifies the reason why $t_{1D}$ and not $t_{nat}$ is the pertinent time unit in the splitting. The time computation concerning any event after the 1-1-0 event requires consideration of $t_{nat}$ as the proper time unit since the event 1-1-0 marks the end of the inversion. But the M 1/2-1/2-0 event is before the 1-1-0 event and thus the relevant time unit is still $t_{1D}$. Thus,

$$T_s = -4/3 t_{1D} \text{ sec.}$$<3>

Finally, from the relations <1> <2> and <3> above, we have the apparent lifetime of c-argon as

$$T = T_d + T_i + T_s$$

= \[1 + (8 \times 156.44/7) - 4/3\] * 1.233148 * 10^{-8}

= 2.2007 * 10^{-6} \text{ sec.}

REFERENCES

3. Larson, Nothing But Motion, p. 34.
4. Ibid., p. 153
MINUTES OF THE BUSINESS MEETING OF THE SIXTH ANNUAL CONVENTION OF THE NEW SCIENCE ADVOCATES

Saturday, August 16, 1981, at the North American Rockwell Plant, Downey, California.

The business meeting of the New Science Advocates was called to-order at 2:00 by Frank Meyer, President. Sixteen members were present.

1. Treasurer Rainer Huck presented his report. The current balance is $1000.71. With $350.00 in loans outstanding, NSA has a net worth of $651.71. The Treasurer's report was approved.

2. The secretary then read minutes of the Fifth Annual Convention, held at the University of Alabama at Huntsville. The report was approved, but there was a question on one of the statements involving the availability of audio cassette tapes of Larson's talks. It was decided that all audio tapes currently held will be made available by the Reciprocity staff.

3. Reciprocity editor (and NSA president) Frank Meyer gave his report. He said that he had appointed Jan Sammer as senior editor and K.V.K. Nehru as associate editor. 975 copies of Vol. XI, no. 1 and 550 copies of Vol. XI, no. 2 of Reciprocity have been sent out. Meyer said that $250 was obtained from the NSA treasury and $600 raised privately to support the publication. Senior editor Sammer stated that paid subscribers are a must so that offset printing can be used (which will cost $300-$500 an issue). He said that the quality of Reciprocity will be improved in the future by use of a word processor. The reports of Meyer and Sammer were approved.

4. The president then called for Old Business.

(a) Phil Porter, chairman of the Name Change Committee, strongly urged that the name of our organization be changed to something more dignified. He presented a list of 11 new names. Member Nehru suggested a 12th new name: "International Society for Unified Science." Secretary Satz suggested that the no. 2 name on the list be prefixed by "International." Porter's procedure was followed to eliminate names; each proposed name to be voted on must have two seconds. In this manner the 13 names were reduced to these four:

International Society for Unified Science
Unified Science Institute
Institute of Unified Science
International Institute of Unified Science
Both names had 7 votes. Then a motion was made to change the word "for" in the first name to "of." Upon a revote, after approval of the motion, this name won over the second, 9 to 7. Porter then moved and Norris seconded that this new name be adopted to replace the name "New Science Advocates." The motion carried, 13 for, none against. Thus the new name of our organization is:

International Society of Unified Science

Treasurer Huck will notify the IRS in Utah of the name change.

(b) Maurice Gilroy, acting as chairman of the Committee to Improve Reciprocity, read some portions of correspondence between him and Elkin and Satz. It was agreed by the Committee to adopt the forms (with some modifications) developed by Satz. After discussion, member Blackburn moved and Norris seconded that these new forms for Reciprocity be adopted. The motion carried unanimously.

Other members suggested improvements of Reciprocity. Meyer asked if there were some means to raise a fund of $10,000 for the publication; but no ideas were put forth. Larson volunteered to contribute the chapters of the second volume of the new edition of The Structure of the Physical Universe as papers for Reciprocity. This should certainly improve the quality of our newsletter-journal. One other suggestion was made to send Reciprocity to all appropriate libraries in the world.

5. The president then returned to New Business.

(a) He appointed Gilroy, Sammer, Satz, and Elkin to the Committee to Increase Subscriptions to Reciprocity, with Gilroy as chairman. The report is expected for the next convention.

(b) Sammer moved and Huck seconded that the subscription price for Reciprocity be increased to $5/yr. The motion was passed.

(c) Sims moved and Halprin seconded that membership dues be increased to $20/yr. The motion was defeated. Satz moved and Gordon Wright seconded that dues be increased to $15/yr. The motion carried.

6. Next, elections of board members and officers were held.

(a) In the election for membership to the board, eight members were nominated: Nehru, Sammer, Long, Gilroy, Brown, Sims, Lefever, Norby. The five elected were Sims, Norby,
Nehru, Sammer, and Gilroy. Thus the 1981-1982 board consists of these five plus Anderson, Berline, Blackburn, Huck, Meyer, Satz, Studtmann, Porter, Halprin, and Elkin.

(b) Huck won re-election to treasurer by acclamation, as did Satz for secretary.

(c) For vice-president, the nominees were Gilroy, Blackburn, Sammer, and Halprin. Blackburn was elected.

(d) For president, Meyer was re-elected by acclamation.

7. After discussion, and some changes of mind, members voted to hold next year's convention in Philadelphia, rather than Vancouver, B.C.

8. Gilroy moved and Satz seconded to give thanks to our California hosts, Richard Long and Hal Norris. Of course, the motion carried unanimously.

9. The meeting adjourned at 5:22.

Ronald W. Satz Secretary, International Society of Unified Science.
Dewey B. Larson, like Copernicus, is a scientific revolutionary. I am pretty well convinced that Larson has made a fundamental breakthrough in our understanding of the physical universe, just as Copernicus (1473-1543) made a fundamental breakthrough in our understanding of the solar system.

Copernicus' proposals, however, contained a serious shortcoming, one which resulted in discrepancies between theory and observation, and thus substantially delayed general acceptance of Copernicus' ideas. Copernicus correctly concluded that the sun, not the earth, is at the center of the solar system. But he incorrectly assumed that the planets traveled around the sun in circles.[2] Perversely, this produced theoretical results which diverged from observation more than did the predictions of Ptolemaic theory, cleaned up with the aid of "epicycles." Kepler (1571-1630) brought Copernicus' proposals to a closer agreement with observations by showing that planetary orbits around the sun are elliptical rather than circular. In the process, he paved the way for Newton (1642-1727) to formulate his laws of gravitation and motion.

I was one of the "founding fathers" of the New Science Advocates and of Reciprocity. I regularly teach college courses in which Larson's ideas are examined very sympathetically. I greatly admire Larson, take his ideas very seriously, and regard him as a very dear personal friend. He may well go down in the history of science as equal to Copernicus, Newton, and Einstein combined. There is always the possibility that his proposals resemble Copernicus' in more ways than one. Even so I think we cannot afford to act on the premise that Larson's present formulations are the end of the road. We must seek to build on Larson's accomplishments and look to the future.

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1. "Habet quisque omni tempore quod agat, quaerat, corrigat, atque augeat" -- At all times there is something for each one to do, to search, to correct and to add.

2. A basic proposition in my recently published textbook (Thinking about Politics: American Government in Associational Perspective D. Van Nostrand Co., New York, 1981) -- which, incidentally, is dedicated to Larson and was greatly influenced by him -- is that "all political discourse is a mixture of sense and nonsense"; but this rule does not apply only to political discourse.
ANNOUNCEMENTS


Dewey Larson's book on scalar motions, The Neglected Facts of Modern Science, is due to be published in the spring of 1982. Copies may be reserved by writing to North Pacific Publishers, Box 13255, Portland, Oregon 97213.

A tape recording of Larson's address on "Scalar Motion," published in this issue, is available on cassette. For information write to Jan Sammer, 78 Hartley Avenue, Princeton, NJ, 08540.

Annual subscription to Reciprocity is $5.00. Single issues: $1.50. Reciprocity is sent free to members of the International Society of Unified Science. Annual ISUS dues of $15.00 also entitle members to attend and vote at the Society's annual conventions.
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A PROPOSAL FOR A CRUCIAL EXPERIMENT

by Ronald W. Satz

SOLID COHESION with Preface to BASIC PROPERTIES OF MATTER

by Dewey B. Larson

We begin the serialization of Dewey B. Larson's *Basic Properties of Matter*, the second volume of a revised and enlarged edition of *The Structure of the Physical Universe* (1959).

PHOTOIONIZATION AND PHOTOMAGNETIZATION

by Ronald W. Satz

Both Quantum Mechanics and the Reciprocal System attempt to explain the two phenomena. Which is more in agreement with observations?

ARE COSMIC RAY PROTONS PRIMARY?

by Frank H. Meyer

A new discovery confirms a prediction of the Reciprocal System.

================================================================

A PROPOSAL FOR A CRUCIAL EXPERIMENT

by Ronald W. Satz

Rutherford's nuclear theory of the atom has held sway in the scientific community for 70 years. I now propose a test which may disprove it. In the original scattering experiment, charged helium atoms (alpha particles) were beamed at a gold foil; the resultant scattering was claimed to be due to Coulombic repulsion by charged nuclei. Now suppose that that non-charged helium atoms are beamed at a gold foil. The Reciprocal System of Theory predicts the same scattering in this case. The Rutherford theory predicts no scattering.

Of course, experimenting with non-charged helium atoms is more difficult than with charged ones. The scattering apparatus will have to incorporate a means to inject electrons to neutralize the alpha particles and a different material to detect the particles after scattering.

Numerous physics laboratories in the world have the capability to carry out this experiment. Which will be the first?
Preface to BASIC PROPERTIES OF MATTER

by Dewey B. Larson

This volume is the second in a series in which I am undertaking to develop the consequences that necessarily follow if it is postulated that the physical universe is composed entirely of motion. The characteristics of the basic motion were defined in Nothing But Motion, the first volume of the series, in the form of seven assumptions as to the nature and interrelation of space and time. In the subsequent development, the necessary consequences of these assumptions have been derived by logical and mathematical processes without the introduction of any supplementary or subsidiary assumptions, and without introducing anything from experience. Coincidentally with this theoretical development, it has been shown that the conclusions thus reached are consistent with the relevant data from observation and experiment, wherever a comparison can be made. This justifies the assertion that, to the extent to which the development has been carried, the theoretical results constitute a true and accurate picture of the actual physical universe.

In a theoretical development of this nature, starting from a postulate as to the fundamental nature of the universe, the first results of the deductive process necessarily take the form of conclusions of a basic character: the structure of matter, the nature of electromagnetic radiation, etc. Inasmuch as these are items that cannot be apprehended directly, it has been possible for previous investigators to formulate theories of an ad hoc nature in each individual field to fit the limited, and mainly indirect, information that is available. The best that a correct theory can do in any one of these individual areas is to arrive at results that also agree with the available empirical information. It is not possible, therefore, to grasp the full significance of the new development unless it is recognized that the new theoretical system, the Reciprocal System, as we call it, is one of general application, one that reaches all of its conclusions in all physical fields by deduction from the same set of basic premises.

Experience has indicated that it is difficult for most individuals to get a broad enough view of the fundamentals of the many different branches of physical science for a full appreciation of the unitary character of this new system. However, as the deductive development is continued, it gradually extends down into the more familiar areas, where

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the empirical information is more readily available, and less subject to arbitrary adjustment or interpretation to fit the prevailing theories. Thus the farther the development of this new general physical theory is carried, the more evident its validity becomes. This is particularly true where, as in the subject matter treated in this present volume, the theoretical deductions provide both explanations and numerical values in areas where neither is available from conventional sources.

SOLID COHESION

The consequences of the reversal of direction (in the context of a fixed reference system) that takes place at unit distance were explained in a general way in chapter 8 of Volume I. As brought out there, the most significant of these consequences is that establishment of an equilibrium between gravitation and the progression of the natural reference system becomes possible.

There is a location outside unit distance where the magnitudes of these two motions are equal: the distance that we are calling the gravitational limit. But this point of equality is not a point of equilibrium. On the contrary, it is a point of instability. If there is even a slight unbalance of forces one way or the other, the resulting motion accentuates the unbalance. A small inward movement, for instance, strengthens the inward force of gravitation, and thereby causes still further movement in the same direction. Similarly, if small outward movement occurs, this weakens the gravitational force and causes further outward movement. Thus, even though the inward and outward motions are equal at the gravitational limit, this is actually nothing but a point of demarcation between inward and outward motion. It is not a point of equilibrium.

In the region inside unit distance, on the contrary, the effect of any change in position opposes the unbalanced forces that produced the change. If there is an excess gravitational force, an outward motion occurs which weakens and eliminates the unbalance. If the gravitational force is not adequate to maintain a balance, an inward motion takes place. This increases the gravitational effect and restores the equilibrium. Unless there is some intervention by external forces, atoms move gravitationally until they eventually come within unit distance of other atoms. Equilibrium is then established at positions within this inside region: the time region, as we have called it.

The condition in which a number of atoms occupy equilibrium positions of this kind in an aggregate is known
as the solid state of matter. The distance between such positions is the inter-atomic distance, a distinctive feature of each particular material substance that we will examine in detail in the following chapter. Displacement of the equilibrium in either direction can be accomplished only by the application of a force of some kind, and a solid structure resists either an inward force, a compression, or an outward force, a tension. To the extent that resistance to tension operates to prevent separation of the atoms of a solid it is commonly known as the force of cohesion.

The conclusions with respect to the nature and origin of atomic cohesion that have been reached in this work replace a familiar theory, based on altogether different premises. This previously accepted hypothesis, the electrical theory of matter, has already had some consideration in the preceding volume, but since the new explanation of the nature of the cohesive force is basic to the present development, some more extensive comparisons of the two conflicting viewpoints will be in order before we proceed to develop the new theoretical structure in greater detail.

The electrical, or electronic, theory postulates that the atoms of solid matter are electrically charged, and that their cohesion is due to the attraction between unlike charges. The principal support for the theory comes from the behavior of ionic compounds in solution. A certain proportion of the molecules of such compounds split up, or dissociate, into oppositely charged components which are then called ions. The presence of the charges can be explained in either of two ways: (1) the charges were present, but undetectable, in the undissolved material, or (2) they were created in the solution process. The adherents of the electrical theory base it on explanation (1). At the time this explanation was originally formulated, electric charges were thought to be relatively permanent entities, and the conclusion with respect to their role in the solution process was therefore quite in keeping with contemporary scientific thought. In the meantime, however, it has been found that electric charges are easily created and easily destroyed, and are no more than a transient feature of matter. This cuts the ground from under the main support of the electrical theory, but the theory has persisted because of the lack of any available alternative.

Obviously some kind of a force must hold the solid aggregate together. Outside of the forces known to result directly from the observable motion, there are only three kinds of force of which there has heretofore been any definite observational knowledge: gravitational, electric and magnetic. The so-called "forces" which play various roles in present-day atomic physics are purely hypothetical. Of the
three known forces, the only one that appears to be strong enough to account for the cohesion of solids is the electric force. The general tendency in scientific circles has therefore been to take the stand that cohesion must result from the operation of electrical forces, notwithstanding the lack of any corroboration of the conclusions reached on the basis of the solution process, and the existence of strong evidence against the validity of those conclusions.

One of the serious objections to this electrical theory of cohesion is that it is not actually a theory, but a patchwork collection of theories. A number of different explanations are advanced for what is, to all appearances, the same problem. In its basic form, the theory is applicable only to a restricted class of substances, the so-called "ionic" compounds. But the great majority of compounds are "non-ionic." Where the hypothetical ions are clearly nonexistent, an electrical force between ions cannot be called upon to explain the cohesion, so, as one of the general chemistry tests on the author's shelves puts it, "A different theory was required to account for the formation of these compounds." But this "different theory," based on the weird concept of electrons "shared" by the interacting atoms, is still not adequate to deal with all of the non-ionic compounds, and a variety of additional explanations are called upon to fill the gaps.

In current chemical parlance the necessity of admitting that each of these different explanations is actually another theory of cohesion is avoided by calling them different types of "bonds" between the atoms. The hypothetical bonds are then described in terms of interaction of electrons, so that the theories are united in language, even though widely divergent in content. As noted in Chapter 19, Vol. I, a half dozen or so different types of bonds have been postulated, together with "hybrid" bonds which combine features of the general types.

Even with all of this latitude for additional assumptions and hypotheses, some substances, notably the metals, cannot be accommodated within the theory by any expedient thus far devised. The metals admittedly do not contain oppositely charged components, if they contain any charged components at all, yet they are subject to cohesive forces that are indistinguishable from those of the ionic compounds. As one prominent physicist, V. F. Weisskopf, found it necessary to admit in the course of a lecture, "I must warn you I do not understand why metals hold together." Weisskopf points out that scientists cannot even agree as to the manner in which the theory should be applied. Physicists give us one answer, he says, chemists another, but "neither of these answers is adequate to explain what a chemical bond is."[1]
This is a significant point. The fact that the cohesion of metals is clearly due to something other than the attraction between unlike charges logically leads to a rather strong presumption that atomic cohesion in general is non-electrical. As long as some non-electrical explanation of the cohesion of metals has to be found, it is reasonable to expect that this explanation will be found applicable to other substances as well. Experience in dealing with cohesion of metals thus definitely foreshadows the kind of conclusions that have been reached in the development of the Reciprocal System of theory.

It should also be noted that the electrical theory is entirely ad hoc. Aside from what little support it can derive from extrapolation to the solid state of the conditions existing in solutions, there is no independent confirmation of any of the principal assumptions of the theory. No observational indication of the existence of electrical charges in ordinary matter can be detected, even in the most strongly ionic compounds. The existence of electrons as constituents of atoms is purely hypothetical. The assumption that the reluctance of the inert gases to enter into chemical compounds is an indication that their structure is a particularly stable one is wholly gratuitous. And even the originators of the idea of "sharing" electrons make no attempt to provide any meaningful explanation of what this means, or how it could be accomplished, if there actually were any electrons in the atomic structure. These are the assumptions on which the theory is based, and they are entirely without empirical support. Nor is there any solid basis for what little theoretical foundation the theory may claim, inasmuch as its theoretical ties are to the nuclear theory of atomic structure, which is itself entirely ad hoc.

But these points, serious as they are, can only be regarded as supplementary evidence, as there is one fatal weakness of the electrical theory that would demolish it even if nothing else of an adverse nature were known. This is our knowledge of the behavior of positive and negative electric charges when they are brought into close proximity. Such charges do not establish an equilibrium of the kind postulated in the theory; they destroy each other. There is no evidence which would indicate that the result of such contact is any different in a solid aggregate, nor is there even any plausible theory as to why any different outcome could be expected, or how it could be accomplished.

It is worth noting in this connection that while current physical theory portrays positive and negative charges as existing in a state of congenial companionship in the nuclear theory of the atom and in the electrical theory of matter, it
turns around and gives us explanations of the behavior of antimatter in which these charges display the same violent antagonism that they demonstrate to actual observation. This is the kind of inconsistency that inevitably results when recalcitrant problems are "solved" by ad hoc assumptions that involve departures from established physical laws and principles.

In the context of the present situation in which the electrical theory is challenged by a new development, all of these deficiencies and contradictions that are inherent in the electrical theory become very significant. But the positive evidence in favor of the new theory is even more conclusive than the negative evidence against its predecessor. First, and probably the most important, is the fact that we are not replacing the electrical theory of matter with another "theory of matter." The Reciprocal System is a complete general theory of the physical universe. It contains no hypotheses other than those relating to the nature of space and time, and it produces an explanation of the cohesion of solids in the same way that it derives logical and consistent explanations of other physical phenomena: simply by developing the consequences of the basic postulates. We therefore do not have to call upon any additional force of a hypothetical nature to account for the cohesion. The two forces that determine the course of events in the region outside unit distance also account for the existence of the inter-atomic equilibrium inside this distance.

It is significant that the new theory identifies both these forces. One of the major defects of the electrical theory of cohesion is that it provides only one force, the hypothetical electrical force of attraction, whereas two forces are required to explain the observed situation. Originally it was assumed that the atoms are impenetrable, and that the electrical forces merely hold them in contact. Present-day knowledge of compressibility and other properties of solids has demolished this hypothesis, and it is now evident that there must be what Karl Darrow called an "antagonist," in the statement quoted in Volume I, to counter the attractive force, whatever it may be, and produce an equilibrium. Physicists have heretofore been unable to find any such force, but the development of the Reciprocal system has now revealed the existence of a powerful and omnipresent force hitherto unknown to science. Here is the missing ingredient in the physical situation, the force that not only explains the cohesion of solid matter, but, as we saw in Volume I, supplies the answers to such seemingly far removed problems as the structure of star clusters and the recession of the galaxies.
One point that should be specifically noted is that it is this hitherto unknown force, the force due to the progression of the natural reference system, that holds the solid aggregate together, not gravitation, which acts in the opposite direction in the time region. The prevailing opinion that the force of gravitation is too weak to account for the cohesion is therefore irrelevant, whether it is correct or not.

Inasmuch as the new theoretical system applies the same general principles to an understanding of all of the inter-atomic and inter-molecular equilibria, it explains the cohesion of all substances by the same physical mechanism. It is no longer necessary to have one theory for ionic substances, several more for those that are non-ionic, and to leave the metals out in the cold without any applicable theory. The theoretical findings with respect to the nature of chemical combinations and the structure of molecules that were outlined in the preceding volume have made a major contribution to this simplification of the cohesion picture, as they have eliminated the need for different kinds of cohesive forces, or "bonds." All that is now required of a theory of cohesion is that it supply an explanation of the inter-atomic equilibrium, and this is provided, for all solid substances under all conditions, by balancing the outward motion (force) of gravitation against the inward motion (force) of the progression of the natural reference system. Because of the asymmetry of the rotational patterns of the atoms of many elements, and the consequent anisotropy of the force distributions, the equilibrium locations vary not only between substances, but also between different orientations of the same substance. Such variations, however, affect only the magnitudes of the various properties of the atoms. The essential character of the inter-atomic equilibrium is always the same.

As indicated in the original discussion of gravitation, even though the various aggregates of matter do not actually exert gravitational forces on each other, the observable results of their gravitational motions are identical with those that would be produced if such forces did exist. The same is true of the results of the progression of the natural reference system. There is a considerable element of convenience in expressing these results in terms of force, on an "as if" basis, and this practice has already been followed to some extent in the previous volume. Now that we are ready to begin a quantitative evaluation of the inter-atomic relations, however, it is desirable to make it clear that the force concept is being used only for convenience. Although the quantitative discussion that follows, like the earlier qualitative discussion, will be carried on in terms of forces, what we will actually be dealing with are the inward
and outward motions of each individual atom.

While the items that have been mentioned add up to a very impressive case in favor of the new theory of cohesion, the strongest confirmation of its validity comes from its ability to locate the point of equilibrium; that is to give us specific values of the inter-atomic distances. As will be demonstrated in Chapter 2, we are already able, by means of the newly established relations, to calculate the possible values of the inter-atomic distance for most of the simpler substances, and there do not appear to be any serious obstacles in the way of extending the calculations to more complex substances whenever the necessary time and effort can be applied to the task. Furthermore, this ability to determine the location of the point of equilibrium is not limited to the simple situation where only the two basic forces are involved. Chapters 4 and 5 will show that the same general principles can also be applied to an evaluation of the changes in the equilibrium distance that result from the application of heat or pressure to the solid aggregate.

Although, as stated in Volume I, the true magnitude of a unit of space is the same everywhere, the effective magnitude of a spatial unit in the time region is reduced by the inter-regional ratio. It is convenient to regard this reduced value, \(1/156.44\) of the natural unit, as the time region unit of space. The effective portion of a time region phenomenon may extend into one or more additional units, in which case the measured distance will exceed the time region unit, or the original single unit may not be fully effective, in which case the measured distance will be less than the time region unit. Thus the inter-atomic equilibrium may be reached either inside or outside the time region unit of distance, depending on where the outward rotational forces reach equality with the inward force of the progression of the natural reference system. Extension of the inter-atomic distance beyond one time region unit does not take the equilibrium system out of the time region, as the boundary of that region is at one full-sized natural unit of distance, not at one time region unit. So far as the inter-atomic force equilibrium is concerned, therefore, the time region unit of distance does not represent any kind of a critical magnitude.

As we saw in our examination of the composition of the magnetic neutral groups, however, the natural unit as it exists in the time region (the time region unit) is a critical magnitude from the orientation standpoint. An explanation of this difference can be derived from a consideration of the difference in the inherent nature of the two phenomena. Where the inter-atomic distance is less than one time region unit, the rotational forces are acting
against the inward force of the progression of the reference system during only a portion of the unit progression. Similarly, where the inter-atomic distance is greater than one time region unit, the unit inward force is acting against only a portion of the greater-than-unit outward rotational forces. The variations in distance thus reflect differences in the magnitudes of the rotational forces. But the orientation effect has no magnitude. It either exists, or does not exist. As we have noted in the previous discussion, particularly in connection with the structure of the benzene molecule, this effect, if it exists, is the same regardless of whether it acts at short range or at long range. The essential requirement that it must meet is that it must be continuously effective. Otherwise, the orientation is destroyed during the off period. Where the rotational forces extend beyond one time region unit, so that the unit orientation effect is coincident with only a portion of the total rotational forces, the orienting effect is not continuous, and no orientation takes place.

In this chapter we are dealing mainly with what we are calling "rotational forces." These are, of course, the same "as if" forces due to the scalar aspect of the atomic rotation that were called "gravitational" in some other contexts, the choice of language depending on whether it is the origin or the effect of the force that is being emphasized in the discussion. For a quantitative evaluation of the rotational forces we may use the general force equation, providing that we replace the usual terms of the equation with the appropriate time region terms. As explained in introducing the concept of the time region in Chapter 8 of Vol. I, equivalent space $l/t$ replaces space in the time region, and velocity is therefore $1/t^2$. Energy, the one-dimensional equivalent of mass, which takes the place of mass in the time region expression of the force equation, because the three rotations of the atom act separately, rather than jointly, in this region, is the reciprocal of this expression, or $t^2$. Acceleration is velocity divided by time: $1/t^3$. The time region equivalent of the equation $F = ma$ is therefore $F = Ea = t^2 x 1/t^3 = 1/t$ in each dimension.

At this point we will need to take note of the nature of the increments of speed displacement in the time region. In the outside region additions to the displacement proceed by units: first one unit, then another similar unit, yet another, and so on, the total up to any specific point being $n$ units. There is no term with the value $n$. This value appears only as a total. The additions in the time region follow a different mathematical pattern, because in this case only one of the components of motion progresses, the other remaining fixed at the unit value. Here the displacement is $1/x$, and the sequence is $1/1$, $1/2$, $1/3$ . . . $1/n$. The
quantity $1/n$ is the final term, not the total. To obtain the total that corresponds to $n$ in the outside region it is necessary to integrate the quantity $1/x$ from $x = 1$ to $x = n$. The result is $\ln n$, the natural logarithm of $n$.

Many readers of the first edition have asked why this total should be an integral rather than a summation. The answer is that we are dealing with a continuous quantity. As pointed out in the introductory chapters of the preceding volume, the motion of which the universe is constructed does not proceed in a succession of jumps. Even though it exists only in units, it is a continuous progression. A unit of this motion is a specific portion of this continuity. A series of units is a more extended segment of that continuity, and its magnitude is an integral. In dealing with the basic individual units of motion in the outside region it is possible to use the summation process, but only because in this case the sum is the same as the integral. To get the total of the $1/x$ series we must integrate.

To evaluate the rotational force we integrate the quantity $1/t$ from unity, the physical datum or zero level, to $t$:

$$F_r = \int_1^t \frac{1}{t} \times dt = \ln t \quad \text{(1-1)}$$

If the quantity $\ln t$ is below unity in any dimension there is no effective outward force in that dimension, but the natural logarithm exceeds unity for all values of $x$ above 2, and the atoms of all elements have a rotational displacement of 2 (equivalent to $t = 3$) or more in at least one dimension. Consequently, all have effective rotational forces.

The force computed from equation 1-1 is the inherent rotational force of the individual atom; that is, the one-dimensional force which it exerts against a single unit of force. The force between two (apparently) interacting atoms is

$$F = \ln t_A \ln t_B \quad \text{(1-2)}$$

For a two-dimensional magnetic rotation this becomes

$$F = \ln^2 t_A \ln^2 t_B \quad \text{(1-3)}$$

As we found in Chapter 12, Vol. I, the equivalent of distance $s$ in the time region is $s^2$, and the gravitational force in this region therefore varies inversely as the fourth power of the distance rather than the square. Applying this factor to the expression for the force of the two-dimensional rotation, together with the inter-regional ratio, the ratio of effective to total force derived in the same chapter, we obtain the effective force of the magnetic rotation of the atom.
\[ F_m = (0.006392)^4 s^{-4} \ln^2 t_A \ln^2 t_B \]  \hspace{1cm} \langle 1-4 \rangle

The distance factor does not apply to the force due to the progression of the natural reference system, as this force is omnipresent, and unlike the rotational force is not altered as the objects to which it is applied change their relative positions. At the point of equilibrium, therefore, the rotational force is equal to the unit force of the progression. Substituting unity for \( F \) in equation 1-4, and solving for the equilibrium distance, we obtain

\[ s_0 = 0.006392 \ln^{1/2} t_A \ln^{1/2} t_B \]  \hspace{1cm} \langle 1-5 \rangle

The inter-atomic distances for those elements which have no electric rotation, the inert gas series, may be calculated directly from this equation. In the elements, however, \( t_A = t_B \) in most cases, and it will be convenient to express the equation in the simplified form:

\[ s_0 = 0.006392 \ln t \]  \hspace{1cm} \langle 1-6 \rangle

The values thus calculated are in the neighborhood of \( 10^{-8} \) cm, and for convenience this quantity has been taken as a unit in which to express the inter-atomic and inter-molecular distances. When converted from natural units to this conventional unit, the Angstrom unit, symbol \( \AA \), equation 1-6 becomes

\[ s_0 = 2.914 \ln t \]  \hspace{1cm} \langle 1-7 \rangle

In applying this equation we encounter another of the questions with respect to terminology that inevitably arise in a basically new treatment of any subject. The significance of the quantity \( t \) as used in the foregoing discussion and in the equations is obvious from the context -- it is the magnitude of the effective rotation -- but the question is: What shall we call it? The basic quantity with which we are dealing, the rotational speed displacement, does not enter into the equations directly. The mathematical structure of these equations requires us to enter them with values that include the initial unit which constitutes the natural zero datum. Furthermore, each double vibrational unit rotates independently, and when the rotation extends to a second such unit the increment in the value of \( t \) is only one half unit per added unit of displacement. Under these circumstances, where the relation of the term \( t \) to the displacement is variable, it seems advisable to give this term a distinctive name, and we will therefore call in the specific rotation.
As brought out in the discussion of the general characteristics of the atomic rotation in Chapter 10, Vol. I, the two magnetic displacements may be unequal, and in this event the speed distribution takes the form of a spheroid with the principal rotation effective in two dimensions and the subordinate rotation in one. The average effective value of the specific rotation under these conditions is \( \left( \frac{t_1^2 + t_2^2}{2} \right)^{1/2} \).

In this case we are dealing with the properties of a single entity, and the mathematical situation seems clear. But it is not so evident how we should arrive at the effective specific rotation where there is an interaction between two atoms whose individual rotations are different. As matters now stand it appears that the geometric mean of the two specific rotations is the correct quantity, and the values tabulated in Chapters 2 and 3 have been calculated on this basis. It should be noted, however, that this conclusion as to the mathematics of the combination is still somewhat tentative, and if further study shows that it must be modified in some, or all, applications, the calculated values will be subject to corresponding modifications. Any changes will be small in most cases, but they will be substantial where there is a large difference between the two components. The absence of major discrepancies between the calculated and observed distances in combinations of atoms with much different dimensions therefore gives some significant support to the use of the geometric mean pending further theoretical clarification.

The inter-atomic distances of four of the five inert gas elements for which experimental data are available follow the regular pattern. The values calculated for these elements are compared with the experimental distances in Table I. Helium, which also belongs to the inert gas series, has some special characteristics due to its low rotational displacement, and will be discussed in connection with other elements affected by the same factors. The reason for the appearance of the 4 1/2 value in the xenon rotation will also be explained shortly.

The calculated distances are those which would prevail in the absence of compression and thermal expansion. A few of the experimental data have been extrapolated to this zero base by the investigators, but most of them are the actual observed values at atmospheric pressure and at temperatures which depend on the properties of the substances under examination. These values are not exactly comparable to the calculated distances. In general, however, the expansion and compression up to the temperature and pressure of observation are small. A comparison of the values in the last two columns of Table I and the similar tables in chapters 2 and 3 therefore gives a good picture of the extent of agreement between the theoretical figures and the experimental results.
Another point about the distance correlations that needs to be taken into account is that there is a substantial amount of variation in the experimental results.

**TABLE I**

DISTANCES - INERT GAS ELEMENTS

<table>
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<tr>
<th>Atomic Number</th>
<th>Element</th>
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<th>Distance Calc.</th>
<th>Obs.</th>
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</table>

If we were to take the closest of these measured values as the basis for comparison, the correlation would be very much better. One relatively recent determination of the xenon distance, for example, arrives at a value of 4.34, almost identical with the calculated distance. There are also reported values for the argon distance that agree more closely with the theoretical result. However, a general policy of using the closest values would introduce a bias that would tend to make the correlation look more favorable than the situation actually warrants. It has therefore been considered advisable to use empirical data from a recognized selection of preferred values. Except for those values identified by asterisks, all of the experimental distances shown in the tables are taken from the extensive compilation by Wyckoff. [2] Of course, the use of these values selected on the basis of indirect criteria introduces a bias in the unfavorable direction, since, if the theoretical results are correct, every experimental error shows up as a discrepancy, but even with this negative bias the agreement between theory and observation is close enough to show that the theoretical determination of the inter-atomic distance is correct in principle, and to demonstrate that, with the exception of a relatively small number of uncertain cases, it is also correct in the detailed application.

Turning now to the elements which have electric as well as magnetic displacement, we note again that the electric rotation is one-dimensional and opposes the magnetic rotation. We may therefore obtain an expression for the effect of the electric rotational force on the magnetically rotating photon by inverting the one-dimensional force term of equation 1-2.

\[ F_e = \frac{1}{\ln t'_A \ln t'_B} \quad \text{<1-8>} \]
Inasmuch as the electric rotation is not an independent motion of the basic photon, but a rotation of the magnetically rotating structure in the reverse direction, combining the electric rotational force of equation 1-8 with the magnetic rotational force of equation 1-4 modifies the rotational terms (the functions of $t$) only, and leaves the remainder of equation 1-4 unchanged.

$$F = (0.006392)^4 \frac{(\ln^2 t_A \ln^2 t_B)/(s^4 \ln t'_A \ln t'_B)}$$  \text{<1-9>}

Here again the effective rotational (outward) and natural reference system progression (inward) forces are necessarily equal at the equilibrium point. Since the force of the progression of the natural reference system is unity, we substitute this value for $F$ in equation 1-9 and solve for $s'$, the equilibrium distance, as before.

$$s_0 = 0.006392 [(\ln^{1/2} t_A \ln^{1/2} t_B)/(\ln^{1/4} t'_A \ln^{1/4} t'_B)]$$ \text{<1-10>}

Again simplifying for application to the elements, where $A$ is generally equal to $B$,

$$s_0 = 0.006392 \ln t/\ln^{1/2} t'$$ \text{<1-11>}

In Angstrom units this becomes

$$s_0 = 2.914 \ln t/\ln^{1/2} t'_A$$ \text{<1-12>}

As already noted, when the rotation is extended to a second (double) vibrational unit, to vibration two, we may say, each added displacement unit adds only one half unit to the specific rotation. Inasmuch as 8 electric displacement units distributed three-dimensionally bring the rotation to a new zero point, and cause the rotational motion to revert to the translational status, the change to vibration two in the electric dimension must take place before the displacement reaches 8. Specific rotation 8 (displacement 7) is therefore followed by 8 $1/2$, 9, $9 1/2$, etc. But the first effective rotational displacement unit is necessarily one-dimensional, and the linear equivalent of the 8-unit limit is 2 units. Thus this first unit has already reached the one-dimensional limit. The succeeding displacement units have the option of continuing on the one-dimensional basis and extending the rotation to vibration two rather than extending it into additional dimensions. The change to vibration two therefore may take place immediately after the first displacement unit. In this case specific rotation 2 (displacement 1) is followed by 2 $1/2$, 3, $3 1/2$, etc. The lower value is commonly found where it first becomes possible; that is, displacement 2 normally corresponds to rotation 2 $1/2$ rather than 3. The next element may take the intermediate value 3 $1/2$, but
beyond this point the higher vibration one value normally prevails.

In the first edition it was indicated that the one or two vibrational displacement units being rotated did not necessarily constitute the entire vibrational component of the basic photon, inasmuch as these one or two units are capable of being rotated independently of the remaining vibrational units, if any. Further consideration now leads to the conclusion that one or two units of a multi-unit photon frequency can, in fact, be set in rotation independently, as previously indicated, and that the original photon may have had an excess of vibrational units, but that in such an event the rotating portion of the photon begins moving inward, whereas the nonrotating portion continues moving outward by reason of the progression of the natural reference system. The two portions therefore separate, and the rotating portion retains no non-rotating vibrational component.

The general pattern of the magnetic rotational values is the same as that of the electric values. The tendency to substitute specific rotation 2 1/2 for 3 applies to the magnetic as well as to the electric rotation, and in the lower group combinations (both elements and compounds) that follow the regular electropositive pattern the specific magnetic rotations are usually 2 1/2 - 2 1/2 or 3 - 2 1/2, rather than 3-3. But the upper limit for specific magnetic rotation on a vibration one basis is 4 (three displacement units) instead of 8, as the two-dimensional rotation reaches the upper zero level at 4 displacement units. Rotation 4 1/2 therefore follows rotation 4 in the regular sequence, as we saw in the values given for xenon in Table I. It is possible to reach rotation 5 in one dimension, however, without bringing the magnetic rotation as a whole up to the 5 level, and 5-4 or 5 - 4 1/2 rotation occurs in some elements either in lieu of, or in combination with, the 4 1/2 - 4 or 4 1/2 - 4 1/2 rotation.

* * *


PHOTOIONIZATION AND PHOTOMAGNETIZATION

by Ronald W. Satz

Introduction: the Reciprocal System vs. Present Theory

Consider a group of atoms in an electric field and bombarded with ultraviolet photons or a group of atoms in a magnetic field and bombarded with radio photons. What happens? Two theories exist that can give an answer: Quantum Mechanics and the Reciprocal system. Both are quantized, but the first is a matter-structure theory, whereas the second is a motion-process theory. Quantum Mechanics considers atoms to consist of various subatoms which have intrinsic charge, magnetic moment, and angular momentum; the atom's charge, moment, and momentum are derived from that of its subatoms. The Reciprocal system views atoms as composed of two photons, each having rotational motion in three dimensions; the atom has no intrinsic electric charge or magnetic moment — electric and magnetic effects result from additions of rotational vibratory motions to the base rotational motions.

Quantum Mechanics' explanation of electric ionization is that previously existing charged particles, the protons and electrons, are separated; the Reciprocal System's explanation is that the positive and negative charges are created in the process, and thus have no prior existence. Quantum Mechanics' explanation of the magnetic resonance experiments is that the experimenters have found intrinsic magnetic moments of nuclei; the Reciprocal System's explanation is that the experimenters have induced temporary magnetic charges in their material. Quantitative details of both theories will now be examined. (Full comprehension of this paper requires previous reading of two of D. B. Larson's books, Refs. 1 and 2, and one of my papers, Ref. 3.)

I. Photoionization

A. Subatoms

1. Present theory.

According to present thought, the electric charge is unanalyzable and undefined, except operationally. Either a particle has or does not have an intrinsic electric charge — there is no possibility of ionizing an uncharged subatom.

Present photoelectric theory states that, upon absorption of a sufficiently energetic photon, a pre-existing charged electron is ejected from its atom to move in an external circuit. [4,5] The energy necessary to tear the electron loose is called the work function of the material. No
commonly accepted equation for the work function, based on Quantum Mechanics, exists.

2. Reciprocal System

For details of subatom and atom motions, see Refs. 1, 2, and 3. In the Reciprocal System, electric charge is not an intrinsic feature of a subatom; rather, charges may be created or destroyed, not necessarily in pairs, and thus charge conservation in a process does not always hold true. However, total motion displacement is conserved in each process.

As with all other phenomena in the Reciprocal system, electric charge is a motion, in this case a simple harmonic rotational vibration, as shown in Figure I.

\[ \phi = \frac{\pi}{4} \cos(4 \nu t) \]  

FIGURE I: ELECTRIC CHARGE

An equation for this motion will now be derived. Let \( \phi \) be the rotation angle in radians, \( \nu \) be its frequency in Hz, and \( t \) be the time in seconds. From the figure, the amplitude of the motion is \( \frac{\pi}{4} \) radians and the angular distance traveled each cycle is \( 4\pi \) radians. Hence the equation is

As shown in a previous paper of mine [3], a negative electric charge has the frequency

\[ \nu_{-\text{elec}} = \frac{R}{2\pi} \]

where \( R \) is the Rydberg frequency (3.288 \( \times \) 10\(^{15} \) Hz).
Electrons exist within matter, but not as intrinsic features of atoms. Also, these electrons are ordinarily uncharged. To travel outside of matter the electrons must become charged or ionized. The energy for the charge and the kinetic energy of the charged electron come from absorption of a photon, thus producing the photoelectric effect. A rigorous equation for this effect, slightly modified from Ref. 6, can now be given. Let

- $h =$ Planck's constant
- $\nu_{\text{phot}} =$ photon frequency
- $v =$ electron velocity (outside of matter)
- $m =$ electron mass
- $eV =$ electric potential surrounding the matter
- $w_o =$ work function of the matter
- $u_k =$ energy of the electron before the process begins
- $u_\ell =$ energy lost by charged electron in moving to surface

The equation for the electron's kinetic energy outside of matter is then

$$\frac{1}{2} mv^2 = h\nu_{\text{phot}} + eV - w_o + u_k - u_\ell \quad \langle 3 \rangle$$

According to the Reciprocal System the work function is the energy necessary to charge an uncharged electron. Since the rotational vibration is scalar, like the linear vibration, Planck's law holds for electric charges as well as for photons:

$$E_{I,e} = h\nu_{\text{elec}} = h \frac{R}{2\pi} = 2.17 \text{ eV} \quad \langle 4 \rangle$$

(Note: any observed values of work function less than 2.17 eV imply previous electron energy, $u_k$). The value of $E_{I,e}$ given in $\langle 4 \rangle$ is modified by the environment of the electron, i.e., by the atom in which it currently exists. The electron's charge may be in the same dimension as one of the atom's magnetic rotations or in the same dimension as the electric rotation. In the Reciprocal system, charge is energy, $t/s$, the inverse of velocity. The atom's magnetic rotation velocity is $v_{\text{mag}}$, its electric rotation velocity is $v_{\text{elec}}$; the inverse of these in natural units is $c/v_{\text{mag}}$ and $c/v_{\text{elec}}$, where $c$ is the speed of light. If the atom has only one electric time displacement unit ($v_{\text{elec}} = (1/2)c$), the ionization energy of the electron is not increased, hence a 1 must be subtracted from $c/v_{\text{elec}}$. Finally, the atomic motions take place in the time region, whereas we want the energy as measured in the time-space region -- so the square root of the inverse velocity expressions must be taken. Thus

$$w_o = 2.17 \times [c/v_{\text{mag}}]^{1/2} \text{ eV.}$$

and/or

$$w_o$$

$\langle 5a \rangle$
\[ w_o = 2.17 \times [c/v_{\text{elec}} - 1]^{1/2} \text{ eV} \]

These equations, theoretically derived, are nearly identical to the "empirical" equation given by Larson in Ref 1 (p. 118), eq. (142'). The set of values of \( w_o \) is

\[ w_o = [2.17, 3.07, 3.76, 4.34, 4.82] \]  

Table I compares the theoretical results with those observed.

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<td>4.5</td>
<td>8.68</td>
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<td>7.52</td>
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<tr>
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<td>7.52</td>
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<tr>
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<td>4.31</td>
<td>8.68</td>
<td>7.287</td>
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The agreement is excellent (the correlation coefficient $r_{corr} = .964$).

As discussed by Ref. 7, the number of electrons emitted per incident photon depends on both the nature of the emitter and the frequency of the incident radiation. At frequencies lower than that at which maximum yield is obtained, reflectivity of incident photons is so high that only a few photons take part in the emission process. At frequencies higher than that at which maximum yield is obtained, the photons penetrate to such a depth that the electrons, newly charged at that depth, lose too much energy in coming to the surface.

Of the remaining subatoms only the positron, proton and $H^1$ can take an electric charge. As shown in Ref 3, a positive electric charge has the frequency

$$\nu_{+\text{elec}} = \frac{2R}{\pi}$$

* Asterisk denotes entry of rotation into second space-time unit in the 4A and 4B groups; also where value 3 appears in magnetic rotation, this is the inverse of actual rotation. Values of $c/v_{\text{mag}}, c/v_{\text{elec}},$ and $W_0$ obs. are taken from Table CIX of Ref. 1.
The ionization energy of a free positron or proton (not including force-coupling effects) is then

\[ E_{I,p} = h \nu_{\text{elec}} = h \frac{2R}{\pi} = 8.68 \text{ eV} \]  \hfill \langle 7 \rangle

Now consider the ionization of the intermediate particle, H\(^+\). Here everything is unity: H has one natural unit of primary mass and one unit of electric space displacement; one positive charge is created and one negative charge. So the required photon energy must also be unity by the Principle of Equivalence (see Ref. 1, p. 21):

\[ E_{I,H^+} = h \frac{R}{2} = 13.595 \text{ eV} \]  \hfill \langle 8 \rangle

as observed.

B. Atoms

1. Present Theory

In present theory, ionization is thought to be the ejection of an electron from its orbital, leaving a net positive charge on the atom. No generally accepted equation has been developed to calculate the energy of ionization from Quantum Mechanics. One might expect the ionization energy to be practically the same as the work function -- but it is not. Indeed, there is no evidence that matter becomes ionized in the photoelectric effect.

Gas and liquid ionization is currently thought to be the break-up of previously existing oppositely-charged units.

2. Reciprocal System

In the photoelectric effect, only charged electrons are created, not charged atoms. But generally in atomic ionization both positive and negative electric charges are created (they do not exist previously). Where negative ions can form, as with the electronegative elements, they do so. But usually negatively-charged electrons serve as the second component of the force couple creating the charges. Thus in most cases a positively-charged ion and a negatively-charged electron are the results of ionization. So, rather than the ionization energy being the binding energy of an electron to a nucleus, it is the energy required to create two charges, one positive and one negative.

Equation \langle 5 \rangle gave the energy necessary to create a negative charge on an electron. From mechanical considerations it is obvious that the energy necessary to create a positive-negative charge pair is twice that needed.
to create the negative charge on the electron. Hence for the first ionization level the energy is

\[ E_{I,\text{atom}} = 4.34 \times [c/v_{\text{mag}}]^{1/2} \text{ ev} \]  \hspace{1cm} \text{(9a)}

\[ E_{I,\text{atom}} = 4.34 \times [c/v_{\text{elec}}]^{1/2} \text{ ev} \]

The set of values of \( E_{I,\text{atom}} \) is

\[ E_{I,\text{atom}} = \{4.34, 6.14, 7.52, 8.68, 9.64\} \]  \hspace{1cm} \text{(9b)}

Table I compares calculated values with observed values of ionization [8]. Agreement is very good. (Avg. \( W_o \) calc. = 3.706; avg. \( W_o \) obs. = 3.779. Avg. \( E_I \) calc. = 7.412; avg. \( E_I \) obs. = 7.366. Avg. \( E_I \) calc./avg. \( W_o \) calc. = 2.000; avg. \( E_I \) obs./avg. \( W_o \) obs. = 1.95. For \( E_I \) obs. and \( E_I \) calc. \( r_{\text{corr}} = .803 \). Individual discrepancies are most likely due to experimental error.)

Ordinarily, solids are not ionized; the resulting forces would overcome the cohesive energy and break apart the solid. Liquids and gases are more readily ionized, with the energy often being supplied by photons. An electric field is of course necessary to prevent the charges from recombining. For a good discussion of liquid ionization, see Ref. 1.

Gaseous ionization depends on both electric field strength and gas pressure. An equation for the saturation electric field will now be derived. Let

- \( I \) = primary current (ions created by photons/time)
- \( E_{\text{phot}}/t \) = photon energy absorbed per unit time
- \( E_I \) = ionization energy
- \( \mathcal{E}_f \) = electric field strength
- \( \mathcal{E}_{\text{fnat}} \) = natural unit of electric field strength
- \( P \) = gas pressure; \( P_{\text{nat}} \) = natural unit of pressure

The equation for the primary ion current is then

\[ I = (E_{\text{phot}}/t) \times (1/E_I) \times \left( \frac{\mathcal{E}_f}{\mathcal{E}_{\text{fnat}}} \right) \times \left( \frac{P_{\text{nat}}}{P} \right) \]  \hspace{1cm} \text{(10)}

Clearly if \( E_{\text{phot}} = E_I, \mathcal{E}_f = \mathcal{E}_{\text{fnat}}, \) and \( P = P_{\text{nat}} \), one ion
per time t will be created. For a fixed energy input, I can be increased either by increasing $E_f$ or decreasing $P$ until

$$\left(\frac{E_f}{E_{fnat}}\right) \times \left(\frac{P_{nat}}{P}\right) = 1$$  \hspace{1cm} \text{<11a>}

Solving for $E_f$ we have

$$E_f = E_{fnat} \times \left(\frac{P}{P_{nat}}\right)$$  \hspace{1cm} \text{<11b>}

With $E_{fnat} = 2.04133 \times 10^{16}$ v/m and $P_{nat} = 1.5539 \times 10^7$ atm., and letting $P = 1 \times 10^{-5}$ atm., then

$$E_{fsaturated} = 13137 \text{ v/m}$$

The newly created ions and charged electrons can themselves cause further ionization, which is called secondary ionization.

The reverse of ionization is the addition of a negatively charged electron to a singly charged positive ion, which results in a neutral atom. Thus the "electron affinity" of a singly charged positive ion is just the negative of the ionization energy of the corresponding neutral atom.[9] Where current theory gets into difficulty is in understanding the "electron affinity" of neutral atoms. According to the Reciprocal System, the electron loses its charge upon absorption in matter, resulting in a reverse photoelectric effect.

II. Photomagnetization

A. Subatoms

1. Present Theory

According to present thought, the magnetic resonance experiments detect the magnetic moments intrinsic to subatoms and atoms (nuclei). The magnetic moment is considered to result from the angular spin of the electric charge of a particle. It is given in units of the Bohr magneton or the nuclear magneton, as derived from Dirac's theory.

A number of problems exist with this theory. The neutron has a magnetic moment, but no electric charge. Pions and alpha particles do have electric charges but no magnetic moment; present theory claims that these particles have zero spin -- but that seems equally strange. The magnetic moment of the proton has been obtained from experiments with ice and water; thus the magnetic moment could actually be that of H
itself, regardless of what theory says. The magnetic moment of the anti-proton has been found not to equal the magnetic moment of the proton (or rather, H1).

More fundamentally, the value of the magnetic moment is not measured directly; it is inferred from the data. To see this, let

\[ \nu_0 \] = resonant photon frequency  
\[ h\nu_0 \] = absorbed photon energy  
\[ B \] = magnetic field strength  
\[ \mu \] = magnetic moment in field direction  
\[ L \] = angular spin no.

The equation (from Ref. 10) is

\[ h\nu_0 = \frac{\mu}{L} \times B \]  \hspace{1cm} \langle 12 \rangle

The energy \( h\nu_0 \) and field \( B \) are measured, \( L \) is inferred from other data (usually spectroscopic), and then \( \mu \) is calculated. If \( L \) is bogus, then \( \mu \) is bogus. All that the experiments tell us is that for a given \( B \) there exists a certain photon frequency at which great amounts of energy are absorbed by the sub-atoms and atoms. The conclusion that the relation between \( h\nu_0 \) and \( B \) is \( \mu/L \) is purely hypothetical.

2. Reciprocal System

My interpretation of the magnetic resonance experiments, on the basis of the Reciprocal System, is radically different. Here the sub-atoms and atoms have no intrinsic magnetic moments or magnetic charges. (Note: the isotopic charges in atoms cancel the magnetic effect of the magnetic charges of the neutrinos contained within). But under certain circumstances, such as in the magnetic resonance experiments, temporary magnetic charges can be induced. A magnetic charge is a rotational vibration of one of the inner magnetic rotations of the sub-atom or atom.

As given in Ref. 3, the vibrational frequency of a unit magnetic charge is

\[ \nu_{\text{mag}} = \frac{2R}{\pi} \]  \hspace{1cm} \langle 13 \rangle

The required energy to produce this vibration depends on the environment: the magnetic field and the velocity of the principal or subordinate magnetic rotation which is modified by the charge. The resulting equation is related to, but different from, the equation for energy of electric ionization, eq. \( \langle 5 \rangle \). In the Reciprocal system, magnetic effects are the square of electric effects -- so the square root of eq. \( \langle 5 \rangle \) is eliminated. Also, as in the equations for
force and distance in the Reciprocal System, the effect of the magnetic velocity is inverse to that of the electric velocity. Thus, instead of the energy being proportional to $\sqrt{v_{\text{mag}}}$, the energy is proportional to $v_{\text{mag}}/c$. The complete expression is

$$\hbar v' = \left[ \hbar' (2R/x) \cdot (v_{\text{mag}}/c) \cdot 1/B_{\text{nat}} \right] \cdot B \quad \text{<14a>}$$

Larson [1] has previously identified magnetic susceptibility as proportional to $v_{\text{mag}}/c$. This provides additional support for that term in the above equation.

\[ V_{\text{prim mag}} \text{ or } V_{\text{sub mag}} \]

\[ V_{\text{sub mag}} \text{ or } V_{\text{sub elec}} \]

\[ \text{(counter-clockwise)} \]

\[ \text{(clockwise)} \]

**FIGURE II: MAGNETIC CHARGE**

As shown in Figure II, the sole difference between a magnetic charge and an electric charge is that the magnetic charge is an electric charge that is given an extra angular spin by either the subordinate magnetic rotation or the electric rotation (depending on whether the charge is placed on the principal or subordinate magnetic rotation).

If no magnetic field is present, and the photons are not reflected, the photon energy is simply transformed to thermal energy of the particle. For a given magnetic field $B, \nu'$ can be calculated for each kind of sub-atom and atom. As discussed in Ref. 3, $v_{\text{mag}}/c$ can take on the following values:

$$v_{\text{mag}}/c = \{0.20, 0.22, 0.25, 0.29, 0.33, 0.40, 0.50\} \quad \text{<14b>}

Setting $B$ equal to 1 Tesla and knowing that $B_{\text{nat}} = 6.813 \cdot 10^7$
Tesla, the following resonance frequencies are obtained:

\[ \nu_0 \text{ in MHz} = \{6.14, 6.83, 7.68, 8.78, 10.24, 12.29, 15.36\} \]

The calculation assumes that no other energy is present that can be utilized in the creation of the magnetic charge. Unfortunately, magnetic resonance experiments have been done at room temperature rather than at temperatures close to 0 degrees K, so the absorption of thermal energy is a definite possibility.

Nearly all atoms have magnetic resonance frequencies at or below 15.6 MHz (with B = 1 Tesla), in accord with eq. (14). But the intermediate particles, the neutron and \( H^1 \), have higher observed frequencies, 29.16 MHz and 42.57 MHz, respectively. One theoretical explanation is that these particles require multiple magnetic charges if they are to have any at all. The neutron is comprised of two rotational systems: a proton rotational system and a cosmic neutrino rotational system. In terms of total rotational speed (in natural units) the notation is

\[ \text{neutron} \begin{cases} \frac{1}{3} - \frac{1}{2} - 1 \\ 2 - 2 - 1 \end{cases} \]

(See Refs. 1 and 3 for details). Suppose each rotational system takes a magnetic charge on its subordinate magnetic rotation. For the proton rotational system, the energy required is

\[ h \ast \left( \frac{2R}{\pi} \right) \ast \left( \frac{1}{2} \right) \ast \left( \frac{B}{B_{\text{nat}}} \right) \]

For the cosmic neutrino rotation (which takes an inverse charge) the energy required is

\[ h \ast \left( \frac{2R}{\pi} \right) \ast 2 \ast \left( \frac{B}{B_{\text{nat}}} \right) \]

The combined energy is

\[ h \ast \left( \frac{2R}{\pi} \right) \ast \left( \frac{B}{B_{\text{nat}}} \right) \]

and the resonance frequency is 30.70 MHz (for \( B \) and \( B_{\text{nat}} \) as before). The small discrepancy between the observed and calculated values may be due to the absorption of thermal energy.

The notation for \( H^1 \) is
\[ H^1 \begin{cases} 1/3 & \text{or} \ 1/2 \\ \left\{ \frac{1}{2} - \frac{1}{2} \right\} \end{cases} 2 \]

In this case, though, each rotational system apparently takes two charges, so that the frequency is \(3R/\eta\) rather than \(2R/\eta\). The energy required is then

\[ [h \ast (3R/\eta) \ast (1/2) + h \ast (3R/\eta) \ast (1/2)] \ast (B/B_{\text{nat}}) \]

giving a resonance frequency of 46.05 MHz. Again the discrepancy between that observed and that calculated may be due to the utilization of thermal energy.

Both the real proton and anti-proton (inverse proton) and the material and cosmic neutrinos and the material and cosmic massless neutrons should have resonance frequencies of 15.36 MHz, unless they take multiple charges.

The electron and positron have no subordinate magnetic displacements at all and thus cannot take magnetic charges. All magnetic effects of these particles (and also the muon), whether uncharged or charged, result from their being in translational motion. To quote Larson [2]:

As we have seen, the electric charge is a one-dimensional modification of the rotational motion of an atom or sub-atomic particle and the magnetic charge is a similar two-dimensional modification. The characteristic effects of the magnetic charge originate because the one-dimensional forces are distributed over two dimensions by the second rotation. But for this purpose it is not necessary that the motion in the second dimension be rotational. We can see why this is true if we examined the behavior of the axes of rotation. The axis of the electric rotation of an atom is a line: a one-dimensional figure. A stationary electric charge thus has no two-dimensional rotational effects. For a magnetic charge the locus of all positions of either axis is a disk: a two-dimensional figure and the magnetic charge has two-dimensional properties. But if we move the electric charge translationally, the locus of all positions of the axis is again a two-dimensional figure, and hence a moving electric charge has a two-dimensional distribution of forces comparable to that of a magnetic charge. . . . If an uncharged electron or positron is given a translational motion, this again is motion in two dimensions and it produces electromagnetism, a magnetic effect.

Particles heavier than the electron and positron would show a
similar magnetic effect if they could be accelerated to the same high velocities.

B. Atoms

1. Present Theory

Present theory regards the magnetic moment of nuclei to result from a combination of the moments of its constituent sub-atoms. Even-even nuclei are regarded as having zero net spin and thus zero moment. According to Segre's account of current theory [11], adding a neutron to an even-even nucleus is supposed to yield \((\ell + 1/2)[ -3.826/(2\ell + 1)]\) nuclear magnetons for the magnetic moment, where \(\ell\) is the spin angular momentum of the added neutron; subtracting a neutron is supposed to yield \((\ell - 1/2)[3.826/(2\ell + 1)]\) nuclear magnetons. Adding a proton is supposed to yield \((\ell + 1/2)[1 + 4.586/(2\ell + 1)]\) nuclear magnetons, whereas subtracting a proton is supposed to yield \((\ell - 1/2)[1-4.586/(2\ell + 1)]\) nuclear magnetons. These expressions do bracket the data, as Segre points out, but that is all: they do not work in detailed application.

The sign given for the moment is an inference, not a result from experiment (which measures only photon energy and magnetic field strength at resonance). In present theory, both the magnetic moment and angular spin are vectors. If they are aligned the magnetic moment is said to be positive; if anti-aligned, negative.

2. Reciprocal System

In the Reciprocal System all basic motions -- including the electric and magnetic charges -- are scalar. In addition, the magnetic charge is intrinsically dipolar: the magnetic rotation of the one-dimensional rotational vibration can be viewed both clockwise and counter-clockwise (see Figure 2). Generally in the magnetic resonance experiments, the atoms are induced to take only a single magnetic charge and thus have resonance frequencies of 15.36 MHz or less. The exceptions, such as F and T1, are apparently induced to take multiple charges.

Table II compares the observed resonance frequencies [12] (of stable isotopes) with the theoretical results from eq. <14>. (Note: Thermal energy and cohesive energy are not taken into account; numerous isotopes (usually unstable) given in Ref. 12 have resonance frequencies less than 6.14 MHz -- these are not given in the table below. Further theoretical work is necessary to include thermal energy, cohesive energy, and instability effects in magnetic resonance).
<table>
<thead>
<tr>
<th>Isotope</th>
<th>Displ.</th>
<th>$v_{\text{mag/c}}$</th>
<th>Mag. Speed</th>
<th>[B=1 Tesla] calc (MHz)</th>
<th>obs (MHz)</th>
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<tbody>
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<td>B$^{11}$</td>
<td>2-2-3</td>
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<td></td>
<td>10.24</td>
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<td>Mn$^{55}$</td>
<td>3-2-7</td>
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<td></td>
<td>10.24</td>
<td>10.57</td>
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<td>Co$^{59}$</td>
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<td>1/3</td>
<td></td>
<td>10.24</td>
<td>10.12</td>
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<td>3-3-(7)</td>
<td>1/3</td>
<td></td>
<td>10.24</td>
<td>10.12</td>
</tr>
<tr>
<td>Ga$^{69}$</td>
<td>3-3-(5)</td>
<td>1/3</td>
<td></td>
<td>10.24</td>
<td>10.24</td>
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<td>As$^{75}$</td>
<td>3-3-(3)</td>
<td>1/4</td>
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<td>7.68</td>
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<td>Ag$^{104}$</td>
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<td>2/7</td>
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<td>9.35</td>
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<tr>
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<td></td>
<td>8.78</td>
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<td>Pb$^{207}$</td>
<td>4-4-(4)</td>
<td>2/7</td>
<td></td>
<td>8.78</td>
<td>8.99</td>
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</table>
The equation appears to work well for the majority of atoms studied ($f_{corr} = .956$ for the table). In those cases where the equation does poorly, the thermal effects may be the culprit. Ideally, the experiments should be repeated with the atoms widely separated and at close to 0 K in temperature -- then the effects of thermal energy and cohesive energy would be eliminated. Under such conditions all frequencies for the induction of a single unit of magnetic charge in a stable isotope should be between 6.14 MHz and 15.36 MHz when the field B is 1 Tesla.

Atoms with an even number of neutrino-induced isotopic charges (half on each rotational system) have no need to acquire another charge for balance. Hence in the current jargon these atoms do not have a 'magnetic moment.'

In the series of isotopes of an element, the placement of the magnetic charge appears to alternate with the placement of the isotopic charge. A quantitative check on this is difficult to do because in most such series there are unstable isotopes -- this instability adds another variable to the problem. Apparently if the number of isotopic charges is greater than that allowed by the magnetic ionization level, the energy required to induce a magnetic charge is decreased. Once the magnetic field is turned off and the photon bombardment ceases, the magnetic charges are transformed to radio photons and lost. Only a few elements, such as Co, Ni, and Fe, are able to retain a magnetic charge.

**Summary.** Electric and magnetic charges are not unanalyzable; they are one and two-dimensional rotational vibrations of a sub-atom or atom. They are also not permanent and inviolate; they may be created or destroyed, so long as overall motion displacement is conserved.

1a. The work function of a material is not the energy required to remove the least tightly bound electron; it is the energy required to charge an uncharged electron in that material.

1b. The ionization energy of an atom is not the energy required to separate pre-existing charged protons and electrons; it is the energy required to create a negative charge (on an electron) and a positive charge (on an atom) and is equal to twice the work function.

2. The magnetic resonance energy of a sub-atom or atom does not indicate a previously existing intrinsic magnetic moment; it is the energy required to induce one or more dipolar magnetic charges in sub-atoms or atoms.
REFERENCES


ARE COSMIC RAY PROTONS PRIMARY?

by Frank H. Meyer

It is not generally known that the answer of the Reciprocal System of physics to this question is definitely no. This answer was published in 1959 by Dewey B. Larson in his book *The Structure of the Physical Universe*, pp. 196-197, and again in 1965 in his book *New Light on Space and Time*, pp. 210-211 among other examples.

The primary particle of cosmic rays, according to the Reciprocal System, is a particle of the cosmic sector, the cosmic proton, the so-called anti-proton, not a particle of the material sector, the proton. The latter is a particle into which the cosmic proton is transformed when it crosses over from the cosmic sector (with speed in excess of unit speed c) to the material sector (with speed less than unit speed c).

The consensus of opinion among astrophysicists involved in cosmic ray studies has been that the answer to the above question is yes. This follows from their unconfirmed conjecture that cosmic rays must be an emanation from somewhere in the material sector: the Sun, the Milky Way, or other galactic nebulae, supernovae, etc. Bruno Rossi, a cosmic ray physicist, wrote in 1953: "Outside the earth's atmosphere cosmic radiation consists mainly of protons (nuclei of hydrogen), varying widely in energy." (*Scientific American*, September, 1953, p. 64). This view has persisted in the absence of knowledge about the Reciprocal System and in spite of much positive evidence incompatible with support for the conjecture.

Recently the hypothesis that the cosmic ray proton is the primary ray particle has received a quite negative blow from an inquiry by Andrew Buffington and Stephen M. Schindler, published in *The Astrophysical Journal*, 247:L105-109, 1981, August 1, with the title: "Recent Cosmic-Ray Antiproton Measurements and Astrophysical Implications." A main conclusion of this paper is that: "In summary, a primary anti-proton hypothesis cannot be ruled out." This inquiry also was reported in *Science News*, October 3, 1981, p. 233 under the title: "Are Cosmic Ray Antiprotons Primary?" The Reciprocal System answers yes; heretofore the prevailing view has implied that the answer should rather be no.
THE SEVENTH ANNUAL CONVENTION
OF THE INTERNATIONAL SOCIETY OF UNIFIED SCIENCE

As was agreed at last year's meeting, the 1982 convention will be held in Philadelphia. The dates selected are August 12, 13 and 14. The Alumni Hall in the Towne Building (220 South 33rd Street) has been reserved for the three days of the convention between the hours 9am and 5pm.

The organizers have reserved twenty rooms at the Holiday Inn for ISUS members. The cost is $54.00/night for a double room. As an alternative for members who want to defray costs the organizers recommend the Divine Tracy Hotel (20 South 36th Street, Philadelphia, PA 19104, tel. 215-382-4310). Prices range from ca. $10.00/night per person, based on double occupancy, to $14.00/night for singles. Interested members should make their own reservations at the Divine Tracy.

Any questions should be addressed to Brad Elkin, 543 South Melville Street, Philadelphia, PA 19143, tel. 215-386-8632.

Dewey B. Larson's new book *The Neglected Facts of Modern Science* is scheduled for publication in May. Orders may be sent to North Pacific Publishers, Box 13255, Portland, Oregon 97213. The cost is $9.00 for hardcover; $7.50 for softcover, postpaid.

Annual subscription to *Reciprocity* is $5.00. Single issues: $1.50. *Reciprocity* is sent free to members of the International Society of Unified Science. Annual ISUS dues of $15.00 also entitle members to attend and vote at the Society's annual conventions.
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THE MYTHICAL UNIVERSE OF MODERN ASTRONOMY

by Dewey B. Larson

For the past two or three years I have been spending all of the time that I could make available for the purpose on the preparation of additional volumes of the revised edition of my first book, The Structure of the Physical Universe. As I think most of you know, the first volume of that revised edition has already been published with the separate title of Nothing But Motion, and I am now working on the next two volumes, concentrating mainly on volume III, which will probably be completed and published ahead of volume II. That may seem like the wrong way of going about it, and perhaps it is, but there are good reasons for it, which I won't go into now.

Volume III is the astronomical volume. In that I am taking the physical laws and principles developed in volumes I and II, and applying them to the astronomical situation. The results that I have obtained in so doing are quite different from what you find in the astronomical literature -- so much so, in fact, that you might almost wonder if we are talking about the same thing. And I am quite sure that those who read the book will want to ask a question that goes something like this: If your results are correct, how in the world did the astronomers arrive at such totally different conclusions? Since that question is going to be asked, I think that I should answer it right in the book itself and I am planning on putting in a chapter for that purpose. What I propose to do this evening is to give you a general idea of the contents of that chapter.

What the astronomers have done is essentially the same thing that I've done. That is, they have taken the physical laws and principles to which they subscribe and have applied them to the astronomical situation. The difference is that I have had the benefit of a general theory, one in which all conclusions in all fields are derived from the same set of basic premises. So that when I make the assumption that the laws and principles that I am using are correct -- that's something all of us have to do in order to establish the logical foundations of our results -- I can do the whole thing with one assumption. The astronomers can't do that, because conventional physical theory has no general physical structure. As described by one prominent physicist, Dr. Richard Feynman, in a quotation that I have given many times before, "The laws of physics are a multitude of parts and pieces that

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1. This is a transcript of Mr. Larson's address to the Seventh Annual Convention of the International Society of Unified Science in Philadelphia, on August 13, 1982.
THE MYTHICAL UNIVERSE OF MODERN ASTRONOMY

\[ A \rightarrow 1 \rightarrow 2 \rightarrow 3 \rightarrow 4 \]

**Pattern**

Contrafactual assumption  Lines of reasoning and successive conclusions

**Singularity**

**Black hole**

**Neutron star**

**Degenerate matter**

**Quarks**
do not fit together very well." So when the astronomers assume the validity of the laws and principles that they are using, they have to make an assumption as to the validity of each one individually, and they have to make a multitude of assumptions, thousands of them. Almost all of those laws and principles are, in fact, valid. I would estimate that not more than one in a hundred or even one in several hundred has anything significantly wrong with it. And on that basis the astronomers have at their disposal a system of laws and principles that is at least ninety-nine percent valid; so it might be assumed, then, that the results that they obtain ought to be at least somewhere in the neighborhood of ninety-nine percent correct. But that's not the way that things work. On the contrary, it can easily happen that if the basic premises are only ninety-nine percent correct, the results may well be ninety-nine percent wrong.

That's the principle on which much of our science fiction is based, particularly the better grade of science fiction. And to illustrate how it operates, I want to discuss briefly a science fiction story of that kind. The one I've chosen for the purpose is Isaac Asimov's story of the remarkable properties of the substance that he calls Thyotimoline. As he tells the story, a group of investigators are working on a project the objective of which was to produce a substance with a very short solution time, that is, one that would go into solution very rapidly. And they succeeded very decidedly. They produced substances with shorter and shorter solution time until eventually they were able to synthesize a substance with a negative solution time, one that went into solution somewhat before it was placed in the solvent.

Now, I imagine you can readily understand that that led to some very interesting practical applications. For example, it enabled the construction of an instrument to measure willpower. Obviously, the material would not go into solution as long as there was any doubt about whether it would or would not be placed in the solvent. So that the maximum possible theoretical negative solution time could only be developed by a person with strong willpower, one whose determination was such that once he had decided upon putting the material in the solvent, he would be sure to carry out the operation. On the other hand an individual who's hesitant or undecided would only be able to develop a fraction of the possible negative solution time. So that by a proper calibration of the instrument the measurement of negative solution time could be interpreted in terms of willpower.

Now you can see that that instrument would have a wide application. For instance, it was not only a valuable tool for measuring willpower, but it also enabled a quick and
accurate diagnosis of schizophrenia. A person with a split personality would naturally have two different levels of willpower. So that when he was tested with the instrument, there would be a period of time during which one portion of the material would go into solution, while the other portion remained undissolved. Now that was not only a valuable diagnostic tool: it also enabled the investigators to discover some different types of the affliction that were previously unknown to the psychiatrists. For instance, there was horizontal schizophrenia. In that type, one layer of the material dissolved, while another layer remained undissolved. And then there was vertical schizophrenia, in which the same difference was noted between the right and left halves of the container. And then there was mixed schizophrenia, in which the undissolved material was scattered at random throughout the solvent.

Now, Asimov goes on to describe a considerable number of other applications of a similar nature; but these that I have given you are all that we need for present purposes, because what we're interested in is the structure of the story. As Asimov himself explains in his discussion of the story, there is only one assumption contrary to fact introduced into that story. Everything else is strictly according to Hoyle, and the lines of reasoning are sound. So that what we have here is the kind of thing that I have been talking about, a situation in which ninety-nine percent of all what goes into the story is correct, but the whole thing turns out to be nothing but entertaining nonsense, and it culminates in such absurdities as vertical schizophrenia.

I have illustrated that structure of the story in the diagram at the bottom of the page that has been passed out. You will note that the one counterfactual assumption is identified by letters, and then the lines of reasoning lead out to the successive conclusions. The astronomers' structure of the universe is exactly the same kind of a structure, except that they introduce many assumptions contrary to fact, and their universe, the structure of their universe is therefore much more complex. When I talk about structure in that connection, what I am actually talking about, of course, is the framework of the structure. The astronomical universe includes many entities and processes, such as stars, planets, galaxies, and so on, that have to enter into any version of the structure. But those entities and processes are like the side panels and ornamentation on a building. They're just hung on to whatever framework may exist. And it's the framework that determines the character of the structure. It's that framework that I have indicated here.
I have shown the assumptions contrary to fact by letters, just as in the lower diagram, and from them the lines of reasoning, generally sound, lead out to the numbered conclusions, with arrows showing the direction of the reasoning. Where the numbered conclusions refer to entities or processes that are totally non-existent, I've also shown the names. Those numbered conclusions that are not accompanied by names refer to entities or processes that actually do exist, but that differ in some significant way from the description that we get from the astronomers. For example, over on the right of the diagram, conclusion number nine refers to what are known as X-ray stars: they are discrete sources of X-ray emission in the galaxy. Those are actually binary star systems as the astronomers say they are. But one member of each binary system is a quite different object from the one that's portrayed by the astronomers, and the process by which the X-rays are emitted is totally different.

There's one more feature of the diagram as a whole to which I want to call your attention before I start tracing the lines of development. And that is the cumulative effect of more of these assumptions contrary to fact. If you look over on the upper left of the diagram, you will see that the numbered conclusions there are subject to the effects of only one of these contrafactual assumptions, and as a result none of those is listed as totally non-existent. Actually, some of those conclusions are wild enough in themselves, as we'll see when we come to look at them individually, but the real dillies are over on the other side of the diagram, where the effects of three, four or five of these contrafactual assumptions converge.

The first of the assumptions contrary to fact to which I want to call your attention, the one marked A on the diagram, is the assumption that the basic entities of the universe are elementary units of matter. That assumption seemed very reasonable when it was first made. But we now know definitely and positively that it's wrong, because we now know that there are processes whereby matter can be converted to non-matter and vice versa. And obviously, that means that matter cannot be basic. For example, radiation is not a form of matter, and matter is not a form of radiation. But matter can be converted to radiation. Consequently, it necessarily follows that both matter and radiation must be forms of some underlying entity, some common denominator, we may say. That's not a question of opinion or judgment; that's a necessary consequence of the observed facts. The relevance of that point in this present connection is that it sets a limit on the extent to which units of matter can be subdivided into simpler units of matter. For example, if we start with a
rock and examine its structure, we find that it is composed
of identifiable material sub-units that we call crystals. If
we examine the crystals, we find that they are composed of
identifiable material sub-units that we call molecules. But
if we continue that process, we eventually come to a material
unit that is clearly not elementary, but for which we cannot
find any sub-units.

The logical conclusion then is that we have arrived at the
point that we know exists, the point where the material unit
is not composed of material sub-units, but is composed of the
common denominator, whatever that may be. That's the logical
conclusion. But the physicists and the astronomers cannot
accept that logical conclusion, because they are committed to
assumption A which says that the basic units are units of
matter. Consequently they have to go out and invent the
units that they cannot find. That is the essence, the basis
of the quark hypothesis, number one on the diagram. Many
prominent scientists have recognized the fallacies in the
quark hypothesis. Werner Heisenberg, for instance, was very
critical of it. And he also recognized the necessity for a
common denominator between matter and non-matter. He sug-
gested that it might be energy; but he admitted that he
couldn't see how energy could meet the requirements.

In a universe of motion the common denominator is, of
course, motion. But strangely enough, these scientists who
have been so able to see the shortcomings of the quark
hypothesis have not usually seen that exactly the same con-
siderations apply to the particles that are supposed to be
constructed of quarks -- the hypothetical constituents of the
atom. No one has been able to find them either. Of course
the situation has been confused to some extent in this case
by the practice of calling those hypothetical constituents by
the names of observed particles. But, as I pointed out in my
talk at the conference last year, that practice is totally
unscientific.

Identity cannot be established by similarity in names. It
has to be established by identity of the descriptions. In
scientific terms, two entities are identical in nature if all
of their properties coincide. If the bird that we see quacks
like a duck and swims like a duck, and so on all the way down
the line, then it's a duck. If it crows like a rooster and
can't swim, then it's not a duck. It doesn't make any dif-
ference how many people insist on calling it a duck, or how
nice it would be for somebody's theories if it were a duck --
it still isn't a duck.

The same identical principle applies to these particles.
The observed neutron, for instance, is an unstable particle:
it has a life of less than fifteen minutes. And it's
gregarious: it has a strong tendency to combine with almost
anything that comes along. The hypothetical neutron consti-
tuent of the atom, on the other hand, has to be stable. And
it has to maintain its identity even in places where the ten-
dency toward combination is very strong. The pure fact is
that they are two totally different particles. Of course,
the theorists tell us, the neutron is an accommodating thing,
and if we put it in the atom, it will accommodate their theo-
reries by becoming stable and by discontinuing this awkward
habit of combining with other things. But that's pure non-
sense. That's in the same category as saying that if we
throw the rooster in the water he will quack and start swim-
mong.

The situation with respect to the other hypothetical par-
ticles in the atom is no different. In fact Herbert Dingle
tells us that we can't even imagine a particle with all of
the properties that are required of the hypothetical electron
constituent. But with these imaginary particles (number two
on the diagram) the theorists have constructed an imaginary
atom (number three).

But even with all of the leeway that they have had for
making assumptions as to the properties of these particles of
which they wanted to build an atom, they could not construct
a plausible theory without making another assumption contrary
to fact, the one marked B on the diagram. That is the
assumption that the atom does not conform to the normal laws
of physics. That's a drastic assumption, and because of that
drastic assumption the people who put this structure together
in the first place, have had to make the admission that their
atom is not a real particle -- that's number four on the dia-
gram. As Heisenberg puts it, "It is in a way only a symbol."
Irwin Schrödinger tells us, "If the question is asked, do
the electrons actually exist on these orbits within the atom,
the answer has to be a decisive no." And Heisenberg specifi-
cally cautions us that we must not think that the physicists'
atom is a material particle in space and time that exists
objectively in the same sense that stones and trees exist.
Then what sense does it exist in? Well, he tries to explain
that, and he says this: "The atom of modern physics can only
be symbolized by a partial differential equation in an
abstract multi-dimensional space." Now when we translate
that from the professional jargon of the physicist to the
vernacular, we find that it says exactly the same thing that
I have been saying. The physicists' atom is an imaginary atom
constructed of imaginary particles. And in this connection I
want to point out that these people that I have been quoting
are not scientific heretics like the present speaker. They
are eminent members of the group that put this thing together
in the first place. When the present-day physicist wants to apply quantum theory to his problems, it is Schrödinger's wave equation that he tries to solve. Now when he gets into difficulties, it's Heisenberg's principle of uncertainty that he calls on to get him out of those troubles.

In order to go any farther along this line of development that I have started tracing, the astronomers have had to make still another assumption contrary to fact: like the first two, this one was borrowed from the physicists. It's their assumption as to the nature of the process whereby energy is generated in the stars. The physicists' attitude on this subject has never changed. They have contended from the very first that whatever the most energetic process known to them might be, that must be the stellar energy generation process, regardless of how much evidence might exist in any other field of science. The fact that they have had to change their ideas as to the nature of that process twice already, the last time under very embarrassing circumstances, has not changed their attitude in the least. Today there is ample astronomical evidence that their present assumption (assumption C) is wrong, just as there was ample geological evidence in the nineteenth century to show that their then current assumption was wrong. But the physicists are no more willing to listen to the astronomical evidence today than they were willing to listen to the geological evidence during the long and acrimonious dispute with the geologists in the nineteenth century. And since the astronomers are not willing to put up the kind of a fight that the geologists did, they have ignored or rejected the evidence from their own field, and have accommodated their evolutionary theories to the physicists' assumption C. I will have some more to say about the astronomical evidence when we come back to this side of the diagram and start up the line toward conclusion fifteen. But for the moment I want to continue along the original line of development.

The first conclusion that is derived from assumption C is the conclusion that the supply of energy in the stars will eventually be exhausted — that's conclusion five. The astronomers have then taken that conclusion five and put it together with conclusion three, the conclusion as to the nature of the atomic structure, and they have arrived at the further conclusion that the result will be a collapse of the atom.

I said earlier that the lines of reasoning represented by the lines on the diagram are generally sound; the reason for putting in that qualifying word "generally" is that I have some reservations in some cases, and this line of reasoning leading to conclusion six is one of them. One of the results
of the application of thermal energy to a material aggregate is to introduce additional space between the atoms or between the molecules of the aggregate. And if we eliminate that thermal motion by exhaustion of the fuel supply, it's logical to assume that that additional space will also be eliminated. But the astronomers are going a step farther, and assuming that that exhaustion of the fuel supply also eliminates some further space in the interior of the atom that the thermal motion had nothing to do with in the first place. The justification for that kind of an assumption is very hard to see. Of course, some of the theorists tell us that when the support given by the thermal pressure is eliminated, the aggregate collapses of its own weight. But that is equivalent to assuming that material is heavier when it's cold than it is when it is hot. And there again, that's an assumption that's very difficult to swallow. In the real world the atoms at the bottom of the pile are subject to the weight of all the overlying layers, regardless of whether they are hot or cold.

In one of the books from which I and my contemporaries learned to read, there's is a story about a man who is going home with a heavy sack of flour. (In those days, I might say, we bought flour in hundred-pound sacks, not in these little bits of things that they sell in the supermarkets). This man was afraid that the heavy weight would be too much for the horse that he was riding, so in order to relieve the weight on the horse he picked the flour up and held it in his arms on the way home.

Now when we were children we laughed at that story. But now we're presented with exactly the same proposition by the astronomers, in a little different language, and we're expected to keep straight faces. But, after all, I suppose we'll have to remember that what you or I may think about this situation is not relevant in the present connection. What we're trying to do is to examine how the astronomers arrived at these conclusions, and this is their conclusion, number six, and they have concluded, then, that the material of the star collapses into a weird condition that they call "degenerate matter," in which all of the hypothetical space in the hypothetical atom has been eliminated and these hypothetical constituents are in a close-packed condition.

Since this degeneracy starts from a condition in which the material is cold, and therefore solid, it would seem natural to assume that the degenerate matter should be some sort of a super-solid. But no, that's not what they tell us. In some strange way it re-acquires some of the properties of a gas. Particularly, it acquires a substitute for the thermal motion that it can no longer have. So that then instead of cold matter, we have an aggregate of hot degenerate matter --
that's conclusion number seven -- and they have identified that aggregate of hot degenerate matter with the white dwarf star -- conclusion number eight.

I have already mentioned number nine, which is the X-ray star. You will also note that the white dwarf, number eight on the diagram, is connected with item number twenty-three: but that's an incoming line. That refers to the effect of contrafactual assumption D on the white dwarf. Now this assumption D has an effect that is quite different in its nature from the effects of the other contrafactual assumptions that I am discussing. So it will be convenient to defer the effect shown by number twenty-three until we are ready to talk about the situation in the conclusions along the top of the diagram.

So let's move on then to conclusion number ten. The ersatz heat of the white dwarf is supposed to be radiated away in the same way as real heat, although nobody's explained why that should be true. And since that's radiated away, the white dwarf is presumed to gradually cool off, and eventually to become a black dwarf, a cold lifeless object that plays no further part in physical activity. These black dwarfs are purely hypothetical. There is no evidence whatever of the existence of any such thing. And there is no definite evidence that the evolution of the white dwarf is in the black dwarf direction. On the contrary, there is a great deal of evidence showing that some stars, and perhaps all of them, end their lives in gigantic explosions.

The astronomers have had to recognize that evidence, of course, and they've compromised: they've decided that the small stars collapse quietly, and end their lives as black dwarfs, and the big stars explode. And they have identified that explosion with the observed phenomenon known as the supernova. That's number eleven on the diagram. The effect of a gigantic explosion of that kind is to pulverize the material of the star and to eject it out into space in the form of a rapidly expanding cloud of dust and gas. But the astronomers have concluded, and they have some evidence to support that conclusion, that a residue remains at the scene of the explosion. And they have identified that residue as degenerate matter. But they have decided that because of the force of the explosion this matter is more degenerate than the degenerate matter of the white dwarfs. And in some strange way that sounds like magic to me, all of the hypothetical constituents of that degenerate matter are converted to neutrons. So that what we have left is a star composed entirely of neutrons -- a neutron star, number twelve in the diagram.
On the basis of some mathematical conclusions the astronomers have further concluded that there is a limit to the size of a neutron star, and they have decided that when the residue exceeds that size, the contraction under the influence of gravitation goes on until the surface gravity of the aggregate is so strong that no radiation at all can escape. What then exists, they say, is a black hole, conclusion number thirteen. Some theorists are not even willing to stop there. They contend that that contraction under the influence of gravity goes on and on until there's nothing left from the whole star but a single point -- a singularity, in scientific jargon (that's conclusion fourteen).

As you can see from the diagram, all of these bizarre conclusions as to the products of the supernova explosion are subject to the effects of all four of the assumptions contrary to fact that I've already mentioned. And in addition they're subject to one more, which I've identified by the letter E on the diagram. This assumption involves some very basic issues, and I won't be able to explain it in detail in the time that I have this evening, but I can say that in essence what it amounts to is an assumption that the astronomers understand the mechanism of gravitation, which obviously they don't. Again I want to call on Dr. Feynman. He says, "No one has given us the machinery of gravitation; all we have is the mathematical form." Now Dr. Feynman is evidently not familiar with the theory of the universe of motion, because we have given the machinery; but his statement is correct in application to the conventional physics that the astronomers are using.

Now here is a little gem for your collection. "Of all the conceptions of the human mind, perhaps the most fantastic is the black hole. Like the unicorn and the gargoyle, the black hole seems much more at home in science fiction or in ancient myth than in the real universe." If you were not told otherwise, you would probably think that that came from me or from some other hard-boiled skeptic. But no, those are the words of Kip Thorn, one of the most enthusiastic advocates of the black hole hypothesis. Of course, he contends that black holes must exist anyway, no matter how fantastic they are. And after making that statement, he goes on to say this: "The laws of modern physics virtually demand that black holes exist." That's absolutely correct.

The whole point of my presentation then is that all of these absurdities, the black holes and the rest of them, are required by the current laws of physics and the current interpretations of those laws by the astronomers. And that is because those laws and those interpretations have not been purged of the effects of these assumptions contrary to fact
that I have been talking about. The black hole is not science fiction; it's fictional science. The difference is that the science fiction writer knows and admits that he is using assumptions contrary to fact. The practitioner of fictional science either doesn't know or is not willing to admit that he is doing exactly the same thing. The black hole is the astronomical equivalent of vertical schizophrenia.

Moving back now to the other side of the diagram, we note that one of the results of conclusion number five, the conclusion as to the exhaustion of the fuel supply, is that the hot massive stars must be young because they are using their fuel at such a prodigious rate that the exhaustion must come relatively soon, astronomically speaking. This is an inherently improbable conclusion, and a great many astronomers have recognized that. Bart J. Bok, for instance, tells us this: "It is no small matter to accept as proven the conclusion that some of our most conspicuous supergiants, like Rigel, were formed so very recently on the cosmic scale of time measurement." And indeed this is no small matter. What Bok evidently realized is that the product is inconsistent with the process. Natural building processes are slow and gradual. The rapid processes, the catastrophic processes, are destructive. Some new combinations may emerge from those processes, but they're no more than incidental. The general effect of those processes is to tear down, not to build up.

It's generally agreed that the raw material from which the stars are formed must be diffuse matter in the form of dust and gas clouds, and if stars are currently forming, those must be cold clouds. The only known force that is capable of drawing the particles of those clouds together to form stars is gravitation. And because of the immense distances involved the force of gravitation is very weak, and it takes a long long time to operate. The formation of a star is therefore a long, slow process. And the initial product, because it is formed from a cold material, is a cool star, not a hot one. In order to form a hot massive star, another long slow process is required. So that the hot massive star cannot be young, it's an old star. There is plenty of astronomical evidence to support that finding. Most of it comes from observation of the star clusters. Since we find that conclusion fifteen is an erroneous result of an assumption contrary to fact, the same considerations also apply to conclusion number sixteen, and they show that the astronomers have their age sequence upside down. Now they will protest that they have evidence to support that age sequence. But if you examine that evidence, you will find that most of it is evidence only of the existence of a sequence and it has nothing to do with direction. And those items which do refer to
the direction of the sequence contradict the astronomers' conclusions. The most conclusive of that kind of evidence comes from the small clusters that are located in the galaxy, rather than around it. Those clusters, the galactic, or open clusters, can be divided generally into two groups. In one group the constituent stars resemble those of the globular clusters. In the other group they are more like the general run of stars in the galactic arms, such as those in the solar neighborhood. These clusters of both groups are all expanding at measurable rates, and their star density, the number of stars per unit volume, is therefore decreasing. Since there's no reason that we know of why the initial conditions should be any different, it follows that the clusters with the greater average density are the younger, and those with the smaller average density are the older.

Here, then, we have something that is very rare in astronomy -- an opportunity to determine the direction of evolution from direct observation. Now according to studies that have been made, the astronomer Otto Struve tells us, the average density of the group composed of the stars of the globular cluster type is the greater. This is therefore identified as the younger group, which is the opposite of the conclusions reached by the astronomers.

Now this is not the only astronomical evidence that shows that they have their sequence upside down, there are quite a number of other items that I won't be able to discuss tonight because we just simply haven't enough time. But there is one item among them to which I do want to call your attention, because it has a particular significance. This item has to do with the age and origin of the globular clusters. If the stars of those clusters are old, as contended by the astronomers (conclusion number sixteen) then the clusters themselves are presumably old -- that's conclusion seventeen. And the astronomers have therefore decided that they must have been products of the original process of galaxy formation, and are part of the galactic structure -- that's conclusion eighteen. This view encounters some very serious difficulties. One of the most obvious of them is that the clusters do not participate to any significant degree in the galactic rotation, and that is very hard to explain if they are part of the galactic structure. But since conclusion eighteen is a logical result of this line of reasoning, stemming from assumption C, to which the astronomers are committed, they have continued to hold on to this conclusion in spite of all the difficulties, hoping that they will ultimately go away.

But alongside this orthodox evolutionary view of the astronomers, there has in recent years grown up a new concept that contradicts the whole set-up. And since that new con-
cept is accepted quite widely in the astronomical profession, that profession is now in the awkward position where they, or at least a substantial segment of their profession, accept two contradictory explanations for the same thing. This new concept is the concept of galactic cannibalism. Quoting the astronomer Wallace Tucker: "The majority of galactic clusters are dominated by a single massive elliptical galaxy. Apparently these monster galaxies have eaten dozens of their smaller companions." Now obviously, if the giant galaxies can swallow the spirals in their vicinity, the big spirals like ours have the capability of swallowing dwarf galaxies and globular clusters. And in the light of that information, the presence of large numbers of globular clusters surrounding every one of the major galaxies takes on a new significance. In the light of that information it's evident that those globular clusters are not part of the galaxy -- they're external objects that are being drawn in where they can be conveniently swallowed.

Now in that connection it's worth noting that the motions of those clusters that are so difficult to explain on the basis of the astronomers' conclusions, fit in very nicely with the cannibalism hypothesis. Again I want to quote the astronomer Otto Struve. He says they move "much as freely-falling bodies attracted by the galactic center." Of course, on the basis of this new concept, that's just exactly what they are.

Returning now to conclusion fifteen, another one of the consequences of the astronomers' age sequence (conclusions fifteen and sixteen) is that stars must be currently forming in the galaxies, because there are a great many of these hot massive stars in the galaxies, particularly in the galactic arms, and according to the astronomers' viewpoint, those must have been formed fairly recently, and close to their present locations. That confronts the astronomers with a very difficult problem. As I mentioned earlier, the force of gravitation is capable under appropriate circumstances of pulling the particles of the dust and gas clouds together to form stars. The difficulty arises because those appropriate circumstances do not exist in the galaxies.

In order to enable the force of gravitation to do the job unassisted, the dust and gas clouds in the galaxies would either have to be very much larger or very much denser than anything that now exists in the galaxies. So that the astronomers, in order to maintain their theories, have had to try to find some auxiliary process that could work in conjunction with gravitation to produce these results. And they have examined quite a number of processes that they thought might work, but so far they have been unable to produce anything that could stand up to critical scrutiny.
So the result is, as described by an astronomer, Simon Mitten, "The process of star formation is almost a total mystery." When we correct the evolutionary direction, and turn the sequence upside down, the problem disappears; because on that basis there are no stars in the galaxy that are young in absolute terms. It's true that on that basis the stars of the globular clusters, or of the globular cluster type, are younger than the hot massive stars, but that doesn't mean that they are young in absolute terms. It does not preclude their having been formed in some region where the appropriate circumstances for star formation do exist, and having been brought into the galaxy by the capture process.

But since the astronomers accept this conclusion that the stars are currently being formed in the galaxies, they have had to arrive at another conclusion, number twenty, the conclusion that the galaxies are older than the stars that they contain. As it's expressed in one textbook, "According to current conceptions in astrophysics, the galaxies were born first in the universe, and the stars within the galaxies were born afterward. The main reason for believing this to be true is the fact that stars can be seen forming in the galaxies at the present time out of gas and dust." Of course, they can't be seen forming, he merely means that the conditions are such that the theory says that that's where they are forming. Now these ideas as to galaxy formation, conclusion twenty, are very vague. John B. Irwin describes them in this manner. "The Milky Way system, like other galaxies, is thought to have originated from a condensation or collapse of the intergalactic medium. The reason for the collapse is not known, and the details of the process are uncertain." What Irwin is in fact telling us is that astronomers know all about the galactic formation process, except the general nature of the process and the details. L. H. John puts the situation into perspective in this statement: "The encyclopaedias and popular astronomical books are full of plausible tales of condensation from vortices, turbulent gas clouds, and the like, but the sad truth is that we do not know how the galaxies came into being." These are astronomers I am quoting, they are not scientific heretics.

The reason for the difficulty the astronomers are having can be easily understood if it is recognized that their conclusions about the galaxies, number twenty-two on the diagram, are derived not only from this conclusion twenty, which is the result of the line of reasoning that we have been following, but also from a conclusion number twenty-one that directly contradicts conclusion number twenty. This conclusion twenty-one is derived from another assumption contrary to fact. That's the astronomers' assumption that the universe, or at least the present stage of the universe, origi-
nated in a gigantic explosion, the Big Bang as it is called. If they applied the same reasoning that they used in determining their ideas as to the consequences of the supernova explosion, then the explosion that they call the Big Bang would have ejected one part of the material of the universe out into space at high speeds, in the form of an expanding cloud, while another part of the material would have been left at the scene of the explosion in the form of a gigantic black hole. But they are already having serious difficulties in finding some reason why the universe is so isotropic. And if they put a black hole out in the middle somewhere, that would compound the difficulties. So they conveniently ignore what they decided over on the other side of the diagram and on this side of the diagram they decide that the entire contents of the universe, as one textbook puts it, "All of the matter and all the radiation in the universe" is ejected out into space in the form of an expanding cloud.

Now the problem comes then to explain how these particles could have been moving outward at high speeds ever since the Big Bang as required by conclusions twenty-one, and at the same time aggregating into galaxies, as required by conclusion twenty. If you stop to think about that for a little bit you'll understand why the astronomers are having such difficulty, and why their ideas about the formation of galaxies are as vague as these statements have shown them to be.

We've now arrived at the point where we need to take contrafactual assumption D into consideration. As I said earlier, the effects of that conclusion are exerted in a manner that is somewhat different from those of the others. Those other conclusions that I have mentioned tear down the barriers that separate fact from fiction and they permit the astronomers to extend their theories into regions that do not actually exist. The effect of conclusion D, on the other hand, is to set up barriers that prevent them from extending their theories into areas that actually do exist, and they force them to invent various kinds of substitutes.

The effects of this conclusion D, which is Einstein's conclusion that the speed of light is an absolute speed limit, are expressed in the form of three prohibitions -- number twenty-three, number twenty-four, and number twenty-six on the diagram. Number twenty-three decrees: "Thou shalt not think of speeds greater than that of light in connection with the high density of the white dwarfs and the products of the supernova explosions." It is this prohibition that forces the astronomers into the strange contortions of thought that result in black holes and singularities.
Number twenty-four similarly dictates, "Thou shalt not think of speeds greater than that of light in connection with the intermittent radiation from the pulsars." The pulsars are number twenty-five on the diagram. And you note that the pulsars get a double dose: they're subject to the prohibitions both twenty-three and twenty-four. The result of this double prohibition can be seen in the present state of knowledge in the field. According to Dr. F. C. Smith, one of the leading investigators in the area, "the manner in which the pulsars are produced is not understood, and little is known about the mechanism of the radiation." That's the result of being prohibited from entering the field of high speeds.

Item twenty-six is another edict, "Thou shalt no think of speeds greater than that of light in connection with the quasars." And since almost all of the observable features of the quasars are a result of speeds greater than that of light, the result is that the astronomers are almost completely baffled by the quasars. There is no better fundamental understanding of the quasars now than there was when they were first discovered, twenty years ago. There has been a great deal of empirical information gathered, but there is no understanding of that information. The general tendency in astronomical circles is to blame the physicists. As expressed by one prominent astronomer, Garry Vershuer, "the existence of quasars strongly suggests that we are dealing with phenomena which present-day physics is at a loss to explain." Now that's true. But the astronomers can't evade all responsibility. They did not have to accept all of these contrafactual assumptions that the physicists have made.

When the first pulsar was discovered, the regularity of the pulses suggested that they might be artificially created, and for a time it was fashionable to refer to them as messages from little green men. When more pulsars were found, it was realized that the pulsars must be natural objects, and the little green men were dropped. That may have been a mistake. This universe that the astronomers have worked so hard to construct is not of much use to us except for entertainment, because we are so constituted that we cannot deal physically with things that are not physical. We have to have things which, as Heisenberg says, exist in the same sense that trees and stones exist. But this universe that they have built would be a very appropriate home for the little green men, perhaps even degenerate little green men.
ANOTHER LOOK AT THE PULSAR PHENOMENON

by K.V.K. Nehru

Astronomers have recognized in the pulsars, the extremely compact pulsating stellar objects, opportunities to test the correctness of the predictions of different theories of gravitation. In fact, the substantial amount of accurate observations accrued on the binary pulsar PSR 1913+16 by J.H. Taylor et al.\(^1,2\) brings this goal nearer to achievement. It is, therefore, possible to test the Reciprocal System on the basis of the information now available on PSR 1913+16 and other pulsars.

According to the Reciprocal System, a pulsar is the ultra-high-speed product of a Type II supernova explosion -- the result of reaching the upper rotational limit of matter. In Quasars and Pulsars\(^3\) Larson gives a brief account of the origin and characteristics of pulsars. Arnold Stu{\textit{d}}tman\(^4\) in his doctoral dissertation Towards a Unified Cosmological Physics gives a critique of Larson's theory of pulsars. A study of these raises some issues that need clarification.

1.0. Firstly: we recall that quasars, too, like the pulsars, are the result of gigantic Type II explosions which impart sufficient speed to carry them past the neutral point and into the region of motion in three-dimensional time. The overcoming of the gravitation that gives rise to the pulsation phenomenon is present in the quasar situation as well. As such, the reason why the pulse phenomenon is not apparent in the case of quasars must be explained.

2.0 If Larson's account of the pulse mechanism is correct, it can be seen that the duration of each pulse cannot be more than a few natural units of time (n.u.t.), at the most, beyond the point where gravitation has decreased to half of unit value. But such a conclusion is not consistent with the observed fact, since the pulse widths range from about 5 to 30 milliseconds. For instance, at the point where gravitation is down to 0.500, half of the radiation from the ultra high speed explosion product is observable in space and the other half is unobservable. We thus receive radiation for 0.152 x 10\(^{-15}\) seconds, after which there is a quiet interval of 0.152 x 10\(^{-15}\) seconds, then another flash of radiation, and so on.\(^1\) Here it is important to note that the fraction to which the unit gravitational speed is reduced gives the ratio of the pulse duration to the pulse period. Thus, in the above example, when gravitation has come down to 0.5, we find that there is radiation for a duration of one n.u.t. succeeded by a quiet interval of one
n.u.t. Thus the period is two n.u.t., and the ratio of
pulse duration to pulse period is 1 n.u.t./2 n.u.t. = 0.5.

Now suppose that gravitation has come down to 0.4. In this
case, as far as the radiation is concerned, the proportion
of the spatially active time units to the spatially inac-
tive time units is 0.4 to 0.6. Since there are no frac-
tional units, we find that there will be a radiation pulse
for a duration of 2 n.u.t., followed by a quiet interval of
3 n.u.t., yielding a pulse period of 5 n.u.t. -- the small-
est whole number of n.u.t. possible. However, the ratio
2/3 of the spatially active to the spatially inactive units
is not the only one which is equal to the ratio 0.4/0.6.
The ratios 4/6, 6/9, 8/12, etc. are all mathematically
equal to it. But the 2/3 ratio is the most probable one
since it involves the least number of consecutive units of
any one kind, spatially active or spatially inactive, in
continuous succession. Thus, as the gravitation goes on
attenuating, the pulse period increases, but the pulse
duration does not grow, being constrained by the discrete
unit postulate and the probability principles. By the time
the pulse period has grown to an observationally detectable
size, the pulse duration remains in the range of one n.u.t.
to a few femtoseconds. But this conclusion is at variance
with the actual observed pulse widths. Neither Larson nor
Studtmann points out this discrepancy.

2.1. One way to get over this problem seems to be by realiz-
ing that the magnetic explosion which drives the stellar
matter to the superluminal speeds does not impart those
speeds to all parts of the affected material at the same
instant of time. Presumably the inception of the explosion
takes place at the center of the star and spreads to the
outer layers at the speed of light. Consequently, differ-
ent portions of the star enter the region of motion in
three-dimensional time at different instants. This engen-
ders a phase difference among the radiation pulses given
out by these various portions, while their respective pulse
periods will be the same, since the period is determined by
the degree of attenuation of the gravitation and not by the
epoch of their reaching the gravitational limit. Thus the
observed pulse can be seen to be the result of juxtaposing
individual subpulses (from the different portions), each of
duration not more than a few femtoseconds.

A total pulse width of 10 milliseconds, say, implies that
the portion of the original stellar material that became
the pulsar is of radius

\[(10 \times 10^{-3} \text{ sec}) \times (2.99793 \times 10^5 \text{ km/sec}),\]
equal to 0.0043 solar radii; the outlying material being dispersed into space to form the SNR (supernova remnant). This does not mean that only material within a radius of 3000 km underwent the catastrophic explosion. The explosion might continue to larger radii, but the speed imparted to it becomes less than is necessary to transport the matter to the region of three-dimensional time. Thus, knowledge of the pulse width will enable one to estimate the fraction of the original star's mass that went into the pulsar.

3.0. The next difficulty with Larson's account of the pulse mechanism concerns the occurrence of two separate peaks in the pulses of many pulsars (like CP 0834, CP 1133, NP 0532, PSR 1913+16, etc.) No explanation has been offered for this from the framework of the Reciprocal System. In the conventional lighthouse model, the double peak is explained by suggesting that the pulsar beam is a hollow cone and the peaks could be the two sides of the cone sweeping past our earth. Though this suggestion is perfectly legitimate, the process whereby such a hollow cone beam of polarized radiation can be generated in the pulsar is far from being understood.

3.1. Two ways of accounting for this pulse structure seem possible in the context of the Reciprocal System. Larson points out that the distribution of emitted radiation takes place two-dimensionally "... when (it) originates in the region of ultra high speeds, where physical action takes place only in two scalar space-time dimensions, and not in 3-dimensional space or time." Furthermore, this is also the reason for the radiation to be polarized, as it is constrained to the two dimensions. It is not clear why Larson, while asserting both the two-dimensional distribution of radiation and its polarization in the case of the quasars, highlights only the polarization aspect with nothing more than a passing reference to the planar emission in the case of the pulsars.

The double peak can easily be explained if the pulse production is regarded as being due to the 2-dimensional distribution of the pulsar radiation coupled with the fact of the rapid spinning of the pulsar. Two peaks are the result if the angle between the spin axis and our line of sight is greater than the angle of tilt of the radiation plane relative to the spin axis.

3.2. The second alternative is the explanation offered in item 2.1. above. As the total pulse is seen to be made up of an ensemble of phase-shifted micropulses originating from different zones that are transported to the realm of
motion in 3-dimensional time at different moments, the general shape of the pulse gives an idea of how the explosion progressed.

Obviously the first material to reach superluminal speeds is that nearer the center of the star where the explosion begins. In the normal course, the explosion spreads radially outward in an expanding spherical shell. Therefore, as the explosion progresses, the quantity of the material involved in the explosion increases nearly as the square of the radius, in the initial stages, with the consequent rise in the magnitude of the explosion. This manifests itself as the corresponding increase in the amplitude (luminosity) of the successive subpulses, starting from zero. However, as the explosion front progresses to larger radii it encounters material at lower and lower densities -- the decrease in the density eventually more than offsetting the increase in the spherical area. This results in a fall in the intensity of the explosion and shows up as a decrease in the amplitude of the successive subpulses.

However, if the size of the exploding star is very large, the above phenomenon is modified. The densities in such a star in the regions beyond the initial parts of the explosion are greater compared to a star of smaller size. Under these conditions, the advancing compression wave due to the explosion in the inner regions is usually sufficient to raise the material density at a larger radius and to step up the strength of the explosion again, resulting in the second peak. It may also be noted that in such a case the height of the second peak has normally to be less than that of the first. In the case of a smaller star the second peak does not occur for the reason that the pressure wave simply ejects the low density matter in the outer layers outward, forming the remnants.

The Type II supernova, which is the origin of the pulsar, is the result of reaching an age limit. This also means that the general size of the star is comparatively large (due to accretion) and hence the double peak in the pulse need not be a rare feature. As already remarked, the shape of the pulse is the signature of the explosion. With a knowledge of the density profiles in stars and the kinetics of the explosion it is not difficult to calculate the critical size of the star necessary to produce two peaks in the pulse. Since, as already noted, the pulse duration gives an idea of the radius of the parent star involved in the explosion, it is possible to estimate the mass of the pulsar, its radius, period of rotation, density, luminosity, and average temperature.
4.0.1. The next difficulty is concerning the calculations of the lifetimes. In *Quasars and Pulsars*, Larson explains that the radiation of the pulsar is continuous until the inner gravitational limit is reached in the explosion dimension. Beyond this distance there is a pulsation with an increasing period. There is also another distance, the outer gravitational limit, beyond which there is no gravitational effect at all and hence the pulsar is not visible as it "leaves the material sector" of the universe. In the *Structure of the Physical Universe*, Larson evaluates these two gravitational limits for a star of one solar mass as being 2.26 and 13350 light years respectively. Consequently, he points out that the life of a one-solar-mass pulsar is limited to about 13,000 years.

Further, as the continued attenuation of the gravitation -- which is responsible for the gradual increase of the pulse period -- is related to the inverse square of the distance traveled (in time) Larson arrives at the following relation between the period $P$ and the age $A$:

$$ P = KA^2 $$

where $K$ is a constant. Since both the age and the period of the Crab Nebula pulsar, NP 0532, are known, he calculates the value of the effective inner gravitational limit in the case as being $6 \times 10^{-4}$ light years.

The inner and outer gravitational limits of a star of $m$ solar masses are respectively given by

$$ d_o = 2.26 \sqrt{m} \text{ and } d_1 = 13350 \sqrt{m} \text{ light years.} $$

Therefore, their ratio:

$$ \frac{d_1}{d_o} = \frac{13350}{2.26} = 5907.1 $$

is seen to be independent of the mass. Thus the outer gravitational limit in the above case of NP 0532 works out to be

$$ d_1 = 5907.1 \times (6 \times 10^{-4}) = 0.354 \text{ light years.} $$

This means that its life is limited to 0.354 years, or 130 days! Thus there is an unresolved incompatibility between the requirement of a small inner gravitational limit as little as $6 \times 10^{-4}$ light years (to account for the pulsar's present period) and the requirement of an outer gravitational limit as being nearly 13350 light years (to account for the lifetime).
4.0.2. Studtmann\textsuperscript{9} estimates the masses of several pulsars on the basis of a relation involving the maximum possible age of a pulsar. For example, the maximum pulse period, for the Vela pulsar, PSR 0833, is computed to be 5.2345 seconds. Then on the basis of $P = K A^2$ relation, the $A_{\text{max}}$ of PSR 0833 is calculated to be

$$1503 \times (5.2345/0.0892)^{3/2} = 11514 \text{ years}$$

where 0.0892 seconds is its present (1969 value) pulse period at the age of 1503 years. Comparing this maximum age with that of a one solar mass pulsar, namely 13350 years, he calculates the mass of PSR 0833 as $(11514/13350)^2 = 0.74$ solar masses.

However, there is an inconsistency in the calculations. This stems from the fact that the present age of the Vela pulsar, 1503 years, used in the above computation is, in the first instance, arrived at in an earlier calculation on the basis that its mass is one solar mass. To be precise, the fact that the value of the constant $K$ in $P = K A^2$ is dependent on the mass of the pulsar seems to have been overlooked. The period $P_o$ of the pulsar at an age $A_o$, when it just arrived at the inner gravitational limit $d_o$, is one n.u.t. Since $d_o = A_o$ (when the former is expressed in light years and the latter in years)\textsuperscript{12} we have

$$A_o = 2.26 \sqrt{m}$$

(see item No. 4.0.1. above). Thus

$$K = \frac{P_o}{A_o^2} = 1.52 \times 10^{-14} / 2.26^2 m$$

Moreover, it will be seen that if $P = K A^2$ is to be true, the maximum possible period, whatever might be the pulsar's mass, turns out to be

$$P_{\text{max}} = (13350/2.26)^3 \times 1.52 \times 10^{-14}$$

$$= 5.31 \times 10^{-4} \text{ seconds}!$$

Once again the inference seems to be that the inner gravitational limit of 2.26 light years is too large.

4.0.3. The next difficulty of the same category is concerning the time derivative of the period, $P$. Studtmann\textsuperscript{11} describes how Larson, from the three relations, $P = K A^2$, $A$ is inversely proportional to $P_{\text{effective}}$, and $P_{\text{effective}} = P_{\text{measured}}$, concludes that $P_{\text{measured}}$ is inversely proportional to $P$ raised to the power of 1.5. But since age $A$ is time, from $P = K A^2$ we have $P = 2KA$. How $A$ is taken to be inversely proportional to $P$ is not clear.
5.0.1. The next category of difficulty is about the pulsar gravitation. Do pulsars exhibit additional redshift like the quasars, which according to the theory arises out of the motion in time?

5.0.2. Because of the ultra high range of speeds imparted to the pulsar material, the material is expanding in time and the gravitation that seems to be acting is gravitation in time. If pulsar gravitation is in time, it is not clear how a pulsar can ever form a binary system (like PSR 1913 + 16, for example).

5.0.3. Further, it must be recalled that gravitation is an inward scalar motion inherent in the very scalar motion forming the material atoms. So long as the material type of atomic rotation is extant, it is not clear how the concomitant gravitation can be anything other than spatial. In the case when the gravitation in space is completely offset by the speed imparted by the explosion, it must be recognized that the explosion speed can only counteract the translational aspect of the gravitation, and cannot nullify the positive scalar rotation much less convert it to the negative rotation of the cosmic atoms which is the source of the gravitation in time. Consequently, even though the two extra units of speed transport the material into the cosmic sector where the gravitation in time is operative, the atoms with the material type rotation cannot form aggregates in 3-dimensional time -- they move outward in time as well as space.

6.0. Explaining the pulsing at X-ray frequencies occurring in the case of some pulsars, Larson says "... accreted low-speed matter will interact with the adjacent portions of the pulsar, and will reduce the speed of some of its constituent particles below the unit level, causing the emission of x-rays ... Inasmuch as all of the three types of radiation, radio, X-ray, and optical, originate in the rapidly moving pulsar, the pulsation rates will be the same for all."\(^{12}\)

But the retarding of the superluminary matter to the region below unit level (thereby causing X-ray emission) will also eliminate the cause for the pulsing phenomenon, since in that speed range radiation is emitted continuously. that is, in every unit of clock time.

6.1 It is suggested that, on the other hand, the x-ray emission could be the result if some portions of the pulsar material are accelerated from the 2-x speed range to the 3-x range, since this speed range brings the motion back into space again (in the second scalar dimension).
7.0. Larson states: "At this . . . 0.500 distance, half of the radiation from the ultra high speed explosion product is observable in space and the other half is unobservable." This description, I think, can be misunderstood by imagining that though the other half of the radiation is unobservable in space, it nevertheless exists. But this is impossible because the photons of radiation, having no independent motion, progress scalarly outward at unit speed and are observable either from the material sector or from the cosmic sector. "The other half" which Larson refers to as being "unobservable" must be radiation which was never emitted. The term "radiation observable in space" could be misleading too.

In his Structure of the Physical Universe, Larson very clearly explains the mechanism of the emission of radiation, making use of the Principle of Inversion. "From this principle we find that the thermal motion of the atoms of matter is in equilibrium with a similar vibratory motion of the space units in which they are located. . . . and as space-time progresses it carries this vibrational motion of the space units along as radiation." The atoms enter new space units as they are moving inward in space (while space-time is progressing outward), and these new units also acquire the vibration and become photons.

So long as the material atoms are continuously moving from one space location to another (in the inward direction) by virtue of their gravitational motion, each successive space unit traversed turns into a photon, and the radiation is continuous. If the radiation is to be intermittent -- as in the case of the pulsars -- this can happen only if the motion of the atom is intermittent. For instance, in the example cited by Larson, where the gravitation is down to 0.500, the atoms move inward to the adjoining space unit in one unit of time and in the next unit of time their movement is coincident with the background space-time progression. From the foregoing it can be seen that if \( L_0 \) is the luminosity calculated from the Stefan-Boltzmann Law, the actual luminosity \( L \) is proportional to \( L_0 / P \) where \( P \) is the pulse period, because the energy leaves the atoms only intermittently. If this argument is legitimate it must lead to the correct theoretical identification of the relationship between the radio luminosity and the period.
REFERENCES


7. Ibid., p. 100.

8. Ibid., p. 169.


9. Ibid., p. 588.

10. Ibid., p. 591.

11. Ibid., p. 592.


A previous paper of mine\(^1\) presented a semi-theoretical equation for cohesive energy of a pure solid at zero temperature and zero external pressure. Since then I have been able to work out a more theoretical expression, which is as follows:

\[
U = [(P_o \times V_o^2)/V] - E_o \quad <1>
\]

where:

- \(U\) = cohesive energy of pure solid at zero temperature
- \(V_o\) = volume at zero temperature and zero external pressure
- \(V\) = volume at zero temperature and any external pressure
- \(P_o\) = internal pressure
- \(E_o\) = zero-point energy

With eq. \(<1\>\) we can easily calculate the bulk modulus, which is defined as

\[
B = V \times (d^2U/dV^2) \quad <2>
\]

(dropping the sign, since \(U\) is also treated as positive).

Here,

\[
\frac{dU}{dV} = - \frac{[P_o \times (V_o^2)]/V^2}{V^2}
\]

\[
\frac{d^2U}{dV^2} = \frac{(2 \times P_o \times V_o^2)/V^2}{V^2}
\]

Thus

\[
B = V \times \left\{ \frac{(2 \times P_o \times V_o^2)/V^2}{V^2} \right\} = \frac{(2 \times P_o \times V_o^2)/V^2}{V^2} \quad <3>
\]

At zero external pressure and temperature, \(V = V_o\), and so

\[
P_o = 2 \times P_o \quad <4>
\]

This equation was previously derived by Larson from the postulates of the Reciprocal System.

Now if in eq. \(<1\>, \ V = V_o\), then

\[
U_o = P_o \times V_o - E_o \quad <5>
\]

The term \(E_o\) is easily calculable from the zero-point temperature, \(T_o\), and is found to be negligible (except possible for the noble elements). The term \(V_o\) is also easily calculable; it is

\[
V_o = G \times N \times s_o^3 \quad <6>
\]
where

\[ G = \text{geometric factor of crystal} \]
\[ N = \text{Avogadro's number} \]
\[ s_0 = \text{nearest neighbor distance}. \]

However, the term \( P_0 \), in application to cohesive energy, has turned out to be different than previously thought. The original equation was

\[ P_0 = \left( K \ast a \ast z \ast y \right) / s_0^1 \]  <7>

where

- \( k = \text{numerical constant} \)
- \( a, z, y = \text{compressibility factors of material} \)

The factor \( y \) (the number of effective rotational units in the third dimension) has been found in the present application to be equal to 1 in all cases, not merely in most cases. Since the value of \( a \) (the number of effective magnetic displacement units) is always 4 (except for the noble elements) this leaves \( z \) as the only adjustable term. Here, \( z \) is the number of effective electric displacement units, ranging from 1 to 8. The value of \( z \) in the present application has been found in nearly all cases to be either the value of \( z \) used in the compressibility relations or the value of \( z \) used in the thermal relations or some intermediate value. Let \( z' \) denote this modified \( z \) value; then the reduced equation for cohesive energy is

\[ U_0 = 100.56 \ast G \ast z' \text{ (KJ/mole)} \]  <8>

Table II of the previous paper is reproduced here with the revisions in the calculations. The last two columns are the experimental values from Kittel\(^2\) and Zhdanov\(^3\) Note that the two experimental values for each element sometimes differ by more than 20 percent.

The equation given in the previous paper for the cohesive energy of the noble elements, \( U_0 = \frac{1}{2} P_0 V_o \), produced the correct values, but as matters now stand it is theoretically unacceptable since the thermal \( \frac{1}{2} \) factor is already taken into account in \( P_0 \). Since \( z' \) is determined by electric displacement and since the noble elements have zero electric displacement, an equation different from equation <8> will have to be worked out for these elements. Possibly equation <5> can be used with \( E = \frac{1}{2} P_0 V_o \).
### TABLE II of previous paper -- revised

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REFERENCES


Volume XII, Number 3  Summer 1983

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RECIROCITY

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A REJOINDER TO K.V.K. NEHRU

by Dewey B. Larson

In a letter published in the May 1975 issue of Reciprocity I stated that I preferred not to comment on articles submitted for publication because "I believe that it is very desirable to encourage free and open discussion of the (Reciprocal) theory and its applications, so that we can have the benefit of as many points of view as possible in extending and clarifying the theoretical structure. I want to avoid saying or doing anything that might give the impression that I am trying to discourage dissenting opinions." These considerations are still applicable, but I think that we have now reached the point where it would be appropriate to discuss the general situation with respect to the extension and refinement of the theory. The article by Dr. Nehru in the Autumn 1982 issue provides a good example of some of the points that need to be emphasized.

The first fact that should be noted is that the theory is derived in its entirety from the fundamental postulates; that is, it consists entirely of the postulates and their necessary consequences, without any content from other sources. This is very important, because it provides the basis for verifying the validity of the theory by application of the probability principles. In physical matters we cannot obtain mathematical certainty: a condition in which the probability of error is zero. We have to settle for what we may call physical certainty: a condition in which the probability of error is so small that it is negligible. This is attained by making a very large number of comparisons with the data from experience. Every comparison of this kind is a test of the theory, and each additional test that is made without finding a discrepancy reduces the probability that any discrepancy exists anywhere. But the theory cannot be tested by comparison with what little is known about a poorly understood phenomenon such as the pulsars. The definitive test is the comparison with the observational knowledge about phenomena that are well known and clearly understood. Since the Reciprocal System has already passed this test in thousands of comparisons, its validity is as clearly established as is possible for a physical theory (even though this fact is not yet realized by the scientific community in general).

It needs to be recognized, however, that the fixed character of the theory that enables establishing its validity also imposes some severe constraints on its further development. In particular, it prohibits introducing any additional assumptions, or anything from observation, in developing the details of application of the theory to specific areas. In order to preserve the status of the theory as a single, integral entity that can be tested as a whole these details must be derived in the same manner as the major conclusions; that is, as necessary consequences of the basic postulates. During the years that have elapsed since the founding of what is now the ISUS, many of those who have participated in the activities of the organization have decided that they would be better satisfied if the conclusions derived from the theory in
certain areas were modified. But as I have just pointed out, the chief merit of the theory, the characteristic that enables us to verify its validity, is its status as a fixed structure, one that we cannot modify to suit our preferences or prejudices.

It does not follow that those of us who have undertaken to develop the details of the theory have necessarily arrived at the correct conclusions in every case. None of us makes any claim to infallibility. Thus it is entirely in order for anyone to take exception to a previous conclusion, providing that he can show that a different conclusion can be derived from a development of the consequences of the fundamental postulates. But if the dissenting opinion is based, either totally or partially, on considerations other than those derived from the postulates of the Reciprocal System it is an expression of a different theory, and it has no claim to a favorable reception by those of us who are working to extend and amplify the Reciprocal System.

This task that we now have ahead of us is to enlarge our area of coverage and apply it to more of the details, meanwhile reexamining and refining the conclusions previously reached that may involve uncertain aspects. We are not looking to see if the theory can produce the right results. We already know, on the strength of the laws of probability, that it is capable of producing the answers that we want. Whether or not we actually find them is not a test of the theory; it is a test of our ability to apply the theory. Even though we have the correct foundation, the answers do not appear automatically. Sometimes they are quite obvious, but more often we have to dig them out.

There are, of course, a multitude of areas still to be covered by the theoretical development. But the issues involved in these areas, such as the list of questions in Dr. Nehru's article, are not "tests of the Reciprocal System," as he calls them. The required tests have already been carried to the point where the results of additional tests have no significance. Dr. Nehru's questions merely amount to a list of some of the things that should be investigated by anyone who undertakes to extend the previous consideration of the pulsars into more detail. This kind of information serves a useful purpose, and we should welcome Dr. Nehru's contribution, but the only thing it "tests" is our ability as investigators.

As it happens, I have considered all of the points mentioned by Dr. Nehru in the course of the investigations that I have undertaken during the past several years in connection with the preparation of the new edition of *The Structure of the Physical Universe*. These investigations have disclosed that in all of the cases that Dr. Nehru mentions, the development of the Reciprocal System of theory produces answers that agree with the known facts. In one instance some modification of the previously published conclusions is required. In all of the other cases my finding is that the previous conclusions are correct, as far as they go.
Most of these matters require more explanation than I can give here, but the first three are relatively simple, and a few comments about them will serve to illustrate the points that I have been making. Dr. Nehru's first question is why the quasars do not pulse as the pulsars do. The answer is that they actually do pulse as they pass through the pulsation zone, but we cannot detect the pulses because they originate from billions of stars and the radiation from these stars is not synchronized. In the second item he points out that the duration of the pulse should be in the range of one unit of time, rather than in seconds, as observed. But the unit of time applies to the unit of mass. The observed pulse is a composite of a vast number of sub-pulses, and it continues as long as there are mass units in the line of travel.

The third item is the reason for two peaks in the pulses of some pulsars. Dr. Nehru says that "no explanation has been offered for this from the framework of the Reciprocal System." This is true. But it is true only because, prior to my recent studies, the results of which have not yet been published, no one had gotten around to examining the question. Just as soon as I had occasion to take a look at the situation, I found the answer obvious. From the explanation of the nature of the pulsars that we derive from theory, it follows that the shape of the pulse is determined by the shape of the pulsating object, specifically its radio structure. The young pulsars, type S as they are known to the astronomers, have pulses with single peaks, which are quite evidently produced by globular structures. The older pulsars, type C, have had time to develop the typical dumbbell form of radio structure, and the double peak simply reflects the existence of this double structure.

These results are typical of those that I have obtained in the astronomical investigation (which I expect to complete in a few more months). Throughout the astronomical field I have found that the application of the Reciprocal System of theory provides simple and logical answers to the outstanding problems. Inasmuch as the extreme conditions to which astronomical objects are subjected stretch physical theory over the widest possible range of application, the fact that the principles and relations developed in the more accessible realms of physical science can be extended to astronomical phenomena without any serious difficulty is very significant.

I do not mean to imply, however, that this is an easy task. In a separate communication Dr. Nehru has raised another issue that brings out the point that exploration of a totally new field of thought, such as that which we are undertaking, is not a simple matter. He notes that my explanation of the destruction of the heavy elements at the stellar temperature limits asserts that the combined space displacement of the ionization and thermal motion neutralizes the rotational time displacement of the atom, and reduces all motion to the linear form. In order to accomplish this, Dr. Nehru comments, the thermal motion must, in some way, be converted to rotation. "The thermal motion, being a linear space displacement, cannot directly destroy the atomic rotation," he says. Actually this is not correct. It would be true if we were deal-
ing with vectorial motion, but all of the motions with which we are here
concerned are scalar, and the scalar situation is quite different.

This is a good illustration of the fact that, even though the theory
has the answers that we are looking for, these answers are by no means
self-evident. I believe that I have a reasonably good understanding of
the primary consequences of the postulates of the Reciprocal System.
Furthermore, I recognized the scalar nature of the basic motion, and
emphasized it in my first book, published in 1959. But it was not until
two or three years ago that I had a clear enough understanding of scalar
motion to be able to answer the point that Dr. Nehru now brings up, if
anyone had raised the issue earlier.

The key to this situation (and to most other questions about the
basic motions as well) is a recognition of the way in which rotational
scalar motion differs from rotational vectorial motion. The difference
can easily be seen if the motion of a point the surface of a rotating
ball (a vectorial motion) is compared with that of a point on the sur-
face of a rotating expanding balloon such as the one that I described in
The Neglected Facts of Science. In the vectorial case the primary
motion of the point is transverse, and the acceleration toward the axis
of rotation causes it to move in a circle around that axis. In the scal-
lar case the primary motion of the point is radial, and the rotation of
its representation in the reference system causes the point to move spi-
 rally outward. The rotation of the atom is a scalar motion similar to
the rotation of the expanding (or contracting) balloon. The thermal
motion is a linear scalar motion that simply adds to, or subtracts from,
the magnitude of the radial motion whose direction is being changed by
the rotation. Attainment of equality between the scalar magnitudes, the
space and time displacements, thus destroys the rotation.

In my opinion, there is no doubt that whatever problems may exist in
other physical areas can similarly be solved by application of the basic
principles and relations that we have derived from the postulates. I am
therefore suggesting to those who are inclined to tackle these problems
that you ought to approach them with the firm conviction that the
answers exist, and that they can be obtained if sufficient time and
effort are applied, along with a little ingenuity.
THEORETICAL EVALUATION OF PLANCK'S CONSTANT

by K.V.K. Nehru

The analysis of physical quantities into their space-time components, made possible by the application of the Reciprocal System, throws fresh illumination on the nature and significance of these quantities. Larson demonstrates that the result of applying the discrete unit postulate to the dimensions of physical quantities results in the principle that the dimensions of the numerator of the space-time expression of any real physical quantity cannot be greater than those of the denominator. Quoting Larson\(^1\):

The most notable of the quantities excluded by this dimensional principle is "action." This is the product of energy, \( t/s \), and time \( t \), and in space-time terms it is \( t^2/s \). Thus it is not admissible as a real physical quantity . . . The equation connecting the energy of radiation with the frequency is

\[
E = h\nu
\]

where \( h \) is Planck's constant . . . expressed in terms of action.

It is clear, however, from the explanation of the nature of the photon of radiation . . . that the so-called "frequency" is actually a speed. It can be expressed as a frequency only because the space that is involved is always a unit magnitude. In reality, the space dimension belongs with the frequency, not with the Planck's constant. When it is thus transferred, . . . the equation for energy of radiation is [in space-time terms]

\[
t/s = t^2/s^2 \neq s/t
\]

In *The Structure of the Physical Universe* Larson derives the value of Planck's constant on this basis, making use of the gravitational constant. In this paper I attempt to do the same, but without bringing the gravitational constant into the picture, with the hope of showing the factors involved more clearly.

We will adopt the suffix \( c \) to denote a quantity expressed in the conventional units, no suffix to denote the quantity expressed in the natural units, and suffix \( n \) to denote the magnitude of the natural unit of a quantity expressed in terms of the conventional units.

Remembering that, on the natural unit basis, any unit of a physical quantity is also the unit of the corresponding inverse quantity, every unit of energy is both a unit of \( t/s \) and a unit of \( s/t \), each in its
proper context, the quantitative relationship between \( E \) natural units of energy and \( u \) natural units of speed can be expressed as

\[
E = (1/1) u
\]
since the numerical magnitude of the \( t^2/s^2 \) term is \((1/1)^2\) in natural units. The speed \( u \) is given by the quotient of \( S \) natural units of space and \( T \) natural units of time. Therefore,

\[
E = S/T
\]

Now we will introduce the conventional units into the equation, but will do so only in the case of those quantities which we want expressed in the conventional units finally. Since \( E = E_c/E_n \) and \( T = T_c/T_n \), we have

\[
E_c = (E_n \times T_n) S/T_c
\]  <2>

However, from what has been quoted earlier, we note that the numerical magnitude \( S \) in eq. 2 is 1, since the vibration is confined to one natural unit of space. The lack of recognition of the true status of the frequency term as a speed term and expressing every quantity in terms of the conventional units (i.e., including 1 cm in place of \( S \)) therefore has the effect of overstating the numerical value on the RHS by a factor of \( 1 \) cm/\( S_n \). As such, the RHS must be multiplied by the reciprocal of this factor. Thus,

\[
E_c = (E_n \times T_n \times S_n /1 \text{ cm}) (1/T_c \text{ cm}) \]  <3>

Or, replacing \( 1/T \) by \( v \), the frequency in Hertz,

\[
E_c = (E_n \times T_n \times S_n /1 \text{ cm}) v
\]  <4>

from which we have Planck's constant as

\[
h = E_n \times T_n \times S_n /1 \text{ cm}
\]  <5>

There are two additional factors to be considered before we can arrive at the numerical magnitude of \( h \). Firstly, since the photon vibration is limited to the time-region while measurements appertain to the outside region, this value of \( h \) is to be reduced by the interregional ratio \( R \). Hence,

\[
h = (E_n \times T_n \times S_n) / (r \times 1 \text{ cm})
\]  <6>

The second factor is concerned with the effect of the secondary mass component \( s \). As long as mass is expressed in the dynamical unit of gram, it becomes necessary to take account of the discrepancy between the units of primary mass and inertial mass. Thus, when adopting the gram-unit, the mass term is to be multiplied by a factor of \( 1 + s \), where 1
is the primary mass and $s$ the secondary mass. In the present case, since energy is $t/s$ while mass is $t^2/s^3$, the multiplying factor is $(1+s)^{1/3}$. Thus,

$$h = \left( \frac{E_n * T_n * S_n}{R * 1 \text{ cm}} \right) * (1+s)^{1/3}$$  \hspace{1cm} <7>

Adopting the values from Ref. 3,

$$E_n = 1.49175 * 10^{-3} \text{ erg}$$

$$T_n = 1.520655 * 10^{-16} \text{ sec}$$

$$S_n = 4.558816 * 10^{-6} \text{ cm}$$

$$R = 156.4444 \text{ (Ref. 5),}$$
and for the secondary mass calculation, from Ref. 6,

$$m, \text{ magnetic mass} = 0.00639205,$$

we have the value of Planck's constant as

$$h = 6.6243162 * 10^{-27} \text{ erg-sec}$$  \hspace{1cm} <8>

But it must be noted that $m$, the magnetic mass, is not the only component of the secondary mass $s$. This is because in the particles with unit net displacement (like, for example, $M \frac{1}{2}$-$\frac{1}{2}$-0), there is always an initial unit of electric mass, of magnitude 0.0005787. Thus $1+s$ becomes 1.00697075. Substituting this in equation <7> gives

$$h = 6.6255857 * 10^{-27} \text{ erg-sec}$$  \hspace{1cm} <9>

This is in close agreement with the experimental value of $6.6256 * 10^{-27}$ erg-sec (within an error of $2.16 * 10^{-4}$ percent).

REFERENCES

2. Ibid., p. 169 (see lines 6-4 from bottom).
3. Ibid., p. 160.
4. Ibid., p. 170.
5. Ibid., p. 162.
6. Ibid., p. 164.
DIMENSIONS IN THE UNIVERSE OF MOTION

by Dewey B. Larson

In my publications I have followed a general policy of not duplicating material that is readily available in the textbooks, in order to conserve space for the new ideas that I am presenting. I therefore do not define terms that are in general use, commenting on the usage only where I have introduced some new concept, or have modified the meaning of a term. There was some confusion about my usage of the term "direction" originally, and I had occasion to discuss this matter in some of my publications. (See, for instance, Nothing But Motion, p. 48). These explanations apparently took care of the problem, as I have heard nothing about directions lately. It now appears that some misunderstandings also exist with respect to my use of the term "dimension." Some comments on the usage of this term may therefore be helpful.

The dimensional situation is complicated by the fact that I necessarily have to use the term in its broadest sense, whereas it is more generally used with a very restricted meaning. From the general standpoint, "dimension" is a mathematical term that may be, but is not necessarily, capable of being represented in geometric form. An n-dimensional quantity is simply one that requires n independent numbers for definition. As one dictionary says, by way of illustration, "a²b²c is a term of five dimensions." Within a certain limited range, dimensions of space may be represented in the conventional reference system, and because this usage is so common, the qualification "spatial" is commonly omitted. Thus we say that a cube is three-dimensional, meaning that it extends into three vectorial dimensions of space. But we also say that space is three-dimensional, and here we mean something different. We do not mean that space extends into three dimensions of space. That statement is an absurdity. What we mean is that three scalar magnitudes — numbers — are required in order to define a location in space.

The space of the conventional reference system is three-dimensional. But it takes all three of these spatial dimensions to represent one dimension of motion in space. Consequently, the present-day physicist, who does not recognize the existence of anything outside the reference system, deal only with one dimension of motion. The prevailing opinion, therefore, is that all real motion can be represented geometrically in the reference system. Where the theorists have to resort to multiple dimensions in order to explain some of the more difficult experimental results, an expedient that has become quite common since observation and measurement have penetrated into the smaller, faster, and more distant regions of the universe, they portray the extra dimensions as in some way unreal. Heisenberg, for example, characterizes the atom as existing in an "abstract multi-dimensional space," whatever that means.

My finding is that the real physical universe extends beyond the one dimension of motion represented in the reference system. What I have done is to take the physicists' vague idea of multiple dimensions, and
put it into concrete form. This was the key to the development of a complete and consistent physical theory. One of the requirements for a full understanding of that theory is a recognition that the dimensions of motion are mathematical. When I refer to dimensions in my works, this term has no geometrical connotations, except where so specified. Dimensions are scalar magnitudes, just numbers. Different phenomena involve different numbers of independent magnitudes. It follows that the number of dimensions with which we are concerned depends on the particular phenomenon with which we are dealing.

The first unit of motion, from the spatial zero to unit speed, the speed of light, is one-dimensional in space. The second unit is one-dimensional in time, but because we base our reference system on a spatial speed of zero, it appears in that reference system as a dimension of motion in space plus a dimension of motion in time (to the extent that the reference system can respond to motion in time) from an inverse speed of unity to the temporal zero. On this linear basis, there are two dimensions of motion between zero spatial motion and zero temporal motion; that is, it takes two numbers, one representing the quantity of motion in space and one representing the quantity of motion in time, to express the total magnitude of the motion difference between these two zero levels. Here, then, in this simple situation, we already have a case where the number of dimensions is either one or two, depending on the nature of the phenomenon with which we are dealing; that is, whether it is something that we refer to a zero base, or something that is necessarily referred to the natural base at unity. This is not all. Further dimensions may be introduced into the same situation because the one-dimensional motion that I have been describing can be distributed over three dimensions, in a manner similar to the way in which radiation from a light source is distributed. This does not change the one-unit magnitude, as the cube of one is still one. But if the two-unit magnitude is so distributed it extends to 2^3, or 8, dimensions.

Inasmuch as our base is the spatial zero, a speed of three units adds a second dimension of motion in space to the two-unit combination. The result, three units of speed equivalent, measured from the spatial zero, is equal to three units of inverse speed equivalent, measured from the temporal zero. Beyond this neutral level, the motion as a whole converts to motion in time. But as long as the total speed remains below the neutral level, any motion in time that may exist acts as a modifier of the magnitude of the motion in space, rather than causing an actual change of position in time. This is easily understood on a mathematical basis. If a small negative number is added to a larger positive number, the result is simply a reduction in the magnitude of the positive number. The second dimension of motion is thus a motion in the spatial equivalent of time.

From the foregoing it can be seen that there are six dimensions of motion between the spatial zero and the temporal zero. The basic fact is that the universe is three-dimensional. Beyond this, the number of dimensions that have to be taken into consideration depends on the pa-
ticular feature of the universe with which we are dealing. Of course, all this is very complicated compared to a simple three-dimensional coordinate system, and many individuals would like to put it into some simpler form. But we are dealing with nature, and nature does not accommodate itself to our preferences. Physical theory claims to be able to deal with all of the modern discoveries without going beyond the one dimension of motion that can be represented in a spatial coordinate system. Conventional physics has found it necessary to place the small-scale phenomena of the physical universe in a strange half-world, the "abstract multi-dimensional space" that Heisenberg refers to, a world that is populated by "virtual" particles and other entities that admittedly do not "exist objectively." These ghostly denizens of the phantom sector of the physicists' universe do not obey the normal physical laws or the rules of logic, and are governed by mysterious "forces" of which there is no physical evidence. When all this is taken into consideration, it can easily be seen that I am not increasing the complexity of physical theory. I am merely taking the metaphysical ideas that are too vague to be useful in practice, and putting them into concrete form. The universe is, in fact, complex, and if we want to understand it we will have to meet it on its own terms.
A NOTE ON METAPHYSICS

by Dewey B. Larson

Some of the readers of my latest book, *The Neglected Facts of Science*, are apparently interpreting the conclusions of this work as indicating that the Reciprocal System of theory leads to a strict mechanistic view of the universe, in which there is no room for religious or other non-material elements. This is not correct. On the contrary, the clarification of the nature of space and time in this theoretical development removes the obstacles that have hitherto prevented science from conceding the existence of anything outside the boundaries of the physical realm.

In conventional science, space and time constitute a framework, or setting, within which the entire universe is contained. On the basis of this viewpoint, everything that exists, in a real sense, exists in space and in time. Scientists believe that the whole of this real universe is now within their field of observation, and they see no indication of anything non-physical. It follows that anyone who accepts the findings of conventional science at their face value cannot accept the claims of religion, or any other non-material system of thought. This is the origin of the long-standing antagonism between science and religion, a conflict which most scientists find it necessary to evade by keeping their religious beliefs separate from their scientific beliefs.

In the Reciprocal System, on the other hand, space and time are contents of the universe, rather than a container in which the universe exists. On this basis, the "universe" of space and time, the physical universe, to which conventional science is restricted, is only one portion of existence as a whole, the real "universe" (a word which means the total of all that exists). This leaves the door wide open for the existence of entities and phenomena outside (that is, independent of) the physical universe, as contended by the various religions and many systems of philosophy.

Inasmuch as the Reciprocal System is a theory of the physical universe only, it arrives at no conclusions as to the validity of the contentions of the various non-scientific schools of thought, but it removes all justification for the assertions that are frequently made to the effect that those contentions are scientifically impossible. Those scientists with strong religious convictions who are now looking askance at the Reciprocal System under the mistaken impression that it envisions a purely materialistic universe should, in fact, welcome it, because it removes the basic conflict between science and their religious beliefs.
THEORY OF ELECTRONS AND CURRENTS
Ronald W. Satz

THE LIFETIME OF THE NEUTRON
K.V.K. Nehru

INTER-ATOMIC DISTANCES
Dewey B. Larson
RECIROCITY

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THEORY OF ELECTRONS AND CURRENTS

by Ronald W. Satz

This paper will present the Reciprocal System theory of electrons and currents and compare it with the conventional theory.

1. The Electron

a. conventional theory

According to present theory\(^1\) electrons are classified (along with muons and neutrinos) as leptons, meaning that they are not affected by the strong interaction of nuclear forces but suffer the weak interaction that causes beta decay. These subatoms are all considered to be fermions: they obey Fermi-Dirac statistics, have spin \(s = \frac{1}{2}\), and have spinor-wave functions that satisfy the Dirac equation.

The present theory does not yield equations enabling the calculation of electron mass, charge, and magnetic moment. The \textit{empirical} values are:

\[
\begin{align*}
\text{mass:} & \quad m = 9.109 \times 10^{-31} \text{ kg} \\
\text{charge:} & \quad e = -1.601 \times 10^{-19} \text{ coulombs} \\
\text{magnetic moment:} & \quad u_e = 9.28 \times 10^{-22} \text{ joule/tesla}
\end{align*}
\]

Also no size or shape is definitely specified. The closest we have is the following:

It is obviously tempting to picture an electron as a spinning sphere of electric charge whose radius is determined by the dimensional relation \(e^2/a = mc^2\) at which the electrostatic self-energy of the charge distribution is comparable with the relativistic energy of the rest mass. This classical electron radius, \(a = 2.81785 \times 10^{-15} \text{ m}\), is an important scale parameter in physics; but the uniqueness of \(e\), the arbitrariness of the quantization rules, and the difficulty of making it properly relativistic, forbid such a purely classical model.\(^2\)

Note that for this radius, and for a spin angular momentum of \(\frac{1}{2} \sqrt{3} \hbar\), the angular velocity of the electron must be \(2 \times 10^{21} \text{ rad/sec}\) — giving an equatorial speed of about 200c!

b. Reciprocal System

The Reciprocal System is much more specific on the details of electron attributes than conventional theory. My previous papers\(^1\) \& have described the shape, size, and all motions constituting the electron.
The electron is a spherical particle resulting from the rotation of a single photon. The frequency of the photon is

\[ \nu_{\text{phot}} = 2R = 6.576115 \times 10^{15} \text{ cycles/sec} \tag{4} \]

(Here \( R \) is the Rydberg frequency). The rotational speeds in revolutions per second around the three axes are \( r/\pi - 2R/\pi - 4R/\pi \) or

\[ \omega_{\text{elec}} = 1.0466212 \times 10^{15} \text{ rev/sec} - 2.0932424 \times 10^{15} \text{ rev./sec} - 4.1864848 \times 10^{15} \text{ rev/sec} \tag{5} \]

The electron may be charged or uncharged. If charged, the electron has an added rotational vibratory motion of

\[ \nu_{\text{-elec}} = R/2\pi = 5.233106 \times 10^{14} \text{ cycles/sec} \tag{6} \]

The diameter \( d \) of the electron is one natural space unit, reduced by the appropriate inter-regional ratio (142.22 here). Thus,

\[ d = 4.55884 \times 10^{-8} / 142.22 = 3.2054 \text{ Å} \tag{7} \]

2. Electron Flow

a. conventional theory

According to present theory, conduction in metals takes place by movement of the electrons in the outermost shells of the atoms making up the crystalline structure of the solid. These electrons reach an average drift velocity which is directly proportional to the electric field intensity

\[ \vec{v}_d = \mu \vec{E} \tag{8} \]

where \( \mu \), the mobility, has the units \( \text{m}^2/\text{V\cdot s} \). For a conductor of length \( l \), conductivity \( \sigma \) (siemens per meter), and cross-sectional area \( A \), eq. \( \tag{8} \) may be rewritten as

\[ v_d = (\mu l/(\sigma A)) I \text{ m/s} \tag{9} \]

**EXAMPLE:** For a copper conductor 100 mm long and 3 mm in diameter, what is the average drift velocity of the electrons if the current is 10 amps?

For copper,

\[ \sigma = 5.8 \times 10^7 \text{ S/M} \]
\[ \mu = 0.0032 \text{ m}^2/\text{V\cdot s} \]

Here \( A = \frac{1}{4} \pi (3 \times 10^{-3})^2 = 7.0686 \times 10^{-6} \text{ m}^2 \)
Thus,
\[ v_d = \frac{0.0032}{(5.8 \times 10^7 + 7.0686 \times 10^{-6})} \times 10 \]
\[ = 7.805 \times 10^{-6} \text{ m/s} \]

b. Reciprocal System

In the Reciprocal System, the natural unit of velocity is \(2.99793 \times 10^8\) m/s (the speed of light) and the natural unit of current, which is also a velocity, is \(1.0535 \times 10^{-3}\) amperes. The conversion is thus

\[ 2.99793 \times 10^8 \text{ m/s} / 1.05353 \times 10^{-3} \text{ amps} = 2.8456048 \times 10^{11} \text{ m/s/amps} \]

Hence the "drift" velocity of electrons (here uncharged and massless) in the Reciprocal System is

\[ v_d = 2.846 \times 10^{11} \times 10 \text{ m/s} \]

EXAMPLE: For the case of the previous example,

\[ v_d = 2.846 \times 10^{11} \times 10 = 2.846 \times 10^{12} \text{ m/s} \]

The answer of the Reciprocal System is \(3.646 \times 10^{17}\) times the answer of conventional theory!

Of course, the number of electrons passing a given point per second must be the same in both theories. In the conventional theory,

\[ N = (10 \text{ C/s})(1 \text{ electron/1.6} \times 10^{-19} \text{ C}) = 6.25 \times 10^{18} \text{ elec/s} \]

In the Reciprocal System,

\[ N = 3.15842 \times 10^6 \text{ esu/s} \times 1 \text{ electron/4.80287} \times 10^{-16} \text{ esu} \times 10 \text{ amps/1.05353} \times 10^{-3} \text{ amps} \]
\[ = 6.24 \times 10^{19} \text{ elec/s} \]

The difference in "drift" velocities must therefore be due to vastly different numbers of electrons in the matter of the two theories. More about this in another paper.

References


THE LIFETIME OF THE NEUTRON

by K.V.K. Nehru

Theoretical findings of the Reciprocal System indicate that the neutron exists in two forms: as the massless type, \( M \frac{1}{2} \cdot \frac{1}{2} = 0 \), and as the compound type, \( M 1-1-(1) = C (\frac{1}{2})-(\frac{1}{2})-1 \). As matters now stand, while the massless neutron is unobserved, the compound neutron is identified as the observed neutron. Larson shows how the mass of the compound neutron, calculated from the Reciprocal System, agrees with the observed value.\(^1\) This paper attempts to arrive at the compound neutron's lifetime on the basis of the same theoretical system and thus add a further element of validation to the identification of the compound neutron.

The motional structure of the compound neutron is rather unusual. First, while its net total displacement is only one unit, like that of the sub-atomic particles, it has two rotating systems like the atoms. Secondly, it is the only structure (of those that have been identified so far) in which the two rotating systems are completely "heteroscalar," that is, while one system is built up on the material rotational base (with negative vibration and positive rotation), the second system is built up on the cosmic rotational base (with positive vibration and negative rotation).

Since basically the gravitation of the cosmic type structure is inward in time, cosmic rotational units cannot exist in the material reference frame (with its outward time progression) for not more than one natural unit of time under ordinary circumstances. This, however, does not apply in the case of the cosmic neutrino type rotation that constitutes the second rotating system of the compound neutron, for its net effective three-dimensional rotational displacement is zero. Nonetheless, the association of \( M 1-1-(1) \) and \( C (\frac{1}{2})-(\frac{1}{2})-1 \) should not last for more than one natural unit of time. The reason is that the corresponding displacements of the two systems, both in the case of the basic photon vibration and in the case of a rotation in any of the dimensions, are respectively of opposite space-time directions. Since the relation of space to time constitutes motion, the two rotating systems must dissociate after the elapsing of one natural unit of time.

The situation, however, is not quite so simple: the two rotating systems belong to different space-time regions, and the motion that is effective across the regional boundary is determined by the interregional factors arising out of the limitation on the number of directions that can be transmitted. We may recall that a material rotating unit — either an atom or a subatomic particle — exists inside one natural unit of space, i.e., the "time region," whereas a cosmic rotating unit exists in the "space region," which is inside of one natural unit of time. Now the crucial point to be recognized is that the expulsion of the c-neutrino motion (from the compound neutron) takes place only if the direction of the c-neutrino motion, interacting across the inter-regional boundary, happens to be antiparallel to the direction of the motion of the proton.
motion, and not otherwise. Thus the lifetime of the compound neutron is the time elapsed before the eventual occurrence of this antiparallel encounter that results in the neutron's decay.

Had the cosmic type rotation in the second rotating system of the compound neutron been a one-dimensional motion, the encounter and resultant decay would take place within one natural unit of time. But the neutrino-type rotation, i.e., \( C(\frac{1}{4})-(\frac{1}{4})-1 \), is three-dimensional, and it is known that the full influence of spatial (or temporal) effects does not get transmitted across the boundary, except when it involves only one dimension. On the other hand, only a fraction of \( 1/c \) in the case of two-dimensional effects, and a fraction of \( 1/c^2 \) in the case of three-dimensional effects gets transmitted.\(^2\) As such, the effect of the c-neutrino motion existing in the space region and interacting with the proton motion existing in the time region is reduced by a factor of \( 1/c^2 \).

Here we must recall:

... the non-rotating photon remains in the same absolute location permanently. ... The rotating photon, on the other hand, is continually moving from one absolute location to another as it travels back along the line of the progression of the natural reference system, and each time it enters a new absolute location the vectorial direction is re-determined by the chance process. Inasmuch as all directions are equally probable, the motion is distributed uniformly among all of them. ...\(^3\)

In the present case, although net effective rotational displacement of the c-neutrino motion is zero, its net total rotation is one negative unit, and after the elapse of each natural unit of time (n.u.t.), its direction is re-determined by chance. Therefore, inasmuch as the chances of the orientation of the c-neutrino motion taking the correct direction in three-dimensional time, required for an antiparallel encounter referred to earlier, are reduced by a factor of \( 1/c^2 \), the probable time for this encounter to happen is increased from one n.u.t. to \( c^2 \) n.u.t.

However, it must be noted that the number of possible orientations that the proton rotation can take in three-dimensional time is not just one but is given by the interregional ratio, \( R. \) As any of these orientations in the time region can deal with the incoming c-neutrino motion, the chances of the antiparallel encounter are increased by the factor \( R. \) In other words, this means that the previous lifetime arrived at, \( c^2 \) n.u.t. or \( c^2 \times t_{nat}/R \) seconds, where \( t_{nat} \) is one n.u.t. expressed in the c.g.s. units.

(It can readily be seen that since \( c^2/R \) represents the total number of possibilities of equal probability for the antiparallel encounter, \( R/c^2 \) is the probability that the neutron decays in one unit of time. Thus it can be identified with \( \lambda \), the classical decay constant).
The value of $R$ pertinent here is not the 128 $(1 + 2/9)$ value computed in *Nothing But Motion*. Firstly, the proton, $M 1-1-(1)$ is a single rotating system unlike the atoms, which are double rotating systems. As such, only one of the nine possible vibrational positions is occupied, bringing the total number of orientations to 128 $(1 + 1/9)$. Secondly, of the two mutually opposite directions in any dimension of the basic photon vibration, only one results in an antiparallel alignment (the other resulting in a parallel alignment). Consequently, the effective vibrational contribution reduces by half. Thus the value of $R$ applicable to the present situation is 128 $(1 + 1/18) = 135.1111$.

Adopting the values of $\gamma$ and $\tau_{\text{nat}}$ from *Nothing But Motion*, we have the mean lifetime of the compound neutron as

$$\tau = \frac{(2.99793 \times 10^4)^2}{135.1111} \times (1.520655 \times 10^{-14})$$

$$= 1.01154 \times 10^3 \text{ sec. or } 16.859 \text{ min.}$$

Or the same result can be expressed in terms of half-life $T$ as

$$T = \tau \times \ln 2$$

$$= 1.01154 \times 10^3 \times \ln 2$$

$$= 701.145 \text{ sec. or } 11.686 \text{ min.}$$

This compares very favorably with the experimental value of $11.7 \pm 3$ min. (American Institute of Physics, HB., pp. 8-118) with a discrepancy of -0.144 percent.

**References**


ADDENDUM

Besides the compound neutron and the mass-one hydrogen isotope belonging to the "intermediate" rotating systems, there appears to be another theoretical possibility. The two rotating systems of this particle are made up of the material neutrino-type rotation and the cosmic electron rotation respectively. Thus it can be designated: M ½-½-(1) = C 0-0-1. As can be seen, while the net displacement of one system is zero, there is a net positive displacement in the other system. As the net total displacement of the combination is equivalent to that of the neutron, M ½-½-0, this seems to be another version of the compound neutron. But due to the small mass and the extremely short lifetime of this combination, it might easily escape detection.

The potential mass of both the neutrino and the c-electron is actualized when the rotations of these particles enter into combination, constituting this compound neutron. In addition, there is an initial electric unit as the two rotational bases are heteroscalar. The resulting mass is 0.00231482.

Since the c-electron has effective rotation in only one dimension, the mean lifetime of this compound particle, calculated on the basis of the considerations developed in the paper is:

\[ \tau = \tau_{\text{nat}}/R = 1.520655 \times 10^{-16}/135.1111 \]

\[ = 1.1255 \times 10^{-16} \text{ sec.} \]
INTER-ATOMIC DISTANCES

by Dewey B. Larson

As equation 1-10 indicates, the distance between any two atoms in a solid aggregate is a function of the specific rotations of the atoms. Since each atom is capable of assuming any one of several different relative orientations of its rotational motions, it follows that there are a number of possible specific rotations for each combination of atoms. This number of possible alternatives is still further increased by two additional factors that were discussed earlier. The atom has the option, as we noted in Chapter 10, Vol. I, of rotating with the normal magnetic displacement and a positive electric displacement, or with the next higher magnetic displacement and a negative electric increment. And in either case, the effective quantity, the specific rotation, may be modified by extension of the motion to a second vibrating unit, as brought out in Chapter 1.

It is possible that each of these many variations of the magnitude of the specific rotation, and the corresponding values of the inter-atomic distances, may actually be realized under appropriate conditions, but in any particular set of circumstances certain combinations of rotations are more probable than the others, and in ordinary practice the number of different values of the distance between the same two atoms is relatively small, except in certain special cases. As matters now stand, therefore, we are able to calculate from theoretical premises a small set of possible inter-atomic distances for each element or compound.

Ultimately it will no doubt be advisable to evaluate the probability relations in detail so that the results of the calculations will be as specific as possible, but it has not been feasible to undertake this full treatment of the probability relationships in this present work. In an investigation of so large a field as the structure of the physical universe there must not only be some selection of the subjects that are to be covered, but also some decisions as to the extent to which that coverage will be carried. A comprehensive treatment of the probability relations wherever they enter into physical situations could be quite helpful, but the amount of time and effort required to carry out such a project will undoubtedly be enormous, and its contribution to the major objectives of this present undertaking is not sufficient to justify allocating so much of the available resources to it. Similar decisions as to how far to carry the investigation in certain areas have had to be made from time to time throughout the course of the work in order to limit it to a finite size.

1 This article is a pre-publication of the second chapter of Volume II of the revised edition of The Structure of the Physical Universe. The first chapter appeared in Reciprocity XII.1.
It might be well to point out in this connection that it will never be possible to calculate a unique inter-atomic distance for every element or combination of elements, even when the probability relations have been definitely established, as in many cases the choice from among the alternatives is not only a matter of relative probability, but also of the history of the particular specimen. Where two or more alternative forms are stable within the range of physical conditions under which the empirical examination is being made, the treatment to which the specimen has previously been subjected plays an important part in the determination of the structure.

It does not follow, however, that we are totally precluded from arriving at definite values for the inter-atomic distances. Even though no quantitative evaluation of the relative probabilities of the various alternatives is yet available, the nature of the major factors involved in their determination can be deduced theoretically, and this qualitative information is sufficient in most cases to exclude all but a very few of the total number of possible variations of the specific rotations. Furthermore, there are some series relations by means of which the range of variability can be still further narrowed. These series patterns will be more evident when we examine the distances in compounds in the next chapter, and they will be given more detailed consideration at that point.

The first thing that needs to be emphasized as we begin our analysis of the factors that determine the inter-atomic distance is that we are not dealing with the sizes of atoms; what we are undertaking to do is to evaluate the distance between the equilibrium positions that the atoms occupy under specified conditions. In Chapter 1 we examined the general nature of the atomic equilibrium. In this and the following chapter we will see how the various factors involved in the relations between the rotations of the (apparently) interacting atoms affect the point of equilibrium, and we will arrive at values of the inter-atomic distances under static conditions. Then in Chapters 5 and 6 we will develop the quantitative relations that will enable us to determine just what changes take place in these equilibrium distances when external forces in the form of pressure and temperature are applied.

As we have seen in the preceding volume, all atoms and aggregates of matter are subject to two opposing forces of a general nature: gravitation and the progression of the natural reference system. These are the primary forces (or motions) that determine the course of physical events. Outside the gravitational limits of the largest aggregates, the outward motion due to the progression of the natural reference system exceeds the inward motion of gravitation, and these aggregates, the major galaxies, move outward from each other at speeds increasing with distance. Inside the gravitational limits the gravitational motion is the greater, and all atoms and aggregates move inward. Ultimately, if nothing intervenes, this inward motion carries each atom within unit distance of another, and the directional reversal that takes place at the unit boundary then results in the establishment of an equilibrium.
between the motions of the two atoms. The inter-atomic distance is the distance between the atomic centers in this equilibrium condition. It is not, as currently assumed, an indication of the sizes of the atoms.

The current theory which regards the inter-atomic distance as a measure of "size" is, in many respects, quite similar to the electronic "bond" theory of molecular structure. Like the electronic theory, it is based on an erroneous assumption — in this case, the assumption that the atoms are in contact in the solid state — and like the electronic theory it fits only a relatively small number of substances in its simple form, so that it is necessary to call upon a profusion of supplementary and subsidiary hypotheses to explain the deviations of the observed distances from what are presumed to be the primary values. As the textbooks point out, even in the metals, which are the simplest structures from the standpoint of the theory, there are many difficult problems, including the awkward fact that the presumed "size" is variable, depending on the nature of the crystal structure. Some further aspects of this situation will be considered in Chapter 3.

The resemblance between these two erroneous theories is not confined to the lack of adequate foundations and to the nature of the difficulties that they encounter. It also extends to the resolution of these difficulties, as the same principles that were derived from the postulates of the Reciprocal System to account for the formation of molecules of chemical compounds, when applied in a somewhat different way, are the general considerations that govern the magnitude of the inter-atomic distance in both elements and compounds. Indeed, all aggregates of electronegative elements are molecular in their composition, rather than atomic, as the molecular requirement that the negative electric displacement of an atom of such an element must be counterbalanced by an equivalent positive displacement in order to arrive at a stable equilibrium in space applies with equal force to a combination with a like atom. As we saw in our examination of the structural situation, electropositive elements are not subject to this restriction, but in many cases the molecular (balanced orientation) type of structure takes precedence over the electropositive structure by reason of collateral factors that affect the relative probability. Because of this fact that the distances follow the structural pattern, the various ways of orienting the atomic rotations that were discussed in Chapter 18, Vol. I, with a few modifications due to the special conditions that exist in the elemental aggregates, determine the manner in which the atoms of an element are able to combine with each other, and the effective values of the specific rotations in these combinations.

In the electropositive elements the specific rotations are based, in the first instance, on the rotational displacements as listed in Chapter 10, Vol. I. Where the inter-atomic orientation is the normal positive arrangement, the displacements as listed are translated directly into specific rotations by addition of the initial unit and reduction of the incremental values where the rotation extends to vibration two. Except for the elements of group 2A, which, as already noted, are subject to
some special considerations because of their low magnetic displacements, the elements of Division I all follow the regular electropositive pattern of specific rotations. The only irregularities are in the electric rotations of the second and third elements of each group, where the point of transition to vibration two varies between groups. The inter-atomic distances in this division are listed in Table 2.

Table 2

Distances - Division I

<table>
<thead>
<tr>
<th>Group</th>
<th>Atomic Number</th>
<th>Element</th>
<th>Specific Rotation Magnetic</th>
<th>Electric</th>
<th>Distance Calc.</th>
<th>Obs.</th>
</tr>
</thead>
<tbody>
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<td>2B</td>
<td>11</td>
<td>Sodium</td>
<td>3-2½</td>
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<td>3.71</td>
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<td>3.17</td>
<td>3.21</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>Aluminum</td>
<td>3-2½</td>
<td>3</td>
<td>2.83</td>
<td>2.86</td>
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<td>2½</td>
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<td>3.18</td>
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<td>Rubidium</td>
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<td>56</td>
<td>Barium</td>
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<td>3</td>
<td>4.36</td>
<td>4.34</td>
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<tr>
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<td>4</td>
<td>3.70</td>
<td>3.74</td>
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<td>Cerium</td>
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<td>3.61</td>
<td>3.63</td>
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<td>3.79</td>
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<tr>
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<td>90</td>
<td>Thorium</td>
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<td>5</td>
<td>3.52</td>
<td>3.56</td>
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The regular electropositive pattern is also applicable in Division II, and a number of the Division II elements of Group 3A crystallize on this basis, with inter-atomic distances determined in the same manner as in Division I. As noted in Volume I, however, the Division II elements generally favor the magnetic type of orientation in chemical compounds because the normal positive orientation becomes less probable as the displacement increases. The same probability considerations operate against the positive orientation in the elements of this division, but instead of employing the magnetic orientation as the alternate, these elements utilize a type of orientation that is available only where all rotations of each participant in a combination are identical with those of the other. This arrangement reverses the effective directions of the rotations of alternate atoms. The resulting relative rotation is a combination of x and 8-x (or 4-x), as in the neutral orientation, and the effective specific rotations are 10 for vibration one and 5 for vibration two. A combination value 5-10 is also common.
This reverse type of structure makes its appearance in body-centered cubic crystal forms of chromium and iron which coexist with the regular positive hexagonal or face-centered cubic structures. Vanadium and niobium, the first Division II elements of their respective groups, combine the positive and reverse orientations. Beyond niobium the positive orientation does not appear in the common Division II forms of the elements, the structures to which the present discussion is limited, and all elements take the reverse orientation, except europium and ytterbium, which combine it with a unit specific rotation; that is, no electric rotational displacement at all, as in the inert gas elements.

On the basis of the considerations discussed in Chapter 1, the effective specific rotation for such rotational combinations has been taken as the geometric mean of the two components. Where the orientations are the same, and the only difference is in the magnitude, as in the 5-10 combination, and in the combinations of magnetic rotations that we will encounter later, the equilibrium is reached in the normal manner. If two different electric rotations are involved, the two-atom pairs cannot attain spatial equilibrium individually, but they establish a group equilibrium similar to that which is achieved where n atoms of valence one each combine with one atom of valence n.

The Division II distances are shown in Table 3. Because of the greater probability of the electropositive types of combinations, the characteristics of Division II carry over into the first elements of Division III, and these elements, nickel, palladium, and lutetium, are included in the table. Some similar modifications of the normal division boundaries have already been noted in connection with other subjects.

The net total rotation of the material atom is a motion with positive displacement—that is, a speed less than unity—and as such it normally results in a change of position in space. Inside unit space, however, all motion is in time. The orientation of the atom for the purpose of the space-time equilibrium therefore exists in the three dimensions of time. As we saw in our examination of the inter-regional situation in Chapter 12, Volume I, each of these dimensions contacts the space of the region outside unit distance individually. To the extent that the motion in a dimension of time acts along the line of this contact it is a motion in equivalent space. Otherwise it has no spatial effect beyond the unit boundary. Because of the independence of the three dimensions of motion in time the relative orientation of the electric rotation of any combination of atoms may be the same in all spatial dimensions, or there may be two or three different orientations.

In most of the elements that have been discussed thus far the orientation is the same in all spatial dimensions, and in the exceptions the alternate rotations are symmetrically distributed in the solid structure. The force system of an aggregate of such elements is isotropic. It follows that any aggregate of atoms of these elements has a structure in which the constituents are arranged in one of the geometrical patterns possible for equal forces: an isometric crystal. All of the
Table 3
DISTANCES - DIVISION II

<table>
<thead>
<tr>
<th>Group</th>
<th>Atomic Number</th>
<th>Element</th>
<th>Specific Rotation</th>
<th>Distance</th>
<th>Obs.</th>
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<td>Electric</td>
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<td>Technetium</td>
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<td>2.73</td>
</tr>
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<td>5</td>
<td>3.43</td>
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<tr>
<td></td>
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<td>Curium</td>
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<td>5-10</td>
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<td></td>
<td>97</td>
<td>Berkelium</td>
<td>4½-4½</td>
<td>5</td>
<td>3.43</td>
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</table>

electropositive elements (Divisions I and II) crystallize in isometric forms, and, except for a few which apparently have quite complex structures, each of the crystal forms of these elements belongs to one or another of three types: the face-centered cube, the body-centered cube, or the hexagonal close-packed structure.

We now turn to the other major subdivision of the elements, the electronegative class, those whose normal electric displacement is negative. Here the force system is not necessarily isotropic, since the most prob-
able arrangement in one or two dimensions may be the negative orientation, a direct combination of two negative electric displacements, similar to the all-positive combinations. It is not possible to have negative orientation in all three dimensions, and wherever it does exist in one or two dimensions the rotational forces of the atoms are necessarily anisotropic. The controlling factor is the requirement that the net total rotational displacement of a material atom as a whole must be in time. Negative orientation in all three dimensions is obviously incompatible with this requirement, but if the negative displacement is restricted to one dimension the aggregate has fixed atomic positions in two dimensions, with a fixed average position in the third because of the positive displacement of the atom as a whole. This results in a crystal structure that is essentially equivalent to one with fixed positions in all dimensions. Such crystals are not usually isometric, as the inter-atomic distance in the odd dimension is generally different from that of the other two. Where the distances in all dimensions do happen to coincide, we will find on further investigation that the space symmetry is not an indication of force symmetry.

If the negative displacement is very small, as in the lower division IV elements, it is possible to have negative orientation in two dimensions if the positive displacement in the third dimension exceeds the sum of these two negative components, so that the net result is still positive. Here the relative positions of the atoms are fixed in one dimension only, but the average positions in the other two dimensions are constant by reason of the net positive displacement of the atoms. An aggregate of such atoms retains most of the external characteristics of a crystal, but when the internal structure is examined the atoms appear to be distributed at random, rather than in the orderly arrangement of the crystal. In reality there is just as much order as in the crystalline structure, but part of the order is in time rather than in space. This form of matter can be identified as the glassy, or vitreous, form, to distinguish it from the crystalline form.

The term "state" is frequently used in this connection instead of "form," but the physical state of matter has an altogether different meaning based on other criteria, and it seems advisable to confine the use of this term to the one application. Both glasses and crystals are in the solid state.

In beginning a consideration of the structures of the individual electronegative elements, we will start with Division III. The general situation in this division is similar to that in Division II, but the negativity of the normal electric displacement introduces a new factor into the determination of the orientation pattern, as the most probable orientation of an electronegative element may not be capable of existing in all three dimensions. As stated earlier, where two or more different orientations are possible in a given set of circumstances the relative probability is the deciding factor. Low displacements are more probable than high displacements. Simple orientations are more probable than combinations. Positive electric orientation is more probable than neg-
ative. In Division I all of these factors operate in the same direction. The positive orientation is simple, and it also has the lowest displacement value. All structures in this division are therefore formed on the basis of the positive orientation. In Division II the margin of probability is narrow. Here the positive displacement x is greater than the inverse displacement 8-x, and this operates against the greater inherent probability of a simple positive structure. As a result, both the positive and reverse types of structure are found in this division, together with a combination of the two.

In Division III the negative orientation has a status somewhat similar to that of the positive orientation in Division II. As a simple orientation, it has a relatively high probability. But it is limited to one dimension. The regular division III structures of Groups 3A and 3B are therefore anisotropic, with the reverse orientation in the other two dimensions. A combination of these two types of orientation is also possible, and in copper and silver, the first Division III elements of their respective groups, the crystals formed on the basis of this combination orientation have cubic symmetry. As in Division II, the elements of Division III in Groups 4A and 4B crystallize entirely on the basis of the reverse orientation. Table 4 lists what may be considered as the

<table>
<thead>
<tr>
<th>Group</th>
<th>Atomic Number</th>
<th>Element</th>
<th>Specific Rotation</th>
<th>Distance</th>
<th>Calc.</th>
<th>Obs.</th>
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<tr>
<td>3A</td>
<td>29</td>
<td>Copper</td>
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<td></td>
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<td>Tungsten</td>
<td>4-4 1/2</td>
<td>2.73</td>
<td>2.74</td>
<td></td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>Rhenium</td>
<td>4-4 1/2</td>
<td>2.73</td>
<td>2.77*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>76</td>
<td>Osmium</td>
<td>4-4 1/2</td>
<td>2.73</td>
<td>2.73</td>
<td></td>
</tr>
<tr>
<td></td>
<td>77</td>
<td>Iridium</td>
<td>4-4 1/2</td>
<td>2.73</td>
<td>2.71</td>
<td></td>
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<tr>
<td></td>
<td>78</td>
<td>Platinum</td>
<td>4-4 1/2</td>
<td>2.73</td>
<td>2.77</td>
<td></td>
</tr>
<tr>
<td></td>
<td>79</td>
<td>Gold</td>
<td>4 1/2-4 1/2</td>
<td>2.87</td>
<td>2.88</td>
<td></td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>Mercury</td>
<td>4-4 1/2</td>
<td>2.98</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>81</td>
<td>Thallium</td>
<td>4 1/2-4 1/2</td>
<td>3.43</td>
<td>3.47</td>
<td></td>
</tr>
</tbody>
</table>

Table 4
DISTANCES - DIVISION III

regular inter-atomic distances of the elements of Division III.
Although the probability of the negative orientation is greater in Division IV than in Division III, because of the smaller displacement values, this type of structure seldom appears in the crystals of the lower division. The reason is that where this orientation exists in the elements of the lower displacements, it exists in two dimensions, and this produces a glassy or vitreous aggregate rather than a crystal. The reverse orientation is not subject to any restrictive factor of this nature, but it is less probable at the lower displacements, and except in Group 4A, where it continues to predominate, this orientation appears less frequently as the displacement decreases. Where it does exist it is increasingly likely to combine with some other type of orientation. As a result of these limitations that are applicable to the inherently more probable types of orientation, many of the Division IV structures are formed on the basis of the secondary positive orientation, a combination of two 8-x displacements.

The secondary positive orientation is not possible in the electropositive divisions, as 8-x is negative in these divisions, and like the negative orientation itself, an 8-x negative combination would be confined to a subordinate role in one or two dimensions of an asymmetric structure. Such a crystal structure cannot compete with the high probability of the symmetrical electropositive crystals, and therefore does not exist. In the electronegative divisions, however, the 8-x displacement is positive, and there are no limitations on it, aside from those arising from the high displacement values.

The effective displacement of this secondary positive orientation is even greater than might be expected from the magnitude of the quantity 8-x, as the change of zero points for the two oppositely directed motions is also oppositely directed, and the new zero points are 16 displacement units apart. The resultant relative displacement is 16-2x, and the corresponding specific rotation is 18-2x. In Division IV the numerical values of the latter expression range from 10 to 16, and because of the low probability of such high rotations, the secondary positive orientation is limited to one or one and one-half dimensions in spite of its positive character. In Division III the 8-x displacements are lower, but in this case they are too low. A two-unit separation of the zero points (16 displacement units) cannot be maintained unless the effective displacement is at least 8 (one full three-dimensional unit). The secondary positive orientation is therefore confined to Division IV.

A special type of structure is possible only for those electronegative elements which have a rotational displacement of four units in the electric dimension. These elements are on the borderline between Divisions III and IV, where the secondary positive and reverse orientations are about equally probable. Under similar conditions other elements crystallize in hexagonal or tetragonal structures, utilizing the different orientations in the different dimensions. For these displacement 4 elements, however, the two orientations produce the same specific rotation: 10. The inter-atomic distance in these crystals is therefore the same in all dimensions, and the crystals are isometric, even though the rota-
tional forces in the different dimensions are not of the same character. The molecular arrangement in this crystal pattern, the diamond structure, shows the true nature of the rotational forces. Outwardly this crystal cannot be distinguished from the isotropic cubic crystals, but the analogous body-centered cubic structure has an atom at each corner of the cube as well as one in the center, whereas the diamond structure leaves alternate corners open to accommodate the abnormal projection of forces in the secondary positive dimension.

In those of the lower elements of Division IV that are beyond the range of the inverse type of orientation, there is no available alternative for combination with the secondary positive orientation. The crystals of these elements therefore have no effective electric rotation in the remaining dimensions, and the relative specific rotation in these dimensions is unity, as in all dimensions of the inert gas elements. The most common distances in the aggregates of the Division IV elements are shown in Table 5.

Up to this point no consideration has been given to the elements of atomic number below 10, as the rotational forces of these elements are subject to certain special influences which make it desirable to discuss them separately. One cause of deviation from the normal behavior is the small size of the rotational groups. In the larger groups the four divisions are distinct, and, except for some overlapping, each has its own characteristic force combinations, as we have seen in the preceding paragraphs. In an 8-element group, however, the second series of four elements, which would normally constitute Division II, is actually in the Division IV position. As a result, these four elements have, to a certain extent, the properties of both divisions. Similarly, the Division I elements of these groups may, in some cases, act as if they were members of Division III.

A second influence that affects the forces and the crystal structures of the lower group elements is the inactivity of the rotational forces in certain dimensions that was mentioned earlier. A specific rotation of two units produces no effect in the positive direction. The reason for this is revealed by equation 1-1. By applying this equation we find that the effective rotational force (ln t) for t = 2 is 0.693, which is less than the opposing space-time force 1.00. The net effective force of specific rotation 2 is therefore below the minimum value for action in the positive direction. In order to produce an active force the specific rotation must be high enough to make ln t greater than unity. This is accomplished at rotation 3.

The specific magnetic rotation of the 1B group, which includes only the two elements hydrogen and helium, and the 2A group of eight elements beginning with lithium, combines the values 3 and 2. Where the value 2 applies to the subordinate rotation (3-2), one dimension is inactive; where it applies to the principal rotation (2-3), two dimensions are inactive. This reduces the force exerted by each atom to 2/3 of the normal amount in the case of one inactive dimension, and to 1/3 for two
Table 5

DISTANCES - DIVISION IV

<table>
<thead>
<tr>
<th>Group</th>
<th>Atomic Number</th>
<th>Element</th>
<th>Specific Rotation</th>
<th>Distance</th>
<th>Calc.</th>
<th>Obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Magnetic</td>
<td>Electric</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2B</td>
<td>14</td>
<td>Silicon</td>
<td>3-3</td>
<td>2.31</td>
<td>2.35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>Phosphorus</td>
<td>3-3</td>
<td>2.19</td>
<td>2.20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3-4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3-4</td>
<td>3.46</td>
<td>3.48*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>Sulfur</td>
<td>3-3</td>
<td>2.11</td>
<td>2.07</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3-3</td>
<td>3.21</td>
<td>3.27*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>Chlorine</td>
<td>3-3</td>
<td>1.92</td>
<td>1.82</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3-3</td>
<td>2.48</td>
<td>2.52</td>
<td></td>
</tr>
<tr>
<td></td>
<td>32</td>
<td>Germanium</td>
<td>4-3</td>
<td>2.46</td>
<td>2.43</td>
<td></td>
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<tr>
<td>3A</td>
<td>33</td>
<td>Arsenic</td>
<td>4-3</td>
<td>2.37</td>
<td>2.44*</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>4-3</td>
<td>4.36</td>
<td>4.36</td>
<td></td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>Selenium</td>
<td>4-3</td>
<td>2.32</td>
<td>2.32</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3-4</td>
<td>3.46</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>3-4</td>
<td>2.46</td>
<td>2.51</td>
<td></td>
</tr>
<tr>
<td>3B</td>
<td>50</td>
<td>Tin</td>
<td>4-4</td>
<td>2.80</td>
<td>2.80</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5-4</td>
<td>3.22</td>
<td>3.17</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>5-4</td>
<td>2.94</td>
<td>3.02</td>
<td></td>
</tr>
<tr>
<td></td>
<td>51</td>
<td>Antimony</td>
<td>5-4</td>
<td>2.83</td>
<td>2.87</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5-4</td>
<td>3.34</td>
<td>3.36*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>52</td>
<td>Tellurium</td>
<td>5-4</td>
<td>2.82</td>
<td>2.86</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>5-4</td>
<td>3.71</td>
<td>3.74</td>
<td></td>
</tr>
<tr>
<td></td>
<td>53</td>
<td>Iodine</td>
<td>5-4</td>
<td>2.68</td>
<td>2.70</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5-4</td>
<td>3.54</td>
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<td></td>
<td></td>
<td></td>
<td>5-4</td>
<td>4.46</td>
<td>4.41*</td>
<td></td>
</tr>
<tr>
<td>4A</td>
<td>82</td>
<td>Lead</td>
<td>4-4</td>
<td>3.43</td>
<td>3.49</td>
<td></td>
</tr>
<tr>
<td></td>
<td>83</td>
<td>Bismuth</td>
<td>4-4</td>
<td>3.43</td>
<td>3.47*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>84</td>
<td>Polonium</td>
<td>4-4</td>
<td>3.43</td>
<td>3.40*</td>
<td></td>
</tr>
</tbody>
</table>

inactive dimensions. The inter-atomic distance is proportional to the square root of the product of the two forces involved. Thus the reduction in distance is also 1/3 per inactive dimension.

Since the electric rotation is not a basic motion, but a reverse rotation of the magnetic rotational system, the limitations to which the basic rotation is subject are not applicable. The electric rotation merely modifies the magnetic rotation, and the low value of the force integral for specific rotation 2 makes itself apparent by an inter-atomic distance which is greater than that which would prevail if there were no electric displacement at all (unit specific rotation).

Theoretical values of the inter-atomic distances of the lower group elements are compared with measured values in Table 6. The figures in

B 13.1-18
Table 6

DISTANCES - LOWER GROUP ELEMENTS

<table>
<thead>
<tr>
<th>Group</th>
<th>Atomic Number</th>
<th>Element</th>
<th>Specific Rotation</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1B</td>
<td>1</td>
<td>Hydrogen</td>
<td>3(1)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Helium</td>
<td>3(1)</td>
<td>1</td>
</tr>
<tr>
<td>2A</td>
<td>3</td>
<td>Lithium</td>
<td>2½-2½</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Beryllium</td>
<td>3(2)</td>
<td>2½</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Boron</td>
<td>3(2)</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>C (diamond)</td>
<td>3(2)</td>
<td>5-10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C (graphite)</td>
<td>3(2)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3-3</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>Nitrogen</td>
<td>3(1½)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3-3</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>Oxygen</td>
<td>3(1½)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3-3</td>
<td>1</td>
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<tr>
<td>9</td>
<td>9</td>
<td>Fluorine</td>
<td>3(2)</td>
<td>10</td>
</tr>
</tbody>
</table>

Parentheses in column 4 of this table indicate the effective number of dimensions. Thus the notation 3(1) shown for hydrogen means that this element has a specific magnetic rotation of 3, effective in only one dimension.

Except where the crystals are isometric, there is still much uncertainty in the distance measurements on these lower group elements, and many other values have been reported in addition to those included in the table. This situation will be discussed at length in Chapter 3, where we will have the benefit of measurements of the distances between like atoms that are constituents of chemical compounds.

As indicated in the introductory paragraphs of this chapter, we are not yet in a position where we can determine specifically just what the inter-atomic distance will be for any given element under a given set of conditions. The theoretical considerations that have been discussed actually do lead to specific values in many cases, but in other instances there is an uncertainty as to which of two or more theoretically possible rotational arrangements corresponds to the observed crystal structure. Continuing progress is being made in both the experimental and the theoretical fields, and it can be expected that these uncertainties will gradually diminish toward the irreducible minimum that was mentioned earlier. In the course of this process there will necessarily be some changes in the identifications of the observed inter-atomic distances with the theoretically possible structures. A comparison of Tables 1 to 6 with the corresponding tabulations of the first edition should therefore be of interest as an indication of the nature and magnitude of the changes that have taken place in our view of this inter-atomic distance situation in the last twenty years, and by
extension, an indication of the amount of change that can be expected in the future.

Such a comparison shows that the modifications of the original conclusions that now appear to be required, in the light of the additional information that has been made available, are confined almost entirely to those which have resulted from a better theoretical understanding of the behavior of the specific magnetic rotation above an effective value of 4. Few changes are required in either the magnetic or electric values in those rotational combinations where the specific magnetic rotation is 4-4 or less.

One of the puzzling features of the rotational situation as it appeared at the time of the original publication was the apparent retrograde progression of the specific magnetic rotation in Groups 4A and 4B. It was recognized at that time that both the 4½ and 5 values of the specific rotation correspond to the same displacement, 4, the difference being that in the case of the 4½ value the rotation extends to two units of vibration, and the last increment of specific rotation in this case is only half size. The next half unit increment, if such an increment were possible, would bring the 4½ rotation back to the 5 value. It would therefore appear that the sequence of specific rotations beyond 4½-4 should be 4½-4½, 5-4½, 5-5, and so on. But the tendency is in the opposite direction. Instead of moving toward higher values as the atomic number increases, there is actually a decreasing trend. This was already evident at the time of publication of the first edition, as the low inter-atomic distances of the series of elements from tungsten to platinum could not be accounted for unless the specific magnetic rotation dropped back to 4-4½ from the higher levels of the preceding elements of the 4A group. This decreasing trend has become even more prominent as distances have become available for additional elements of Group 4B, as some of these values indicate specific magnetic rotations of 4-4, or possibly even 4-3½.

As it happens, the continuation of the trend toward lower values in the more recent data has had the effect of clarifying the situation. It is now evident that the 5-5 specific rotation is not reached within the accessible portion of Groups 4A and 4B. (Considerations that will be discussed later show that the specific rotation of 5-5 would be unstable.) The lower values in the 4A and 4B groups do not result from a decrease in the magnetic displacement, but from a shift of the existing displacement units from vibration one to vibration two, a process which reduces the specific rotation of the units by one half. On a vibration one basis, rotational displacements 4-3 correspond to specific rotations 5-4. Conversion of successive units of displacement to vibration two, without change in the number of displacement units, results in a series of specific rotations, 5-4, 4½-4, 4-4½, 4-4, and so on. A similar series with one additional displacement unit goes through the values 5-4½, 4½-5, 4½-4½, 4½-4, and then follows the same route as the series with the lower displacement.
The modifications that have been made in the theoretical rotational values applicable to the elements of these two highest rotational groups since the publication of the first edition are the result of a review of the situation in the light of this new understanding of the trend of the specific rotation. The general pattern in group 4A is now seen to be that of the series from 5-4\(\frac{1}{2}\) to 4-4\(\frac{1}{2}\), with a return to 4\(\frac{1}{2}\)-4\(\frac{1}{2}\) in the lower electronegative elements. So far as can be determined at this time, Group 4B follows the same pattern one step farther advanced; that is, it begins with 4\(\frac{1}{2}\)-5 rather than 5-4\(\frac{1}{2}\).

The difference in the inter-atomic distance corresponding to one of the steps in this conversion process is relatively small, and in view of the substantial variation in the experimental values it has not appeared advisable to take into account the possibility of combinations such as 4\(\frac{1}{2}\)-5 specific rotation of one atom of a pair and 4\(\frac{1}{2}\)-4\(\frac{1}{2}\) in the other. It seems clear that such combinations do exist in some of the lower group elements, sodium, for example, and they probably play some part in the higher groups. Most of the reported distances for holmium and erbium, for instance, agree more closely with a combination of 5-4\(\frac{1}{2}\) and 4\(\frac{1}{2}\)-5 than with either individually. However, all of these values are theoretically possible, and the only question at issue in this and many other similar cases is which theoretical value corresponds to the observed distance. Definitive answers to identification questions of this kind will have to wait until the theoretical probabilities are specifically evaluated, or the experimental uncertainties are resolved.

Many questions concerning alternate crystal structures will also have to wait for more information from theory or experiment, particularly where crystal forms that exist only at high temperatures or pressures are involved. There is, however, a large body of information already available in this area, and it can be tied into the theoretical picture as soon as someone has the time and the inclination to undertake the task.
A NOTE FROM THE EDITORS

One of the principal objectives of the editors of *Reciprocity* has always been to diversify its contents by increasing the number of contributors. Unfortunately, the steps that have been taken toward this goal have not, thus far, had the desired effect. For that reason, the 1963 convention at Vancouver, B.C., approved some new policies which it is hoped will encourage the submission of papers by the members. Those involve first, a clarification of the requirements that a contributed paper must meet in order to qualify for publication, and second, some arrangements for editorial assistance in those cases where a limited amount of revision will enable a paper to meet the requirements.

The relevant portions of the text of the new statement of policy are reproduced elsewhere in this issue, but some further explanation of the meaning of the provisions may be helpful, particularly to the contributors who are not experienced in preparing material for publication.

As the statement of policy emphasizes, the primary requirement for publication is that the subject matter of the paper must be some aspect of the Reciprocal System of physical theory. That theory, as defined, consists of the two fundamental postulates and everything that can be derived from those postulates by logical and mathematical processes, without introducing anything from any other source. Thus any paper presenting conclusions derived from the postulates by such processes complies with the basic requirements. Alternatively, the paper may be an extension of previous work; that is, it may be based wholly, or in part, on previously published conclusions that meet the basic requirements.

Particular attention should be given to the requirement that no additional assumptions can be introduced into the development of thought in the papers. The Reciprocal System, by definition, is based entirely on the two fundamental postulates. This is the feature that enables us to demonstrate its validity. Consequently, if a paper introduces an additional assumption, it is no longer dealing with the Reciprocal System, and is not qualified for publication in a journal whose objective is to contribute to the understanding and advancement of that system. This is the most common reason for the failure of papers to meet the publication standards.

In this connection, it should be recognized that the term "postulate" is merely another name for an assumption or group of assumptions. When an author states, in the course of his presentation, that he is postulating something as a part of his development, he is automatically taking his argument outside the Reciprocal System, and disqualifying his paper from publication. Any other added assumption has the same effect, whether or not the author of the paper actually realizes that he is making an assumption.

This does not mean, however, that the views expressed in the papers must necessarily agree with those expressed in previously published books and
articles. None of these is "official" in the same sense as the postulates of the theory, and alternative ideas are acceptable, as long as these ideas and the arguments supporting them are developed within the framework of the Reciprocal System.

PUBLICA TION POLICY

As stated in the by-laws, the objective of the ISUS is the advancement of the Reciprocal System of physical theory. This theory, as it is defined, consists of two fundamental postulates, together with everything that can be derived from those postulates by logical or mathematical processes, without introducing anything from any other source.

The unitary character of the theory, resulting from the derivation of all of its conclusions from the same set of premises, is its most essential feature. It is this status of the theory as a general physical theory — the only thing of its kind — that enables proof of its validity by the probability method, and enables extension of the theory into areas inaccessible to observation.

The purpose of Reciprocity is to contribute toward the accomplishment of the objective of the organization. Acceptance of items for publication shall therefore be determined by the following criteria:

1. All items must have relevance to the stated objective of the ISUS.

2. Original technical articles must deal with the Reciprocal System of theory, as defined above, or aspects thereof; that is, the propositions supported must purport to be derived from the postulates of the Reciprocal System, or from previously published conclusions reached on that basis, without introducing further assumptions.

3. Arguments advanced against previously published material must be similarly based.
DISTANCES IN COMPOUNDS
Dewey B. Larson

THOUGHTS FROM DOWN UNDER
David Halprin

NOTE ON THE FORCE OF THE SPACE-TIME PROGRESSION
Ronald W. Satz
DISTANCES IN COMPOUNDS

by Dewey B. Larson

Thus far in the discussion of the inter-atomic distances we have been dealing with aggregates composed of like atoms. The same general principles apply to aggregates of unlike atoms, but the existence of differences between the components of such systems introduces some new factors that we will now want to examine.

The matters to be considered in this chapter have no relevance to direct combinations of electropositive elements (aggregates of which are mixtures or alloys, rather than chemical compounds). As noted in Chapter 18, Vol. I, the proportions in which such elements can combine may be determined, or limited, by geometrical considerations, but aside from such effects, unlike atoms of this kind can combine on the same basis as like atoms. Here the forces are identical in character and concurrent, the type of combination that we have called the positive orientation. The resultant specific electric rotation, according to the principles previously set forth, is \( V(t_1 t_2) \), the geometric mean of the two constituents. If the two elements have different magnetic rotations, the resultant is also the geometric mean of the individual rotations, as the magnetic rotations always have positive electric displacements, and these combine in the same manner as the positive electric displacements. The effective electric and magnetic specific rotations thus derived can then be entered in the applicable force and distance equations from Chapter 1.

Combinations of unlike positive atoms may also take place on the basis of the reverse orientation, the alternate type of structure that is available to the elemental aggregates. Where the electric rotations of the components differ, the resultant specific rotation of the two-atom combination will not be the required neutral 5 or 10, but a second pair of atoms inversely oriented to the first results in a four-atom group that has the necessary rotational balance.

As brought out in Volume I, the simplest type of combination in chemical compounds is based on the normal orientation, in which Division I electropositive elements are joined with Division IV electronegative elements on the basis of numerically equal displacements. The resultant effective specific magnetic rotation can be calculated in the same manner as in the all-positive structures, but, as we saw in our consideration of the inter-atomic distances of the elements, where an equilibrium is established between positive and negative electric rotations, the resultant is the sum of the two individual values, rather than the mean.

When this arrangement unites one electropositive atom with each electronegative atom the resulting structure is usually a simple cube with the atoms of each element occupying alternate corners of the cube. This is called the Sodium Chloride structure, after the most familiar member of the family of compounds crystallizing in this form. Table 7 gives the inter-atomic distances of a number of common NaCl type crystals.

From this tabulation it can be seen that the special rotational

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TABLE 7

DISTANCES - NaCl TYPE COMPOUNDS

<table>
<thead>
<tr>
<th>Compound</th>
<th>Specific Rotation Magnetic</th>
<th>Elec.</th>
<th>Distance Calc.</th>
<th>Obs.</th>
</tr>
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<tr>
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<td>3(2)</td>
<td>3(2)</td>
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<td>2.04</td>
</tr>
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<td>LiF</td>
<td>3(2)</td>
<td>3(2)</td>
<td>3</td>
<td>2.04</td>
</tr>
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<td>LiCl</td>
<td>3(2)</td>
<td>3½-3⅓</td>
<td>4</td>
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</tr>
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<td>LiBr</td>
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<td>4</td>
<td>2.77</td>
</tr>
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<td>LiI</td>
<td>3(2)</td>
<td>5-4</td>
<td>4</td>
<td>2.96</td>
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<td>5-4</td>
<td>5½</td>
<td>3.13</td>
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<tr>
<td>ScN</td>
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<td>TiC</td>
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<td>8½</td>
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<td>RbF</td>
<td>4-4</td>
<td>3(2)</td>
<td>4</td>
<td>2.77</td>
</tr>
<tr>
<td>RbCl</td>
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<td>3½-3⅓</td>
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<td>4</td>
<td>3.61</td>
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<td>SrO</td>
<td>4-4</td>
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<td>5½</td>
<td>2.51</td>
</tr>
<tr>
<td>SrS</td>
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<tr>
<td>SrSe</td>
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<td>5½</td>
<td>3.10</td>
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<td>5½</td>
<td>3.26</td>
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<td>CsF</td>
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<td>3(2)</td>
<td>4</td>
<td>2.96</td>
</tr>
<tr>
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<td>4</td>
<td>3.47</td>
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<tr>
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<td>3(2)</td>
<td>5½</td>
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<td>5½</td>
<td>3.17</td>
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<tr>
<td>BaSe</td>
<td>5-4½</td>
<td>4-4</td>
<td>5½</td>
<td>3.30</td>
</tr>
<tr>
<td>BaTe</td>
<td>5-4½</td>
<td>5-4</td>
<td>5½</td>
<td>3.47</td>
</tr>
<tr>
<td>LaN</td>
<td>5-4</td>
<td>3(2)</td>
<td>6</td>
<td>2.61</td>
</tr>
<tr>
<td>LaP</td>
<td>5-4</td>
<td>4-3</td>
<td>6½</td>
<td>2.99</td>
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<tr>
<td>LaAs</td>
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<td>4-4</td>
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<td>3.04</td>
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<td>LaSb</td>
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<td>7</td>
<td>3.20</td>
</tr>
<tr>
<td>LaBi</td>
<td>5-4</td>
<td>5-4½</td>
<td>7</td>
<td>3.24</td>
</tr>
</tbody>
</table>

Characteristics which certain of the elements possess in the elemental aggregates carry over into their compounds. The second element in each group shows the same preference for rotation on the basis of vibration two that we encountered in examining the structures of the elements.
Here, again, this preference extends to some of the following elements, and in such series of compounds as CaO, ScN, TiC, one component keeps the vibration two status throughout the series, and the resulting effective rotations are 5½, 7, 8½, rather than 6, 8, 10. The elements of the lower groups have inactive force dimensions in the compounds just as in the elemental structures previously examined. If the active dimensions are not the same in both components, the full rotational force of the more active component is effective in its excess dimensions, the effective rotation in an inactive dimension being unity. For example, the value of ln t for magnetic rotation 3 is 1.099 in three dimensions, or 0.7324 in two dimensions. If this two-dimensional rotation is combined with a three-dimensional magnetic rotation x, the resultant specific rotation is V(0.7324 x), the geometric mean of the individual values, in two dimensions, and x in the third. The average value for all three dimensions is (0.7324 x²)³/³.

This dimensional inactivity in the lower groups plays only a minor role in the structures of the elements, as can be seen from the fact that it did not need any attention until almost the end of Chapter 2. In the compounds, however, it is very significant, because the compounds that contain lower group elements (below atomic number 10) constitute the great bulk of all chemical compounds.

Except for certain types of crystals that are essentially interchangeable, the structures of the elements are determined almost entirely by the nature of the orientations. In compounds there is another active factor: the relative proportions of the components. Where two atoms of one kind form a compound with one atom of another on the basis of the normal orientation, the unequal proportions make the NaCl arrangement impossible, and instead the crystal has the Calcium Fluoride structure, which is also cubic but has a different atomic arrangement. Inter-atomic distances for a number of common CaF₂ type crystals are listed in Table 8.

The compounds of lithium with valence one negative elements follow the regular pattern, and were included in Table 7, but the compounds with valence two elements are irregular, and they have therefore been omitted from Table 8. As we will see in Chapter 6, the irregularity is due to the fact that the two lithium atoms in a molecule of the CaF₂ type act as a radical rather than as independent constituents of the molecule.

These two normal orientation tables, 7 and 8, provide an impressive confirmation of the validity of the theoretical findings. One of the problems in dealing with the inter-atomic distances of the elements is that because of the relatively small total number of elements, the number to which any particular magnetic rotational combination is applicable is quite small, and consequently it is rather difficult to establish a prima facie case for the authenticity of the rotational values. But this is not true of the normal type compounds, as they are more numerous and less variable. There are two elements in these tables, sulfur and chlorine, that have different magnetic rotations under different conditions. These elements have 4-3 rotation in the CaF₂ type crystals, and in the NaCl type combinations with elements of group 4A. In the other compounds of the NaCl type they take the 3½-3½ rotations. There are also two more elements, each of which, according to the information now available, deviates from its normal rotations in one of the listed
**TABLE 8**

**DISTANCES - CaF$_2$ TYPE COMPOUNDS**

<table>
<thead>
<tr>
<th>Compound</th>
<th>Specific Rotation</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na$_2$O</td>
<td>3-2$\frac{1}{2}$</td>
<td>3(2)</td>
</tr>
<tr>
<td>Na$_2$S</td>
<td>3-2$\frac{1}{2}$</td>
<td>4-3</td>
</tr>
<tr>
<td>Na$_2$Se</td>
<td>3-2$\frac{1}{2}$</td>
<td>4-4</td>
</tr>
<tr>
<td>Na$_2$Te</td>
<td>3-2$\frac{1}{2}$</td>
<td>5-4$\frac{1}{2}$</td>
</tr>
<tr>
<td>Mg$_2$Si</td>
<td>3-3</td>
<td>4-3</td>
</tr>
<tr>
<td>Mg$_2$Ge</td>
<td>3-3</td>
<td>4-4</td>
</tr>
<tr>
<td>Mg$_2$Sn</td>
<td>3-3</td>
<td>5-4</td>
</tr>
<tr>
<td>Mg$_2$Pb</td>
<td>3-3</td>
<td>5-4$\frac{1}{2}$</td>
</tr>
<tr>
<td>K$_2$O</td>
<td>4-3</td>
<td>3(2)</td>
</tr>
<tr>
<td>K$_2$S</td>
<td>4-3</td>
<td>4-3</td>
</tr>
<tr>
<td>K$_2$Se</td>
<td>4-3</td>
<td>4-4</td>
</tr>
<tr>
<td>K$_2$Te</td>
<td>4-3</td>
<td>5-4$\frac{1}{2}$</td>
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<tr>
<td>CaF$_2$</td>
<td>4-3</td>
<td>3(2)</td>
</tr>
<tr>
<td>Rb$_2$O</td>
<td>4-4</td>
<td>3(2)</td>
</tr>
<tr>
<td>Rb$_2$S</td>
<td>4-4</td>
<td>4-3</td>
</tr>
<tr>
<td>Sr$_2$</td>
<td>4-4</td>
<td>3(2)</td>
</tr>
<tr>
<td>SrC$_{12}$</td>
<td>4-4</td>
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</tr>
<tr>
<td>BaF$_2$</td>
<td>5-4</td>
<td>3(2)</td>
</tr>
<tr>
<td>BaC$_{12}$</td>
<td>5-4$\frac{1}{2}$</td>
<td>4-3</td>
</tr>
</tbody>
</table>

Compounds. Otherwise, all of the elements entering into the 60 compounds in the two tables have the same specific magnetic rotations in every compound in which they participate.

Furthermore, when the inherent differences between the elemental and compound aggregates are taken into account, there is also agreement between these rotations in the compounds and the specific rotations of the same elements in the elemental aggregates. The most common difference of this kind is a result of the fact that the Division IV element in a compound has a purely negative role. For this reason it takes the magnetic rotation of the next higher group. In the elemental aggregates half of the atoms are reoriented to act in a positive capacity. Consequently, they tend to retain the normal rotation of the group to which they actually belong. For example, the Division IV elements of Group 3A, germanium, arsenic, selenium, and bromine, have the normal specific rotation of their group, 4-3, in the crystals of the elements, but in the compounds they take the 4-4 specific rotation of Group 3B, acting as negative members of that group.

Another difference between the two classes of structures is that those elements of the higher groups that have the option of extending their rotation to a second vibrational unit are less likely to do so if they are combining with an element which is rotating entirely on the basis of vibration one. Aside from these divisions due to known causes, the values of the specific magnetic rotation determined for the elements in Chapter 2 are also generally applicable to the compounds. This equivalence does not apply to the specific electric rotations, as they are determined by the way in which the rotations of the constituents of each aggregate are oriented relative to each other, a relation that is
different in the two classes of structures.

This applicability of the same equations and, in general, the same numerical values, to the calculation of distances in both elements and compounds contrasts sharply with the conventional theory that regards the inter-atomic distance as being determined by the "sizes" of the atoms. The sodium atom, or "ion," in the NaCl crystal, for example, is asserted to have a radius only about 60 percent as large as the radius of the atom in the elemental aggregate. If this atom takes part in a compound which cannot be included in the "ionic" class, current theory gives it still a different "size": what is called a "covalent" radius. The need for assuming any extraordinary changeability in the size of what, so far as we can tell, continues to be the same object, is now eliminated by the finding that the variations in the inter-atomic distance have nothing to do with the sizes of the atoms, but merely indicate differences in the location of the equilibrium between the inward and the outward forces to which the atoms are subject.

Another type of orientation that forms a relatively simple binary compound is the rotational combination that we found in the diamond structure. As in the elements, this is an equilibrium between an atom of a Division IV element and one of Division IIIm the requirement being that $t_1 + t_2 = 8$. Obviously, the only elements that can meet this requirement by themselves are those whose negative rotational displacement (valence) is 4, but any Division IV element can establish an equilibrium of this kind with an appropriate Division III element.

Closely associated with this cubic diamond-like Zinc-Sulfide class of crystals is a hexagonal structure based on the same orientation, and containing the same equal proportions of the two constituents. Since these controlling factors are identical in the two forms, the crystals of the hexagonal Zinc Oxide class have the same inter-atomic distances as the corresponding Zinc Sulfide structures. In such instances, where the inter-atomic forces are the same, there is little or not probability advantage of one type of crystal over the other, and either may be formed under appropriate conditions. Table 9 lists the inter-atomic distances for some common crystals of these two classes.

The comments that were made about the consistency of the specific rotation values in Tables 7 and 8 are applicable to the values in Table 9 as well. Most of the elements participating in the compounds of this table have the same specific rotations as in the previous tabulations, and where there are exceptions, the deviations are of a regular and predictable nature.

A feature of Table 9 is the appearance of one of the normally electro-positive elements of group 2B, aluminum, in the role of a Division III element. Beryllium and magnesium also form ZnS type compounds, but like the lithium compounds previously mentioned they are irregular, probably for the same reason, and have not been included in the tabulation. The Division III behavior of these normally Division I elements is a result of the small size of the lower groups, which puts their Division I elements into the same positions with respect to the electronegative zero point as the Division III elements of the larger groups. This relationship is indicated in the following tabulation, where the asterisks identify those elements that are normally in Division I.
TABLE 9
DISTANCES - DIAMOND TYPE COMPOUNDS

<table>
<thead>
<tr>
<th>Compound</th>
<th>Specific Rotation</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZnS (Cubic) Class</td>
<td></td>
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<tr>
<td>AlP</td>
<td>3-4 3½-3½</td>
<td>10</td>
</tr>
<tr>
<td>AlAs</td>
<td>3-4 4-4</td>
<td>10</td>
</tr>
<tr>
<td>AlSb</td>
<td>3-4 5-4½</td>
<td>10</td>
</tr>
<tr>
<td>SiC</td>
<td>3-4 3(2)</td>
<td>10</td>
</tr>
<tr>
<td>CuCl</td>
<td>3-4 3½-3½</td>
<td>10</td>
</tr>
<tr>
<td>CuBr</td>
<td>3-4 4-4</td>
<td>10</td>
</tr>
<tr>
<td>CuI</td>
<td>3-4 5-4</td>
<td>10</td>
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<tr>
<td>ZnS</td>
<td>3-4 3½-3½</td>
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</tr>
<tr>
<td>GaSb</td>
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<td>10</td>
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<td>AgI</td>
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<td>10</td>
</tr>
<tr>
<td>CdS</td>
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<td>10</td>
</tr>
<tr>
<td>CdTe</td>
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<td>10</td>
</tr>
<tr>
<td>InP</td>
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<td>10</td>
</tr>
<tr>
<td>InAs</td>
<td>4-4 4-4</td>
<td>10</td>
</tr>
<tr>
<td>InSb</td>
<td>4-4 5-4</td>
<td>10</td>
</tr>
<tr>
<td>AlN</td>
<td>3-4 3(2)</td>
<td>10</td>
</tr>
<tr>
<td>ZnO</td>
<td>3-4 3(2)</td>
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<td>ZnS</td>
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<td>GaN</td>
<td>3-4 3(2)</td>
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<tr>
<td>AgI</td>
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<td>CdS</td>
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<td>10</td>
</tr>
<tr>
<td>InN</td>
<td>4-4 3(2)</td>
<td>10</td>
</tr>
</tbody>
</table>

Division III: Be*, Mg*, Zn
B*, Al*, Ga
C  Si  Ge
N  P  As
O  S  Se
F  Cl  Br

None of the orientations thus far considered is applicable to compounds of the Division II elements. The normal orientation does not exist above a specific rotation of 5, as the higher value would put the relative rotation above the limiting value 10. The Zinc Oxide and Zinc Sulfide types of combination are electronegative structures, and the reverse orientation of the Division II elemental structures is not available for compounds with negative elements. The Division II
elements therefore form their compounds on the basis of the magnetic orientation. This type of structure is theoretically available for any element, but its use is limited by probability considerations. It is utilized in many of the compounds of Divisions III and IV, especially in the higher rotational groups, but rarely appears in Division I combinations because of the very high probability of the normal orientation in this division.

Since the magnetic rotation is distributed over all three dimensions, its effective component is not altered by a change in position, and has the same value in the magnetic orientations as in the corresponding compounds based on the electric orientations. In order to establish the magnetic type of equilibrium, however, the axis of the negative electric rotation has to be parallel to that of one of the magnetic rotations, and it is therefore perpendicular to the axis of the positive electric rotation. Consequently, the latter takes no part in the normal inter-atomic force equilibrium, and it constitutes an additional orienting influence, the effects of which were discussed in Volume I. In these compounds of the magnetic type the displacement of the negative component (-x) is balanced by a numerically equal positive displacement (x). Thus the magnetic orientation is somewhat similar to the normal orientation. However, the magnetic rotation is opposite in vectorial direction to the electric rotation, and the resultant relative rotation effective in the dimension of combination is therefore one of the neutral values 10, 5, or a combination of these two, rather than the 2x of the normal orientation.

Compounds based on the magnetic orientation occur in a variety of crystal forms, the nature of which depends on the degree of force symmetry and the number of atoms of each kind in the equilibrium system. In some cases there is enough symmetry to make isometric structures of the NaCl, CaF₂, and similar types possible. Other crystals are asymmetric. A common arrangement for the binary compounds is the Nickel Arsenide structure, a hexagonal crystal in which the positive atoms occupy the face positions and the negative atoms are in the central positions, spaced alternately 1/4 and 3/4 along the c axis. Table 10 shows the inter-atomic distances calculated for some NiAs and NaCl type crystals of binary magnetic orientation compounds of Group 3A.

Almost all of the NiAs type compounds that have been examined in the course of this present work take the vibration one value of the specific electric rotation: 10. The magnetic orientation compounds with the NaCl structure are quite evenly divided between the 10 rotation and the combination 5-10 in the 3A group, but utilize the 5-10 rotation almost exclusively in the higher groups. In order to show as wide a variety of the features of these magnetic type compounds as is possible in the limited amount of space that can be allotted to them, Table 10 has been restricted to Group 3A compounds, and the following Table 11 gives the data for a representative sample of the compounds of the rare earth elements (from Group 4A), together with a selection of compounds from Group 4B, in which the identical values of the inter-atomic distance in the combinations of the elements of this group with the Division IV elements of Group 2A are emphasized.

Thus far the calculation of equilibrium distances has been carried out by crystal types as a matter of convenience in identifying the effect of various atomic characteristics on the crystal form and dimensions. It
TABLE 10
DISTANCES - BINARY MAGNETIC ORIENTATION COMPOUNDS

<table>
<thead>
<tr>
<th>Compound</th>
<th>Specific Rotation Magnetic</th>
<th>Specific Rotation Elec.</th>
<th>Distance Calc.</th>
<th>Distance Obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NiAs (Hexagonal) Class - Group 3A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VS</td>
<td>4-3</td>
<td>3½-3½</td>
<td>10</td>
<td>2.42</td>
</tr>
<tr>
<td>VSe</td>
<td>4-3</td>
<td>4-4</td>
<td>10</td>
<td>2.56</td>
</tr>
<tr>
<td>CrS</td>
<td>4-3</td>
<td>3½-3½</td>
<td>10</td>
<td>2.42</td>
</tr>
<tr>
<td>CrSe</td>
<td>4-3</td>
<td>4-4</td>
<td>10</td>
<td>2.56</td>
</tr>
<tr>
<td>CrSb</td>
<td>4-3</td>
<td>5-4½</td>
<td>10</td>
<td>2.73</td>
</tr>
<tr>
<td>CrTe</td>
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<td>5-4½</td>
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<td>2.73</td>
</tr>
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<td>4-4</td>
<td>10</td>
<td>2.56</td>
</tr>
<tr>
<td>MnSb</td>
<td>403</td>
<td>5-4½</td>
<td>10</td>
<td>2.73</td>
</tr>
<tr>
<td>FeS</td>
<td>4-3</td>
<td>3½-3½</td>
<td>10</td>
<td>2.42</td>
</tr>
<tr>
<td>FeSe</td>
<td>4-3</td>
<td>4-4</td>
<td>10</td>
<td>2.56</td>
</tr>
<tr>
<td>FeSb</td>
<td>4-3</td>
<td>5-4</td>
<td>10</td>
<td>2.69</td>
</tr>
<tr>
<td>FeTe</td>
<td>3-4</td>
<td>5-4</td>
<td>10</td>
<td>2.59</td>
</tr>
<tr>
<td>CoS</td>
<td>3-4</td>
<td>3½-3½</td>
<td>10</td>
<td>2.32</td>
</tr>
<tr>
<td>CoSe</td>
<td>3-4</td>
<td>4-4</td>
<td>10</td>
<td>2.46</td>
</tr>
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<td>CoSb</td>
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<td>5-4</td>
<td>10</td>
<td>2.59</td>
</tr>
<tr>
<td>CoTe</td>
<td>3-4</td>
<td>5-4</td>
<td>10</td>
<td>2.59</td>
</tr>
<tr>
<td>NiS</td>
<td>3½-3½</td>
<td>3½-3½</td>
<td>10</td>
<td>2.37</td>
</tr>
<tr>
<td>NiAs</td>
<td>3½-3½</td>
<td>4-3</td>
<td>10</td>
<td>2.42</td>
</tr>
<tr>
<td>NiTe</td>
<td>3½-3½</td>
<td>5-4</td>
<td>10</td>
<td>2.64</td>
</tr>
</tbody>
</table>

NaCl (Cubic) Class - Group 3A

| VN       | 4-3                         | 3(2)                    | 10             | 2.04         | 2.06         |
| VO       | 4-3                         | 3(2)                    | 10             | 2.04         | 2.05         |
| CrN      | 4-3                         | 3(2)                    | 10             | 2.04         | 2.07         |
| MnO      | 3½-3½                       | 3(2)                    | 5-10           | 2.18         | 2.22         |
| MnS      | 3½-3½                       | 3½-3½                   | 5-10           | 2.59         | 2.61         |
| MnSe     | 3½-3½                       | 4-4                     | 5-10           | 2.75         | 2.72         |
| FeO      | 3-4                         | 3(2)                    | 5-10           | 2.12         | 2.16         |
| CoO      | 3-4                         | 3(2)                    | 5-10           | 2.12         | 2.12         |

is apparent from the points brought out in the discussion, however, that identification of the crystal type is not always essential to the determination of the inter-atomic distance. For example, let us consider the series of compounds NaBr, Na₂Se, and Na₃As. From the relations that have been established in the preceding pages we may conclude that these Division I compounds are formed on the basis of the normal orientation. We therefore apply the known value of the relative specific electric rotation of a normal orientation sodium compound, 4, and the known values of the normal specific magnetic rotations of sodium and the Group 3B elements, 3-3½ and 4-4 respectively, to equation 1-10, from which we ascertain that the most probable inter-atomic distance in all three compounds is 2.95, irrespective of the crystal structure. (Measured values are 2.97, 2.95, and 2.94 respectively.)
### TABLE 11
**DISTANCES - BINARY MAGNETIC ORIENTATION COMPOUNDS**

<table>
<thead>
<tr>
<th>Compound</th>
<th>Magnetic Specific Rotation</th>
<th>Magnetic Elec.</th>
<th>Distance Calc.</th>
<th>Distance Obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CeN</td>
<td>5-4</td>
<td>3(2)</td>
<td>5-10</td>
<td>2.52</td>
</tr>
<tr>
<td>CeP</td>
<td>5-4</td>
<td>4-3</td>
<td>5-10</td>
<td>2.94</td>
</tr>
<tr>
<td>CeS</td>
<td>5-4</td>
<td>31/2 - 3½</td>
<td>5-10</td>
<td>2.89*</td>
</tr>
<tr>
<td>CeAs</td>
<td>5-4</td>
<td>4-4</td>
<td>5-10</td>
<td>3.06</td>
</tr>
<tr>
<td>CeSb</td>
<td>5-4</td>
<td>5-4</td>
<td>5-10</td>
<td>3.22</td>
</tr>
<tr>
<td>CeBi</td>
<td>5-4</td>
<td>5-4</td>
<td>5-10</td>
<td>3.22</td>
</tr>
<tr>
<td>FeN</td>
<td>5-4</td>
<td>3(2)</td>
<td>5-10</td>
<td>2.52</td>
</tr>
<tr>
<td>FeP</td>
<td>5-4</td>
<td>4-3</td>
<td>5-10</td>
<td>2.94</td>
</tr>
<tr>
<td>FeAs</td>
<td>4½-4</td>
<td>4-4</td>
<td>5-10</td>
<td>2.98</td>
</tr>
<tr>
<td>FeSb</td>
<td>4½-4</td>
<td>5-4</td>
<td>5-10</td>
<td>3.14</td>
</tr>
<tr>
<td>NdN</td>
<td>5-4</td>
<td>3(2)</td>
<td>5-10</td>
<td>2.52</td>
</tr>
<tr>
<td>NdP</td>
<td>5-4</td>
<td>4-3</td>
<td>5-10</td>
<td>2.94</td>
</tr>
<tr>
<td>NdAs</td>
<td>4½-4</td>
<td>4-4</td>
<td>5-10</td>
<td>2.98</td>
</tr>
<tr>
<td>NdSb</td>
<td>4½-4</td>
<td>5-4</td>
<td>5-10</td>
<td>3.14</td>
</tr>
<tr>
<td>EuS</td>
<td>5-4</td>
<td>4-3</td>
<td>5-10</td>
<td>2.94</td>
</tr>
<tr>
<td>EuSe</td>
<td>5-4</td>
<td>4-4</td>
<td>5-10</td>
<td>3.06</td>
</tr>
<tr>
<td>EuTe</td>
<td>5-4</td>
<td>5-4½</td>
<td>5-10</td>
<td>3.26</td>
</tr>
<tr>
<td>GdN</td>
<td>5-4</td>
<td>3(2)</td>
<td>5-10</td>
<td>2.52*</td>
</tr>
<tr>
<td>YbSe</td>
<td>4½-4</td>
<td>4-4</td>
<td>5-10</td>
<td>2.98</td>
</tr>
<tr>
<td>YbTe</td>
<td>4½-4</td>
<td>5-4</td>
<td>5-10</td>
<td>3.14</td>
</tr>
<tr>
<td>ThS</td>
<td>4½-4½</td>
<td>3½ - 3½</td>
<td>5-10</td>
<td>2.85</td>
</tr>
<tr>
<td>ThP</td>
<td>4½-4½</td>
<td>4-3</td>
<td>5-10</td>
<td>2.91</td>
</tr>
<tr>
<td>UC</td>
<td>4½-4½</td>
<td>3(2)</td>
<td>5-10</td>
<td>2.47</td>
</tr>
<tr>
<td>UN</td>
<td>4½-4½</td>
<td>3(2)</td>
<td>5-10</td>
<td>2.47*</td>
</tr>
<tr>
<td>UO</td>
<td>4½-4½</td>
<td>3(2)</td>
<td>5-10</td>
<td>2.47</td>
</tr>
<tr>
<td>NpN</td>
<td>4½-4½</td>
<td>3(2)</td>
<td>5-10</td>
<td>2.47</td>
</tr>
<tr>
<td>PuC</td>
<td>4½-4½</td>
<td>3(2)</td>
<td>5-10</td>
<td>2.47</td>
</tr>
<tr>
<td>PuN</td>
<td>4½-4½</td>
<td>3(2)</td>
<td>5-10</td>
<td>2.47</td>
</tr>
<tr>
<td>PuO</td>
<td>4½-4½</td>
<td>3(2)</td>
<td>5-10</td>
<td>2.47</td>
</tr>
<tr>
<td>AmO</td>
<td>4½-4½</td>
<td>3(2)</td>
<td>5-10</td>
<td>2.47</td>
</tr>
</tbody>
</table>

The possible inter-atomic distances in the more complex compounds can be calculated in a similar manner, without the necessity of analyzing the great variety of geometrical structures in which these compounds crystallize. The usefulness of this procedure in application to compounds in general is limited, at the present stage of the theoretical development, because we are not normally able to define the specific rotations from theoretical premises as definitely as in the foregoing illustration. It is of considerable value, however, in dealing with the lower electronegative elements, whose specific electric rotations are confined to the neutral values, and whose variability in the magnetic dimensions is only in the number of inactive dimensions (that is, dimensions in which the specific rotation is 2). The elements involved are those of groups 1B and 2A; hydrogen, carbon, nitrogen, oxygen, and...
fluorine, together with boron, one of the normally electropositive elements of Group 2A. The other two positive elements of this group, lithium and beryllium, are also two-dimensional under most conditions, but they take the positive orientation, and have much greater inter-atomic distances.

Table 12 gives the theoretically possible inter-atomic distances of these lower group elements, with some examples of the measured values corresponding to the calculated distances. The experimental results are not all in agreement with the theory. On the contrary, they are widely scattered. The measured C-C distances, for example, cover almost the entire range from 1.18, the minimum for this combination, to the maximum 1.54. However, the basic compounds of each class do agree with the theoretical values. The paraffin hydrocarbons, benzene, ethylene, and acetylene, have C-C distances approximating the theoretical 1.54, 1.41, 1.30, and 1.18 respectively. All C-H distances are close to the theoretical 0.92 and 1.06, and so on. It can reasonably be concluded, therefore, that the significant deviations from the theoretical values are due to special factors that apply to the less regular structures.

A detailed investigation of the reasons for these deviations is beyond the scope of this present work. However, there are two rather obvious causes that are worth mentioning. One is that forces exerted by adjacent atoms may modify the normal result of a two-atom interaction. An interesting point in this connection is that the effect, where it occurs, is inverse; that is, it increases the atomic separation, rather than decreasing it as might be expected. The natural reference system always progresses at unit speed, irrespective of the positions of the structures to which it applies, and consequently the inward force due to this progression always remains the same. Any interaction with a third atom introduces an additional rotational (outward) force, and therefore moves the point of equilibrium outward. This is illustrated in the measured distances in the polynuclear derivatives of benzene. The lowest C-C distances in these compounds, 1.38 and 1.39, are found along the outer edges of the molecular structures, while the corresponding distances in the interiors of the compounds, where the influence of adjoining atoms is at a maximum, characteristically range from 1.41 to 1.43.

Another reason for discrepancies is that in many instances the measurement and the theoretical calculation do not apply to the same quantity. The calculation gives us the distance between structural units, whereas the measurements apply to the distances between specific atoms. Where the atoms are the structural units, as in the compounds of the NaCl class, or where the inter-group distance is the same as the inter-atomic distance, as in the normal paraffins, there is no problem, but exact agreement cannot be expected otherwise. Again we can use benzene as an example. The C-C distance in benzene is generally reported as 1.39, whereas the corresponding theoretical distance, as indicated in Table 12, is 1.41. But, according to the theory, benzene is not a ring of carbon atoms with hydrogen atoms attached; it is a ring of CH neutral groups, and the 1.41 neutral value applies to the distance between these neutral groups, the structural units of the atom. Since the hydrogen atoms are known to be outside the carbon atoms, if these atoms are coplanar it follows that the distance between the effective centers of the CH groups must be somewhat greater than the distance between the carbon atoms of these groups. The 1.39 measurement between the carbon
TABLE 12
DISTANCES - LOWER NEGATIVE ELEMENTS

<table>
<thead>
<tr>
<th>Specific Rotation</th>
<th>Distance n.u.</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetic</td>
<td>Elec.</td>
<td></td>
</tr>
<tr>
<td>3(1) 3(1)</td>
<td>10</td>
<td>.241</td>
</tr>
<tr>
<td>3(1) 3(1½)</td>
<td>10</td>
<td>.317</td>
</tr>
<tr>
<td>3(1½) 3(1½)</td>
<td>10</td>
<td>.363</td>
</tr>
<tr>
<td>3(1) 3(2)</td>
<td>10</td>
<td>.406</td>
</tr>
<tr>
<td>3(1½) 3(2)</td>
<td>10</td>
<td>.445</td>
</tr>
<tr>
<td>3(2) 3(2)</td>
<td>10</td>
<td>.483</td>
</tr>
<tr>
<td>3(2) 3(2) 5-10</td>
<td></td>
<td>.528</td>
</tr>
</tbody>
</table>

Calc. Comb. Example Obs.

.70 H-H H₂ .74
.92 H-F HF .92
  H-C Benzene .94
  H-O Formic acid .95
1.06 H-N Hydrazine 1.04
  H-C Ethylene 1.06
  C-N NaCN 1.09
  N-N N₂ 1.09
  C-O COS 1.10
1.18 C-O CO 1.15
  C-N Cyanogen 1.16
  H-B B₂H₆ 1.17
  N-N CuN₃ 1.17
  N-O N₂O 1.19
  C-C Acetylene 1.20
1.30 H-B B₂H₆ 1.27
  C-O C₃O₂ 1.29
  B-F BF₃ 1.30
  C-N Oxamide 1.31
  C-F CF₂Cl 1.32
  C-C Ethylene 1.34
1.41 C-C Benzene 1.39
  N-O HNO₃ 1.41
  C-C Graphite 1.42
  C-N dl-Alanine 1.42
  C-O Methyl ether 1.42
  C-F CH₃F 1.42
1.54 C-C Diamond 1.54
  C-C Propane 1.54
  B-C B(CH₃)₂ 1.56
atoms is therefore entirely consistent with the theoretical distance calculations.

The same kind of a deviation from the results of the (apparent) direct interaction between two individual atoms occurs on a larger scale where there is a group of atoms that is acting structurally as a radical. Many of the properties of molecules composed in part, or entirely, of radicals or neutral groups are not determined directly by the characteristics of the atoms, but by the characteristics of the groups. The NH₄ radical, for example, has the same specific rotations, when acting as a group, as the rubidium atom, and it can be substituted in the NaCl type crystals of the rubidium halides without altering the volume. Consequently, the inter-atomic distances have no direct significance in compounds containing these groups. It is theoretically feasible to locate the effective centers of the various groups, and to measure the inter-group distances that correspond to those calculated from theory, but this task has not yet been undertaken, and it will not be possible at this time to present a comparison between theoretical and experimental distances in compounds containing radicals comparable to the comparisons in Tables 1 to 12.

Some preliminary results have been made, however, on the relation between the theoretical distances and the density in complex compounds. There are a number of factors, not yet investigated in detail, that have some influence on the density of solid matter, and for that reason the conclusions thus far derived from theory are somewhat tentative, and the correlations between theory and observation are only approximate. Nevertheless, certain aspects of these tentative results are significant, and are of enough interest to justify giving them some attention.

If we divide the molecular mass, in terms of atomic weight units, by the density, we arrive at the molecular volume in terms of the units entering into the density measurement. For present purposes it will be convenient to convert this quantity to natural units of volume. The applicable conversion factor is the cube of the time region unit of distance divided by the mass unit atomic weight. In the cgs system of units it has the numerical value 14.908.

In Table 13 the average volumes per volumetric group of a representative number of inorganic compounds containing radicals (V), as calculated from the measured densities, are compared with the cubes of the inter-group distances (sᵣ³), as calculated on the theoretical basis previously described. The specific electric rotation (c) for the compounds with the normal orientation is 4, as in the valence one binary compounds. Those with the magnetic orientation take the neutral value 5. The applicable specific magnetic rotations for the positive component and the negative radical are shown in the columns headed ab₁ and ab₂, respectively. Columns 2, 3, and 4 give the molecular mass (m), the density of the solid compound (d), and the number of volumetric units in the molecule (n). Here, again, as in the earlier tables, the calculated and empirical values are not exactly comparable, as the measured values of the densities have been used directly, rather than being projected back to zero temperature, a refinement that would be required for accuracy, but is not justified at this early stage of the investigation.

In this table there are five pairs of compounds, such as Ca(NO₃)₂ and KNO₃, in which the inter-group distances are the same, and the only difference between the pairs, so far as the volumetric factors are
TABLE 13

MOLECULAR VOLUME

<table>
<thead>
<tr>
<th></th>
<th>m</th>
<th>d</th>
<th>n</th>
<th>V</th>
<th>s₉</th>
<th>c</th>
<th>ab₁</th>
<th>ab₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>NaNO₃</td>
<td>85.01</td>
<td>2.261</td>
<td>2</td>
<td>1.261</td>
<td>1.241</td>
<td>4</td>
<td>3-3</td>
<td>4-5</td>
</tr>
<tr>
<td>KNO₃</td>
<td>101.10</td>
<td>2.109</td>
<td>2</td>
<td>1.608</td>
<td>1.565</td>
<td>4</td>
<td>4-3</td>
<td>4-5</td>
</tr>
<tr>
<td>Ca(NO₃)₂</td>
<td>164.10</td>
<td>2.36</td>
<td>3</td>
<td>1.554</td>
<td>1.565</td>
<td>4</td>
<td>4-3</td>
<td>4-5</td>
</tr>
<tr>
<td>RbNO₃</td>
<td>147.49</td>
<td>3.11</td>
<td>2</td>
<td>1.590</td>
<td>1.631</td>
<td>4</td>
<td>4-4</td>
<td>4-4</td>
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<tr>
<td>Sr(NO₃)₂</td>
<td>211.65</td>
<td>2.986</td>
<td>3</td>
<td>1.585</td>
<td>1.631</td>
<td>4</td>
<td>4-4</td>
<td>4-4</td>
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<td>CsNO₃</td>
<td>194.92</td>
<td>3.685</td>
<td>2</td>
<td>1.774</td>
<td>1.825</td>
<td>4</td>
<td>4-4</td>
<td>4-4</td>
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<tr>
<td>Na₂CO₃</td>
<td>106.00</td>
<td>2.509</td>
<td>3</td>
<td>0.944</td>
<td>0.970</td>
<td>4</td>
<td>3-3</td>
<td>3½-3½</td>
</tr>
<tr>
<td>MgCO₃</td>
<td>84.33</td>
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<td>0.931</td>
<td>0.970</td>
<td>4</td>
<td>3-3</td>
<td>3½-3½</td>
</tr>
<tr>
<td>K₂CO₃</td>
<td>138.20</td>
<td>2.428</td>
<td>3</td>
<td>1.272</td>
<td>1.222</td>
<td>4</td>
<td>4-3</td>
<td>3½-3½</td>
</tr>
<tr>
<td>CaCO₃</td>
<td>100.09</td>
<td>2.711</td>
<td>2</td>
<td>1.238</td>
<td>1.222</td>
<td>4</td>
<td>4-3</td>
<td>3½-3½</td>
</tr>
<tr>
<td>BaCO₃</td>
<td>197.37</td>
<td>4.43</td>
<td>2</td>
<td>1.494</td>
<td>1.532</td>
<td>4</td>
<td>4½-4½</td>
<td>3½-3½</td>
</tr>
<tr>
<td>FeCO₃</td>
<td>115.86</td>
<td>3.8</td>
<td>2</td>
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<td>0.976</td>
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<td>3½-3½</td>
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<tr>
<td>CoCO₃</td>
<td>118.95</td>
<td>4.13</td>
<td>2</td>
<td>0.966</td>
<td>0.976</td>
<td>5</td>
<td>4-3</td>
<td>3½-3½</td>
</tr>
<tr>
<td>Cu₂CO₃</td>
<td>187.09</td>
<td>4.40</td>
<td>3</td>
<td>0.950</td>
<td>0.976</td>
<td>5</td>
<td>4-3</td>
<td>3½-3½</td>
</tr>
<tr>
<td>ZnCO₃</td>
<td>125.39</td>
<td>4.44</td>
<td>2</td>
<td>0.947</td>
<td>0.976</td>
<td>5</td>
<td>4-3</td>
<td>3½-3½</td>
</tr>
<tr>
<td>Ag₂CO₃</td>
<td>275.77</td>
<td>6.077</td>
<td>3</td>
<td>1.015</td>
<td>1.096</td>
<td>5</td>
<td>4-4</td>
<td>3½-3½</td>
</tr>
</tbody>
</table>

Concerned, is in the number of structural groups. Because of the uncertainties involved in the measured densities, it is difficult to reach firm conclusions on the basis of each pair considered individually, but the average volume per group, calculated from the density, in the five two-group structures is 1.267, whereas in the five three-group structures the average is 1.261. It is evident from this that the volumetric equality of the group and the independent atom which we noted in the case of the NH₄ radical is a general proposition, in this class of compounds at least. This is a point that will have a special significance when we take up consideration of the liquid volume relations.

In closing the discussion in this chapter it is appropriate to reiterate that the values of the inter-atomic and inter-group distance derived from theory apply to the separations as they would exist if the equilibrium were reached at zero temperature and zero pressure. In the next two chapters we will consider how these distances are modified when the solid structure is subjected to finite pressures and temperatures.
Thoughts from Down Under

David Halprin

As noted in an earlier issue, none of the conclusions reached in the various books and articles, dealing with the aspects of the Reciprocal System of Theory, is 'official' in the same sense as the Basic Postulates of the system, and alternative ideas are acceptable for publication in Reciprocity as long as the arguments therein are developed within the framework of the theoretical system.

In the following article David Halprin brings up the issue of the nature of reality, arguing that those things, which we observe and measure, constitute 'normal reality', and that there are alternative ways of expressing the more general truths, the 'transcendental realities', that we perceive only partially and indirectly. On this basis, he contends that a real difference between Einstein's fundamental views and Larson's is in the inverse relation between space and time, which Einstein did not recognize.

This paper will examine a physical theory from a different standpoint. It is stimulated by Abbott's Flatland.

A two-dimensional being would probably believe his world, a two-dimensional plane, to be the entire universe. He must deduce or infer all physical laws from within that framework, since that is the only possible 'reality'. A more gifted Flatlander with a modicum of insight may hypothesize a third dimension for the purpose of a mathematical model. This will, no doubt, explain many of his physical laws and some other previously inexplicable observations with greater facility. Two such inhabitants may well argue over which is the true 'reality', the older two-dimensional model, or the new three-dimensional model, and this argument may never be settled. However, what counts is the ability of the model to produce the results, which explain or predict events. Needless to say, whatever one deduces from the three-dimensional formulae must be interpreted within the framework of a two-dimensional universe to match up with what the inhabitants observe, either with their senses or with their instruments.

We can draw an analogy with ourselves, the inhabitants of Earth, who exist in a three-dimensional spatial environment and perceive a one-dimensional temporal experience (duration).

'Reality' requires rigorous analysis, and perhaps we will conclude it to be as relative as other personal quantities or qualities. So to include the concept of 'reality' in any article or treatise requires a definition; then a question arises.

What, for instance, is really observed by a scientist either microscopically or macroscopically? Is it the 'real' thing, the truth, the whole truth, or is it a personal or partly personal 'reality', perhaps common to most observers, but not necessarily to all observers? When all is said and done, this is really another way of saying that reality is what we perceive by our senses and/or measuring and recording devices.

Eastern philosophies, which involve the in-depth study of the mind, have an interpretation of reality as being so closely related to the mind, that the physical universe itself becomes a state of the mind. Fritjof Capra goes to great lengths on this, showing, in his book The Tao of Physics, that subatomic particles are closely linked with the mind. However, without going to this extreme of interpretation, we can extrapolate to a higher dimension, as a mathematical model, and then interpolate for our local conditions, as has been done both by Einstein and Larson, to achieve the quantitative results, that are not attained by the solely qualitative approach of Eastern thought. To make an analysis along this line of approach, let us see where there is an absolute clash of views and where there is not, keeping an open mind when making this comparison.
A mixture of philosophy and semantics can cause one to be so bogged down, that progress can seem impossible. For instance, if I were to say that certain statements fall into two divisions, namely Fact and Opinion, it would be argued that fact to one person may be opinion, or even false opinion, to another.

What I say is fact could be regarded by someone else as merely my opinion of what is fact.

Similarly, what I say is opinion, on my part or on the part of others, may be considered by others as indisputable fact.

So I shall assume that the reader will use a common sense approach to the following statements and their division and placement into two groups.

**FACTS**

1) The development of thought should be carried out by unfaultable logical processes, based on ‘reasonable’ assumptions.

2) Analogy is a useful tool, even though some analogies are inferior to others.

**OPINIONS**

1) Theories in Physics, whether Einstein’s, Larson’s or Newton’s.

2) The merit of a particular analogy in a logical argument. (Because there is no clear-cut algorithm for evaluation of all types).

When a physicist attempts an explanation of the physical universe and its various facets, extreme care must be taken not to fall into any traps. It is very easy to fall into a special type of trap, namely, failure to recognize the existence of traps.

Let us consider a universe, in which there is only a single observer, one endowed with senses, that enable him to perceive the entire universe, (space-time), as a whole, in all of its dimensions and facets. Such a being could envision light, matter and gravitation as they would manifestly appear to a hypothetical observer, who existed in, and observed directly, the three dimensions of space, but for whom time was experienced as a one-dimensional duration only, [i.e. A temporal displacement akin (analogous) to a spatial displacement along one of the dimensions in space]. Then, perhaps, this space-time being would observe those properties of matter, gravitation and light, as perceived by us earthlings. Here we have two perspectives of the physical universe, one being objective, (implicit), where space-time is comprised solely of three-dimensional motion(s), and the other being subjective, (explicit), where space appears as a three-dimensional continuum, and time manifests as a one-dimensional continuum.

This is a direct analogy between what is actually observed by a conjectured three-dimensional creature of the objective universe and what is perceived by Man in the subjective material sector of the universe.

This compares with the analogy of the Flatlanders’ observed ‘universe’ and the planar intersection, which it would be seen as, by Man. The innovative thinker in Flatland may theorize on the existence of a third spatial dimension and induce that the two-dimensional universe, in which he lives, is merely a projection of the three-dimensional world.

For instance a sphere would be theorized from the appearance of a circle in two-dimensions, as we humans correspondingly would imagine a four-dimensional hypersphere from being shown a sphere.

The objective of the preceding was to point out how difficult it is to conceive a higher-dimensional space, than one can observe, however its existence can be theorized freely, perhaps with great
advantage for mathematical and scientific problem solving. If, therefore, we elect to use an objective mathematical model for the description of the physical universe, we must, of needs, interpolate into the realm of the lower-dimensional subjective universe, in which our perceptions, either by our senses or our instruments, can be measured and observed. This, perhaps, is why Einstein found that gravitation, when expressed in its four-dimensional form, is an instantaneous force, (with no propagation), but when observed here in three-dimensional space, where there is a duration perception, and where the case of moving masses, such as a binary star system, or a solar system, is under consideration, then it is deemed to be propagated at the speed of light.

This brings us to the nub of it all. How much of Einstein’s theory really clashes with the Reciprocal System of Theory, and how much is in agreement, obviously or subtly, or, at least, non-contradictory?

The work of D.B. Larson may be divided into two distinct sections:

1) That, which deals with the region of space-time (objective).

2) That, which deals with the actually perceived sector (that is, perceived by Man, his senses and instruments.

I believe that the Matter concept, defined by Larson, is that matter, which exists in space-time, and it has those properties, concomitant with space-time (objective). However, I believe that it is necessary to interpolate to three-dimensional space and one-dimensional time in order to arrive at the properties of matter in this, the subjective universe.

Back to Abbott’s Flatland for a moment. Consider that the physicists there have to consider the three-dimensional extrapolations of the circle, parabola and hyperbola. Although the task might be mind-boggling, they could extrapolate the equation of a sphere from that of a circle, and a parabolic cylinder or paraboloid from the parabola etc., but one of them, if clever enough, could group all three problems together, and say that they are all two-dimensional sections of a cone, and thereby obtain an equation, from which all three two-dimensional curves, mentioned above, could be interpolated.

So may it be with Larson’s objective paradigm. We humans are only absolutely sure about our senses of sight, hearing, touch, smell and taste. Other phenomena are observed by our instruments and recording devices. Man’s mind, per se, is not taken into account as a sense, with which to ‘observe’ other phenomena, although, as mentioned earlier, some practitioners of Eastern ways, such as Zen Buddhists, claim to experience higher dimensions of space and time, but since Western Man refers to this as supernatural, it is made suspect. The establishment frowns upon it and physicists are expected to avoid it.

To mention J.W. Dunne in his book An Experiment with Time. He seemed to experience it as serial time, and believed that he had a deeper understanding of time than most people, particularly with respect to Man’s relationship with this ‘medium’ via his mind. Dunne theorized that the regressed mind was capable of receiving impressions from the past, present and future.

So despite any remarks in the books on the Reciprocal System of Theory, that suggest or state outright that the Reciprocal System of Theory and Einstein’s Relativity Theories are mostly at variance, due to having taken different forks in the road to truth, there remain at least these two observations:

1) The mathematics of the Reciprocal System of Theory is often the same as that of Einstein, especially with respect to the use of the Lorentz Transformation.

2) The statement of instantaneity of gravitational action in space-time may be equivalent to a propagated gravitational disturbance in space.

These ‘observations’ suggest, therefore, not two completely different theories in opposition all down
the line, but in many respects merely a different perspective of the same basic tenets, with, however, at least one essential and non-ignorable difference, the inverse aspect of time.

The Reciprocal System of Theory gives time a status, equivalent to that of space, whereas Einstein placed time in an imaginary sector, whose coordinates involve ‘i’ as the coefficient of a term with ‘t’ as one sees in the Argand Plane, when one plots ‘x’ against ‘iy’.

Higher dimensions imply a ‘transcendental reality’, while in our own observed (subjective) universe we have a ‘normal reality’. But to a higher-dimensional thinker, where does one stop in one’s extrapolation into higher dimensions, perhaps an increasing order of ‘transcendental realities’? Just as we can concede some possible types of two-dimensional life, why not life forms, that are of a different dimensional make-up to ours? Not that I seriously believe that there is any evidence of this, but if it can be, hypothetically, then, in the Larson tradition, so mote it be. I take this fork in the road only to make the point:

We humans are, to the best of our knowledge, creatures of three dimensions spatially and one dimension temporarily, albeit we exist in a universe of three temporal dimensions. Hence we must interpolate from our mathematical model, (the objective paradigm of three dimensions of motion), for our observations to have meaning in our subjective universe of four dimensions.

c.f. A Flatlander using a three dimensional spatial model, whereby he theorizes a sphere, must, of necessity, relate it back to the circle of his observations.

Similarly, the Einsteinian protagonists must do likewise, whereby they can have, with Larsonians, common experiences, albeit with differing explanations of same.

Before we look at Einstein’s method of predicting the apparent bending of light in the presence of mass, we must examine the lead-up philosophy and concomitant mathematics, which helped achieve the result, and above all, we must see where there is genuine contradiction with the tenets of RS and where there is no contradiction. This division of contradiction and non-contradiction may sometimes be hard to distinguish.

For instance, we must be constantly aware of any implicit assumptions, such as those, which assume continuity, where RS states none exists. Space and Time are discrete (discontinuous), but motion is continuous. This means that many equations of the Newtonian and Einsteinian ilk are useable in RS, while some are not so. We must NOT deny on principle something, that is not at all at variance with RS.

The three-dimensional space around us is Euclidean, according to RS. Now, as far as I can see, the three-dimensional space of Einstein is never anything but Euclidean also. Where the ‘curvature of space’ is mentioned, it is only where there are considerations of a four-dimensional framework, where the fourth dimension is not time, as so often is stated, but is actually ‘ict’ so as to give a negative term, \(-c^2\), in the metric. This is really another spatial term, a displacement, equivalent to the distance travelled by light in time ‘t’, but it is placed in an imaginary sector. Since we cannot contemplate, in reality, a fourth spatial dimension, comparable to the other three, when we want to develop an acceptable mathematical model for our laws of physics, Einstein envisaged this fourth term, as above, whereby we bring time ‘t’ into the metric as an independent variable, on which this fourth spatial term is entirely dependent.

When transforming from one framework to another, moving at a constant speed, ‘u’, relative to the first framework, there is an invariance, showing the laws to be independent of the framework, to which they are referred; an obvious necessity for any laws. This invariance, under the Lorentz transformation, not only added weight to the argument for the negative fourth term in the metric, but to the very necessity for this fourth term. It follows, therefore, that there are counterparts to displacement, velocity, time etc., in this four-dimensional framework. So, as it proceeded, tensors became necessary to relate these transformations in curvilinear coordinates, to get away from a fixed frame of reference, and use moving trihedrals.
\[ ds = \sqrt{c^2 t^2 - dx^2 - dy^2 - dz^2} \]

'T', Tau, the four-dimensional counterpart to time, 't', is given by

\[ \frac{dT}{dt} = \sqrt{1 - \beta^2} \quad \text{where} \quad \beta = \frac{u}{c} \]

and 'u' is the relative speed of the two inertial systems. Similarly there is an expression for \( V_4 \) in terms of \( V_3, s, t, T & \beta \).

\[ V_4 = \frac{d}{dT} = \frac{ds}{dt} \frac{dt}{dT} = \frac{ds}{dt} \sqrt{1 - \beta^2} = \sqrt{\frac{c^2 - v^2}{1 - \beta^2}} \]

In tensor notation, the metric tensor is expressed in curvilinear coordinates:

\[ ds^2 = g_{\alpha\beta}dx^\alpha dx^\beta, j,k = 1,2,3,4 \]

where each element of g is a scalar product of two unitary base vectors, belonging to a moving trihedral in curvilinear coordinates.

\[ e.g. \quad g_{11} = \frac{dr}{du_1} \cdot \frac{dr}{du_1} \quad ; \quad g_{23} = \frac{dr}{du_2} \cdot \frac{dr}{du_3} \]

There are several assumptions of Einstein to be dealt with:

One is that light rays travel along geodesics in this four-dimensional space. Thus one can predict the observation of an apparent bending of light rays, which pass through gravitational fields.

Also an apparent reduction in the speeds of 'propagation' of these fields, notwithstanding the 'slowing down' of the light, due to interaction with the field, thereby causing a delay in the expected return of the signal, sent out by laser emission etc..

So for us to investigate this within the framework of the Reciprocal System of Theory, there must be a clarification of what Einstein actually alleged, before we attempt a rebuttal.

The way I see it, there are two distinct aspects of the gravitation question within Einstein's Theory.

One is that the gravitational force between two masses is a field, that exists concurrently with the existence of the masses themselves. This seems to me not to be stated as a propagation.

Secondly, when one reads various treatises on the theory, one finds reference to gravitational disturbances, which, of necessity, must be propagated to be effective. That is, if there is a change in quadrupole moment, a source of radiation is thereby created, and a gravitational disturbance takes place, which cannot be instantaneous, as could be proven by reductio ad absurdum. For instance, this 'absurd' example would mean that we could relay information instantaneously over 'infinite' distances. However, the effects of this gravitational disturbance are accomplished by some sort of 'wave', whose effect is manifested in a plane, which is orthogonal to the line of transmission and is not a form of gravitational attraction to, or away from, the body being so affected. In fact,
disturbances are transverse waves, polarized, and at 45 degrees to each other, and each has two orthogonal effects, namely, attraction between particles in one direction, and repulsion, orthogonal to the attraction.

To repeat, the gravitational field, itself, is static, and therefore there can be no propagation, unless there is a change in quadrupole moment, such as a change in shape, [say from spherical to oblate spheroid and back to spherical again; (e.g. Our sun)], or there is motion in a system, such as a binary star system or a solar system, looked upon as a generating system of gravitational disturbances, especially contributed to by the heavier planets. This, however, is a non-linear system, and therefore the sixth degree of the change is found to manifest itself.

e.g. If the planet Jupiter travelled at 10 times its present orbital speed, there would be one million more times the gravitational disturbance radiated.
NOTE ON THE FORCE OF THE SPACE-TIME PROGRESSION

by Ronald W. Satz

In a previous paper of mine\(^1\) I discussed Hubble's Law and the Reciprocal System. I integrated Hubble's equation to obtain the following equation representing the distance of a galaxy from our galaxy as a function of time:

\[
    r = r_o + (v_i - r_o) e^{Ht}
\]  

(1)

where \( r_o \) is the gravitational limit, \( H \) is Hubble's constant, and \( v_i \) is the initial distance.

Now if we go back to Hubble's original equation,

\[
    V = Hr
\]  

(2)

we can differentiate this, instead of integrating it as before.

\[
    \frac{dv}{dt} = H \frac{dr}{dt} = a = Hv = H^2r
\]  

(3)

Hence, the force of the space-time progression must be

\[
    F_p = m_{G_2} H^2r + F_{G_1-G_2}
\]  

(4)

where \( m_{G_2} \) is the mass of the galaxy moving away and \( F_{G_1-G_2} \) is the gravitational attraction. This equation should have many applications in the Reciprocal System.

A Preview of Dewey B. Larson's THE UNIVERSE OF MOTION

This new work extends the physical principles and relations developed in Nothing But Motion and Larson's other publications to the astronomical and cosmological fields. As in the earlier work, all of the conclusions that are reached are derived entirely by development of the necessary consequences of the postulates that define the universe of motion, without introducing anything from any other source. This book therefore gives us a purely physical view of the astronomical universe, completely independent of any information from astronomical sources. The relevant observational results are described, but they are not used in the development of the theoretical picture of the universe; they are employed only for the purpose of showing that the theoretical results agree, item by item, with the observations.

As could be expected in a field where factual information is scarce, and existing theory is largely speculation, this new development, based on physical principles that have been positively verified in fields readily accessible to observation, gives us a picture that is very different in many respects from that which we get from the astronomers. Now, fully verified, explanations for such phenomena as quasars and pulsars, the galactic recession, the white dwarf stars, and supernovae, eliminate the need for the fantastic products of the imagination — degenerate matter, singularities, black holes, etc. — that the astronomers are now calling upon to provide answers to the problems posed by the latest observational discoveries. In addition to returning these more recently discovered phenomena to the land of reality, the new, fully integrated, and solidly based theoretical development uncovers some serious errors in the currently accepted concepts of the evolutionary paths of stars and galaxies. Correction of these errors eliminates many of the long-standing astronomical problems.

This clarification of the astronomical situation is not only an important addition to scientific knowledge, but also has a major significance in relation to the physical laws and principles derived from the postulates that define the universe of motion, because astronomy is the great testing ground for physical theories. If a theoretical proposition is wrong, or incomplete, its shortcomings become apparent when they are greatly magnified by the extremes of size, speed, temperature, and pressure to which astronomical objects are subjected. The fact that the answers to the major astronomical questions emerge easily and naturally from this theoretical development, even in those cases, such as the quasar situation, where the astronomers have been completely baffled, thus adds another dimension to the already strong confirmation of the validity of the fundamental postulates of the theory of the universe of motion.
The following reproduction of the Table of Contents indicates the scope of the work:

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3 Globular Clusters 19 X-ray Emission
4 The Giant Star Cycle 20 The Quasar Situation
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11 Planetary Nebulae 27 Pre-Quasar Phenomena
12 Ordinary White Dwarfs 28 Inter-Sector Relations
13 The Cataclysmic Variables 29 The Non-Existent Universe
14 Limits 30 Cosmology
15 The Intermediate Regions 31 Implications
16 Type II Supernovae

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__________________________________
A GRAPHICAL COMPARISON OF THE OLD AND NEW PERIODIC TABLES
D. Maurice Gilroy

RELATIVE ABUNDANCE OF THE ELEMENTS
K.V.K. Nehru

THE PROPERTIES OF MATERIALS: A CLASSIFICATION
Ronald W. Satz
A GRAPHICAL COMPARISON OF THE OLD AND NEW PERIODIC TABLES

by D. Maurice Gilroy

Abstract

This paper presents a graphical comparison of the traditional (18 position) and the new (32 position) formats of the periodic table. The plots of the four physical properties presented permit the reader to judge the quality of the representations of the periodic nature of the elements provided by the 18 and 32 position formats. After comparing the plots of the data and the positions of silicon and tungsten in the old and new formats, the author concludes that the traditional 18 position periodic table does a better job of illustrating the periodic nature of the elements than that done by the new 32 position table, that the "rare earths" or "lanthanides" do deserve a special place in the periodic table, and that further theoretical work is needed to explain the "nonconformist" tendencies of the rare earth elements.

Introduction

The periodic table of the elements can be a useful tool in developing an understanding of the periodic nature of the physical and chemical properties of the elements. The traditional 18 column periodic table can be found in most chemistry textbooks, handbooks, lecture rooms and laboratories. Fig. 1 is a skeletal example of this format of the periodic table.

A new or revised periodic table with a 32 position format has been introduced into the literature of the reciprocal system. It first appeared on pages 42 and 43 of "The Unmysterious Universe" by Ronald Satz (1971). (Fig. 2 is an adaptation of the Satz table.) It appeared again in a modified form on page 137 of "Nothing but Motion" by Dewey Larson (1979). (Fig. 3 is an adaptation of the Larson table.)

The new or revised periodic table is not a critical part of the reciprocal system. Satz refers to it without comment (page 40 of "UU") as "the table of chemical elements". Larsen comments (pages 136 & 138 of "NBM") that it was being presented "... merely as a convenient graphical method of expressing some portions of that information." ("that information" being the magnetic and electric rotational motions of the elements).

(The text continues on page 5.)
Fig. 1

THE OLD PERIODIC TABLE (WITH LARSON MODIFICATION)  

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# 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | #Ce | Pr | Nd | Pm | Sm | Eu | Gd | Tb | Dy | Ho | Er | Tm | Yb | Lu | #

# 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | #Th | Pa | U  | Np | Pu | Am | Cm | Bk | Cf | Es | Fm | Md | No | Lr | #
The new periodic table (with Larson modification)

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**Figure 2**

OLD AND NEW PERIODIC TABLES

D. Maurice Gilroy
Fig. 3 - THE NEW PERIODIC TABLE
(LARSON VERSION)

+++

: 3: 11: 19: 37: 55: 87:
: Li : Na : K : Rb : Cs : Fr : 1

: 4: 12: 20: 38: 56: 88:
: Be : Mg : Ca : Sr : Ba : Ra : 2

: B : Al : Sc : Y : La : Ac : 3

: C : Si : Ti : Zr : Ce : Th : 4

: 23: 41: 59: 91:
: V : Nb : Pr : Pa : 5

: 24: 42: 60: 92:
: Cr : Mo : Nd : U : 6

: 25: 43: 61: 93:
: Mn : Tc : Fm : No : 7

: 26: 44: 62: 94:
: Fe : Ru : Sm : Pu : 8

: 27: 45: 63: 95:
: Co : Rh : Eu : Am : 9

: 28: 46: 76: 110:
: Ni : Pd : Pt : ??: 24

: 29: 47: 79: 111:
: Cu : Ag : Au : ?? : 25

: 30: 48: 80: 112:
: Zn : Cd : Hg : ?? : 26

: 31: 49: 81: 113:
: Ga : In : Tl : ??: 27

: 6: 14: 32: 50: 82: 114:
: C : Si : Ge : Sn : Pb : ?? : 28

: 7: 15: 33: 51: 83: 115:
: N : P : As : Sb : Bi : ?? : 29

: 8: 16: 34: 52: 84: 116:
: O : S : Se : Te : Po : ?? : 30

: 1: 9: 17: 35: 53: 85: 117:

: 2: 10: 18: 36: 54: 86:***:
: He : Ne : Ar : Kr : Xe : Rn : ***: 32

+++

B 13.3-4
Introduction (Cont...)

The author's concern about the new 32 position format of the periodic table is both theoretical and practical.

The theoretical concern is that the new format table implies that the rare earth elements do not deserve a special place in the periodic table of the elements (and in the theory of the fundamental rotational motions that establish the nature of the elements). If this implication is wrong, and the rare earths do not fit into the patterns of the physical properties of the other elements in the atomic number sequence, then more fundamental theoretical work needs to be done to explain the special nature of the rare earth elements.

The practical concern is that the new format tables give what the author judges to be a small benefit for a larger cost. The benefit is the illustration of the periodic nature of the theoretical rotational motions within the atoms. The cost is a radical change from the form of the table that every chemistry student has studied, to an unfamiliar form that could be one more obstacle to broader acceptance of the reciprocal system of physical theory.

Periodic Table Element Placement

Before going on to the physical property data plots it may be helpful to point out two differences in the placement of the elements in the old and new formats of the periodic table.

In the traditional table carbon (6), silicon (14) and germanium (32) are in column 14. In the new periodic table these three elements share column 28. In addition carbon and silicon also share column 4 with Titanium (22). In the traditional periodic table chromium (24), molybdenum (42), tungsten (74) and element 106 share column 6. In the new periodic table tungsten shares column 20 with element no. 106.

One of the simple beauties of the periodic table is that it groups elements with similar physical or chemical properties together. Silicon and germanium are the semiconductors of solid state electronics. Silicon has little in common with titanium which is the light, high strength metal used in the construction of supersonic aircraft. Molybdenum and tungsten are the high melting point metals of the atomic number series. If a periodic table is to express the periodic nature of the elements by grouping like elements together, then silicon should not be in the group with titanium, and tungsten should be in the group with molybdenum.
The Physical Property Data

Table 1 is a tabulation of the physical property data that appears in the data plots that follow. The columns of data and their sources are as follows:

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<td>A &quot;plot switch&quot; used to suppress plotting of the rare earth data in the 18 wide data plot.</td>
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<td>Electron work function data from &quot;Photoionization and Photomagnetization&quot; by Ronald W. Satz published in the Winter 1981-1982 issue of Reciprocity (This data tabulation appears to be selections from Table CIX (pages 120-121) of The Structure of the Physical Universe by Dewey B. Larson published in 1959.)</td>
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(The text continues on page 9.)
## Table 1 - The Physical Property Data

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<td>5.7</td>
<td>3.7</td>
<td>0</td>
<td>160</td>
<td>0</td>
<td>3.64</td>
<td></td>
<td></td>
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<tr>
<td>92</td>
<td>U URANIUM</td>
<td>6.7</td>
<td>3.7</td>
<td>0</td>
<td>1132</td>
<td>30</td>
<td>2.85</td>
<td>3.63</td>
<td>395.0</td>
</tr>
<tr>
<td>93</td>
<td>Np NEPTUNIUM</td>
<td>7.7</td>
<td>3.7</td>
<td>0</td>
<td>640</td>
<td>0</td>
<td>3.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>94</td>
<td>Pu PLUTONIUM</td>
<td>8.7</td>
<td>3.7</td>
<td>0</td>
<td>641</td>
<td>0</td>
<td>3.15</td>
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<td></td>
</tr>
<tr>
<td>95</td>
<td>Am AMERICIUM</td>
<td>9.7</td>
<td>3.7</td>
<td>0</td>
<td>994</td>
<td>0</td>
<td>3.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>96</td>
<td>Cm CURIUM</td>
<td>10.7</td>
<td>3.7</td>
<td>0</td>
<td>1340</td>
<td>0</td>
<td>3.10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Data Plots

Each of the four physical properties is plotted in three ways:

1 - In atomic number sequence (96 wide)

2 - In the new periodic table format (32 wide) that includes the rare earth element data

3 - In the traditional periodic table format (18 wide) that excludes the rare earth element data

An atomic number sequence plot of the 1977 work function data is included for comparison purposes. The 1969 work function data is used in the periodic table comparison plots.

Plots of both untruncated and truncated values of the magnetic susceptibility data are presented in atomic number sequence. The truncated data is used in the periodic table comparison plots.

The Melting Point Data Plots

Figures 4, 5 & 6 which follow are the plots of the melting point data.

Please note that in the atomic number sequence plot the melting points of elements 58 to 71 (in box) form an uneven "stairstep" pattern, with two missing "steps", that does not conform to the 18 wide "tall building" pattern of the other elements.

Also note that in the 18 wide periodic table plot the melting points of the elements in column 6 (chromium, molybdenum and tungsten) form a pattern similar to the elements in columns 4, 5, 7 & 8.

And please note the overall pattern of the 18 wide periodic table plot and the relative appearance of the 32 and 18 wide periodic table plots.

(The text continues on page 13.)
Fig. 4 - MELTING POINTS OF THE ELEMENTS
Fig. 6 - MELTING POINTS OF THE ELEMENTS

-3600 -3300 -3000 -2700 -2400 -2100 -1800 -1500 -1200 -900 -600 -300 0 300 600 900 1200 1500 1800 2100 2400 2700 3000 3300 3600

PERIODIC TABLE COLUMN NO.
The Interatomic Distance Data Plots

Figures 7, 8 & 9 which follow are the plots of the interatomic distance data.

Please note that in the atomic number sequence plot the interatomic distances of the elements 58 to 71 (in box) form a pattern that is something of a "rounded knoll" with two "flag poles" on it. This pattern does not conform to the 18 wide "spire and roof" pattern of the other elements.

And again, please compare the relative appearance of columns 4 through 8 of the 32 and 18 wide periodic table plots.

(The text continues on page 17.)
Fig. 7 - Interatomic Distances of the Elements
Fig. 8 - INTERATOMIC DISTANCES OF THE ELEMENTS
Fig. 9 - Interatomic Distances of the Elements
The Electron Work Function Data Plots

Figures 10, 11, 12 & 13 which follow are the plots of the electron work function data.

Atomic number sequence plots of both the 1959 and 1977 tabulations of work function data are included. The 1977 tabulation has a few more values than that of 1959, but the later tabulation should not be considered to be more accurate. Many of the values included in this later tabulation were marked as questionable or estimated.

Please note that in the atomic number sequence plot the incomplete work function data for the elements 58 to 71 (in boxes) form the beginnings of a pattern that is lower than the irregular 18 wide patterns formed by the data for the other elements.

And again, please compare columns 4 through 8 of the 32 and 18 wide periodic table plots.

(The text continues on page 22.)
Fig. 12 - WORK FUNCTIONS OF THE ELEMENTS
Fig. 13 - WORK FUNCTIONS OF THE ELEMENTS
The Magnetic Susceptibility Data Plots

Figures 14, 15, 16 & 17 which follow are the plots of the magnetic susceptibility data.

An atomic number sequence plot of the untruncated magnetic susceptibility data (Fig. 14) is included to better illustrate the "nonconformist" nature of the rare earth elements for which magnetic susceptibility data is available. The data for figures 15, 16 and 17 have been truncated to a maximum value of 750 to permit the relatively small magnetic susceptibility values of the other elements to be seen.

(The text continues on page 27.)
Fig. 14 - MAGNETIC SUSCEPTIBILITY OF THE ELEMENTS
Fig. 15 - MAGNETIC SUSCEPTIBILITY OF THE ELEMENTS

(TRUNCATED)
Observations

When the plots of the observed melting point, interatomic distance, electron work function and magnetic susceptibility data are examined the following patterns in the data (and deviations from the patterns) can be observed:

1 - Starting around element no. 18 (argon) the physical property data form three large patterns, and where the data is more complete, the beginning of a fourth.

2 - The first two patterns are 18 elements wide. The beginning or end of the third pattern is distorted by the presence of the distinctly different properties of the 14 elements (nos. 58 to 71) known as the rare earths or lanthanides. The resultant third pattern is 32 elements wide.

3 - In both the melting point and the interatomic distance data two of the elements in the 58 to 71 group (nos. 63 and 70) exhibit anomalous property values. Their melting points are lower and their interatomic distances are higher than the adjacent members of the group.

4 - The elements 63 and 70 are eight elements apart in the atomic number sequence.

5 - The four elements with the highest reported magnetic susceptibility are in this 63 to 70 subgroup. (For three of the eight elements no data were reported.)

Conclusions

Based on a careful review of the data plots the author has reached the following conclusions:

1 - The traditional 18 column wide periodic table with the 14 rare earth elements shown separately is more in harmony with the physical property data and better illustrates the periodic nature of the elements.

2 - The 14 element group from 58 to 71 and the 8 element subgroup from 63 to 70 are a unique atomic phenomenon that does not fit into the patterns established by the rest of the atomic series.

3 - If the reciprocal system of physical theory does not currently predict the occurrence of the uniquely different rare earth elements in the natural sequence of the elements, then more fundamental theoretical work needs to be done on the rotational motions of the atoms.
RELATIVE ABUNDANCE OF THE ELEMENTS
by K.V.K. Nehru

A general physical theory, like the Reciprocal System, should satisfy two types of criteria in order to establish its truth. Firstly, it should be able to explain completely those physical phenomena that remained recalcitrant without explanation in the previous theories. More desirably, it should lead to predictions which are definitely in conflict with those of the preceding theories but can be validated by observation or experimentation. The second type of requirement to be satisfied by the general theory is that it is not inconsistent with any of the definitely established physical facts. This may be called the negative criterion, whereas the previous one may be called the positive criterion.

It can be seen that the positive criterion, being more powerful in establishing the new theory, demands greater attention (and challenge) from the point of view of its proponents. The negative criterion, on the other hand, is a rather weak condition for positively establishing the new theory. Further, in view of the extremely vast number of genuine physical facts that were recognized, it is neither possible nor worthwhile to bestow more than a limited amount of consideration — especially in the early stages of the development of the new theory — to showing that the theory is not inconsistent with any of these facts. However, the negative criterion, though a weak one in establishing the new theory, is all-powerful in invalidating it if a single instance of inconsistency is found. For this reason the adherents of the conventional theory not infrequently, tend to invoke the negative criterion, having already armed themselves with some sort of explanations for some of these facts. They often ask how the new theory accounts for some of such recognized facts. In such instances — especially when information of a quantitative nature is involved — it is incumbent on the proponents of the new theory to pay more consideration and work out the details to demonstrate that the negative criterion is well satisfied.
I wish to bring to your attention two such questions which lectures on the astronomical aspects of the Reciprocal System invariably seem to elicit. The first one of these is about the genesis of the elements and their relative cosmic abundance. The second concerns the background microwave radiation and the value of its temperature. These, therefore, seem to warrant greater consideration in working out the details in the context of the Reciprocal System. The detailed study of the cosmic abundance problem is also important from the point of view of stellar evolution and energy generation processes.

In the following I attempt a cursory analysis of the cosmic abundance problem, giving nothing more than a general outline of the argument.

According to the Reciprocal System (i) the element building process starts with the formation of hydrogen from the decay products of cosmic matter — namely, the massless neutrons and their equivalents — ejected into the material sector;¹ (ii) the assembling of the elements with higher atomic numbers then continues by the successive additions of the positive rotational displacement units (PDU).² Let:

\[ N_d = \text{the total number of PDU in the material sector of the universe, locked up in the material atoms} \]
\[ N_t = \text{the total number of atoms in the material sector} \]
\[ N_e = \text{the number of rotational displacement units ejected into the cosmic sector from the material sector} \]
\[ = \text{the number of rotational displacement units ejected into the material sector from the cosmic sector (under steady state conditions)} \]
\[ N_n = \text{the number of free PDU in the material universe involved in transmuting the elements} \]
\[ N_z = \text{the number of atoms of the element with atomic number } Z \]
\[ a_z = \text{the relative cosmic abundance of the element } Z = \frac{N_z}{N_t} \]
We will consider the element with atomic number $Z$. We find that its population, $N_z$, is being increased by the atoms that get transmuted to element $Z$ from lower $Z$ values. At the same time $N_z$ is being decreased by those atoms that get transmuted to atomic numbers higher than $Z$. In addition, some atoms of element $Z$ are lost through Type II explosions. Since the universe as a whole is under steady state, the number $N_z$ can be taken as constant. This means that the inflow must be equal to the outflow.

**Total PDU**

The total number of the positive rotational displacement units contained in all the atoms in the material sector is given by

$$N_d = \sum_z Z^* N_z = N_t \sum_z Z^* a_z$$

(1)

**Transmutation, Outgoing**

$O_Z$, the number of atoms of element $Z$ that are outgoing by getting transmuted to element(s) of higher atomic number by combining with the free PDU can be arrived at as follows:

Let $D_z$ be the number of PDU captured by the atoms of element $Z$, out of $N_n$, the total number of PDU available for transmutation. Then, the ratio $D_z/N_n$ must be equal to the ratio of the PDU locked up in all the atoms of element $Z$ to the total number of PDU in the material sector. That is,

$$\frac{D_z}{N_n} = \frac{Z^* N_z}{N_d}, \quad \text{or} \quad D_z = Z (N_t * a_z) \frac{N_n}{N_d}$$

(2)
Now, the major portion of the outgoing atoms from element Z end up as atoms of element Z+1. This involves the capture of a single PDU by each atom. Let this number of atoms be \( O_z \). In addition, it is also probable that a small fraction of the atoms capture simultaneously two PDU, resulting in transmutation to element Z+2. Let this number be \( O_z \). Thus \( O_z \) is made up of two parts, \( O_z \) and \( O_z \), such that

\[
O_z = k O_z + (1-k) O_z
\]

where \( k \) is a distribution fraction.

Of the number of \( D_z \), we take that the number of PDU involved in the single capture event is \( D_z \) and the number involved in the double capture event is \( D_z \). Then \( D_z = O_z \), whereas \( D_z = 2O_z \). Using eq. (3) we have

\[
D_z = O_z + 2O_z = [k + 2(1-k)] O_z = (2-k) O_z
\]

Substituting for \( D_z \) from eq. (2),

\[
O_z = \frac{N_t N_a}{N_d (2-k)} Z_a
\]

Transmutation, Incoming

From what has been said above, it can be seen that the number of atoms, \( I \), coming in by getting transmuted to element Z from elements of lower atomic number comprises two separate streams: \( I_{Z-1} \), the number that is coming in from element Z-1 due to single capture, and \( I_{Z-2} \), the number coming in from element Z-2 due to double capture (see fig. 2). From eq. (3) we note that
\[ I_{z-2} = I_{O^{+}_{z-2}} = (1-k)^{O^{+}_{z-2}} \text{ and} \]

\[ I_{z-1} = I_{O^{+}_{z-1}} = k^{O^{+}_{z-1}} \]

Thus, the total number of incoming atoms adding to the population of element \( Z \) is, (substituting \( Z+2 \) and \( Z+1 \) respectively, for \( Z \) in eq. (4))

\[ I = I_{z-2} + I_{z-1} \]

\[ = \left[ N_{t}^{*} N_{n}/N_{d}(Z-k) \right] \left[ (1-k)(Z-2)a_{z-2} + k(Z-1)a_{z-1} \right] \]  \hspace{1cm} (5)

Ejection

We will assume that the relative abundance in the matter that is ejected to the c-sector by the Type II explosions is the same as that in the material sector of the universe in general. If \( E_{z} \) is the number of atoms of element \( Z \) that are ejected, we have the total number of PDU that are leaving the material sector by way of ejection as
\[ N_e = \sum_z Z^* E_z \]  

(6)

If the matter is uniformly distributed, we have \( E_z \) proportional to \( N_z \); that is, \( E_z = g^* N_z \), where \( g \) is a fraction less than 1.0. Then

\[ E_z = g^* N_t^* a_z \]  

(7)

Therefore, from eq. (6) above,

\[ N_e = \sum (g^* N_t^* a_z) = g^* N_t \sum a_z \]

Hence, from eq. (1), \( N_e = g^* N_d \), or \( g = N_e/N_d \). Finally, from eq. (7),

\[ E_z = (N_t^* N_e/N_d) a_z \]

\[ = [N_t^* N_e/N_d (2-k)] [N_e (2-k)/N_n^* a_z] \]  

(8)

Equilibrium

By steady state we mean, in the material sector, uniformity with respect to time. Under steady state conditions, therefore, the relative abundance does not vary. That is, \( N_z \), the number of atoms of the element \( Z \) is constant.

In other words, \( I = O_z + E_z \) (see fig. 2). Thus, from eqs. (4), (5) and (8),

\[ [N_t^* N_e/N_d (2-k)] [(1-k)(Z-2)a_{z-2} + k(Z-1)a_{z-1}] \]

\[ = [N_t^* N_e/N_d (2-k)] [Z^* a_z + (N_e (2-k)/N_n^*) a_z] \]

Or
\[ a_z = \frac{(1-k)(Z-2)a_{z-2} + k(Z-1)a_{z-1}}{Z + \sigma} \]  

(9)

where \( \sigma = \frac{N_e(2-k)}{N_n} \)  

(10)

**Hydrogen**

Since with \( Z = 1 \), hydrogen is the first element, the case of inflow from elements of lower atomic number does not arise. On the other hand, the displacement units ejected from the c-sector form the incoming flow. Since, of the \( N_e \) displacement units entering the material sector, \( N_n \) PDU are used up for the purpose of transmutation, the number of PDU that eventually transform to hydrogen atoms is \( N_e - N_n \). Therefore, from eqs. (4) and (8), balancing the inflow and the outflow,

\[ N_e - N_n = \left[ N_t N_e/N_d (2-k) \right] \left[ 1 \ast a_1 + \left( N_e(2-k)/N_n \right) a_1 \right] \]

Or,

\[ \frac{N_e - N_n}{N_e N_d} = \left( \frac{2-k}{N_t N_n} \right) = (1 + \sigma) a_1 \]

Substituting from eqs. (1) and (10),

\[ a_1 = \frac{\sigma - (2-k)}{\sigma + 1} \sum Z a_z \]  

(11)

Since \( a_z \) is a function of \( a_1 \), \( a_1 \) cancels out from both sides of the equation (11). The equation, therefore, serves as the compatibility
criterion between values of $\sigma$ and $k$.
Further, since $N_t = \Sigma N_z$,

$$\Sigma a_z = 1$$  \hspace{1cm} (12)

Eq. 12 is the normalizing condition which fixes the value of $a_1$, and hence of all $a_z$, for given values of $\sigma$ and $k$.

**Comparison with Empirical Data**

The values of the two parameters $\sigma$ and $k$ in the above equations are to be arrived at by logical processes from the postulates of the Reciprocal System. This still remains to be done. Meanwhile, a good agreement with the empirical values of the relative cosmic abundance $^3$ can be demonstrated by appropriate choice of $\sigma$ and $k$. The theoretical curve is plotted in Fig. 1, with $\sigma = 9.5$ and $k = 0.9$. 

![Graph showing comparison between theoretical and empirical data](image-url)
It must be noted that, in the figure, the abundance values are plotted on a logarithmic scale and hence the discrepancy between the theoretical and the observational values wherever it occurs should not be underestimated. However, it is clear that, as far as it goes, the trend of the theoretical curve conforms well to the actual.

Further refinement is in order in considering the possibility of transmutation by triple or multiple capture of PDU, which have a non-zero probability at the higher Z values. In fact, the comparatively higher abundance of the Even-Z elements over those of the Odd ones can be explained on the basis of the corresponding distribution in the values of k for the single, double, or higher multiple capture events. Remembering that the atomic number is the net total electric displacement units, and Even Z can be seen to correspond to an Odd speed \(1/(1+Z)\). As Larson explains, Odd speeds (like 1/3 or 1/5) are the direct result of scalar directional reversals, whereas Even speeds (like 1/4 or 1/6) are obtained only by way of compounding two Odd speeds. As such, the probability of an Odd speed (Even Z) is comparatively higher than that of an Even speed (Odd Z).

Among the assumptions made, the first is that the relative abundance is uniform in the universe. The second one is that the magnetic ionization level is zero. This may be true only in the case of interstellar and intergalactic matter, most of which lies undetected. Consequently, the contribution of this matter to the cosmic abundance is not reflected adequately in the observational values. The zero ionization level assumption, therefore, is likely to give rise to a large error in the predicted values, especially at the higher atomic numbers. Evaluation based on the consideration of the atomic weight rather than the atomic number will be more appropriate to the situation as it takes care of the
rotational displacement present as the gravitational charge as well.

Another important factor that has not been taken into account in this preliminary analysis is the disintegration of matter that occurs on attaining the destructive thermal limit (as in the stellar energy generation process). Also to be considered is the effect of supernova explosions on the abundance of the Fe group of elements, and the possibility that the relative abundance in the matter ejected out of the material sector in Type II explosions is considerably different from that applicable at large.

References

3 American Institute of Physics Handbook, 1963
4 D. B. Larson, Nothing But Motion, op. cit., p. 98.
THE PROPERTIES OF MATERIALS: A CLASSIFICATION

by

Ronald W. Satz

1. INTERACTIONS OF ATOMS

A. Interaction of Atoms of Same Kind

1. Solid state

a. mechanical properties

1) structural
   a) geometrical configuration
   b) interatomic distance and density
   c) internal pressure and cohesive energy
   d) grain size
   e) structural defects

2) moduli
   a) modulus of bulk
   b) modulus of rigidity
   c) modulus of elasticity
      (1) in tension
      (2) in compression
      (3) in flexure

3) strengths
   a) elastic limit
   b) yield strength
   c) fatigue-endurance limit
   d) Izod impact strength
   e) ultimate strength
      (1) in tension
      (2) in compression
      (3) in flexure
      (4) in shear

4) dimensional change
   a) Poisson's ratio
   b) elongation
   c) reduction of area
5) hardness and surface treatment
   a) Moh's hardness
   b) Brinell hardness
   c) Rockwell hardness
   d) Shore hardness
   e) friction

b. thermal properties
   1) temperature and specific heat
   2) thermal coefficient of expansion
   3) phase changes

2. Liquid state
   a. mechanical properties
      1) structural
      2) volume relations and bulk modulus
   b. thermal properties
      1) fusion temperature
      2) latent heat of fusion
      3) specific heat
      4) viscosity
      5) surface tension

3. Gaseous State
   a. mechanical properties
      1) structural
      2) volume relations
   b. thermal properties
      1) evaporation temperature
      2) latent heat of vaporization
      3) gas constant and molecular mass
      4) triple point
      5) critical point
      6) viscosity

4. Vapor State
   (see list of properties for gaseous state)
B. Interaction of Atoms of Different Kinds

1. Solid solutions
   a. mechanical properties
      1) structural
         a) valence and chemical composition
         b) formation of compounds, alloys, mixtures
         c) geometric configuration
         d) interatomic distance and density
         e) internal pressure and cohesive energy
         f) structural defects
         g) corrosion

      2) moduli
         a) modulus of bulk
         b) modulus of rigidity
         c) modulus of elasticity
            (1) in tension
            (2) in compression
            (3) in flexure

      3) strengths
         a) elastic limit
         b) yield strength
         c) fatigue endurance limit
         d) Izod impact strength
         e) ultimate strength
            (1) in tension
            (2) in compression
            (3) in flexure
            (4) in shear

      4) dimensional change
         a) Poisson's ratio
         b) elongation
         c) reduction of area

      5) hardness and surface treatment
         a) Moh's hardness
         b) Brinell hardness
         c) Rockwell hardness
         d) Shore hardness
         e) friction
2. Liquid solutions
   a. mechanical properties
      1) structural
      2) volume relations and bulk modulus
   b. thermal properties
      1) fusion temperature
      2) latent heat of fusion
      3) specific heat
      4) viscosity
      5) surface tension

3. Gas solutions
   a. mechanical properties
      1) structural
      2) volume relations
   b. thermal properties
      1) evaporation temperature
      2) latent heat of vaporization
      3) gas constant and molecular mass
      4) triple point
      5) critical point
      6) viscosity

4. Vapor solutions
   (see list of properties for gas solutions)
II. INTERACTIONS OF ATOMS WITH OTHER PHYSICAL EXISTENTS

A. Interactions with Space-Time

B. Interactions with Photons
   1) Spectroscopy and color
   2) Work function
   3) Reflection coefficient
   4) Absorption coefficient
   5) Transmission coefficient
   6) Index of refraction

C. Interactions with Electrons and Positrons
   1) Positron absorption
   2) Electrical resistivity
   3) Dielectric constant
   4) Thermal conductivity
   5) Ionic creation

D. Interactions with Neutron Group
   1) Neutron absorption cross section
   2) Isotopes
   3) Magnetism
MINUTES OF THE BUSINESS MEETING OF THE 10TH ANNUAL CONVENTION
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MOTION AND THE SCHISM IN PHYSICS
Frank H. Meyer

PRECESSION OF THE PLANETARY PERIHELIA
DUE TO THE CO-ORDINATE TIME
K.V.K. Nehru

MOTION, NOT A PROPERTY OF MATTER
Frank H. Meyer

PREPARE TO ATTEND THE 11TH ANNUAL ISUS CONVENTION DURING AUGUST, 1986 IN NEW YORK CITY!
RECIROCITY

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ISUS CALL TO STRUGGLE

The new and better in science can win over the old and good only with the aid of knowledge and sustained struggle. The Reciprocal System of physics is the integrated theory of unified physics. It is the first and only one of its kind in the world of humankind and likely to remain so. The R.S. can secure the interest, understanding and appreciation of the world public when enough people study, examine and discover for themselves that R.S. physics is truer, more accurate and more adequate than the customary space-time nuclear, relativity, quantum, etc. mathematical physical theories.

The Reciprocal System is bio-centered physics. Modern sun-centered physics will be remembered, not because atom bombs could be made with it, but because, like geocentric physics, it is not free of physical error.

Recently one of the last of the outstanding physicists, who helped to engineer the early 20th century scientific revolution in physics and a contemporary of Dewey Larson: Paul Dirac died. No one understood so well as Dirac that the quantum theory of electricity and magnetism he did so much to create, is not completely satisfactory. The last sentence of the fine book he wrote about this subject says: "It seems that some essentially new physical ideas are here needed."

The purpose of ISUS, INC., RECIPROCITY and ISUS NEWS is to publicize and circulate some essentially new physical ideas, integrated into a revalued unified physics, which constitute the Reciprocal System of physics. ISUS calls old and new members of our movement to be an active part of this purpose, which we recognize to be a mighty one. Begin by reading the Minutes of the Business Meeting of the 10th Annual ISUS Convention, Prepare now to attend ISUS Annual Convention on the campus of Columbia University in New York City during August, 1986. Please renew your support of ISUS and RECIPROCITY; people, money and thoughtful, discursive contributions to RECIPROCITY are needed urgently to resume interrupted publication of RECIPROCITY.

PUBLICATION POLICY: As stated in the by-laws, the objective of the ISUS is the advancement of the R.S. of physical theory. This theory, as it is defined, consists of two fundamental postulates, together with everything that can be derived from those postulates by logical or mathematical processes, without introducing anything from any other source.

The unitary character of the theory, resulting from the derivation of all of its conclusions from the same set of premises, is its most essential feature. It is this status of the theory as a GENERAL physical theory—the only thing of its kind—that enables proof of its validity by the probability method, and enables extension of the theory into areas inaccessible to observation.

The purpose of RECIPROCITY is to contribute toward the accomplishment of the objective of the organization. Acceptance of items for publication shall therefore be determined by the following criteria:
1. All items must have relevance to the stated objective of the ISUS.
2. Original technical articles must deal with the R.S. of theory, as defined above, or aspects thereof; that is, the propositions supported must purport to be derived from the postulates of the R.S., or from previously published conclusions reached on that basis, without introducing further assumptions.
3. Arguments advanced against previously published material must be similarly based.

PREPARE TO ATTEND THE 11TH ANNUAL ISUS CONVENTION DURING AUGUST, 1986 IN NEW YORK CITY!
THIS ISSUE AND THINGS TO COME

Jan Sammer has resigned temporarily as Editor, RECIPROCITY to complete some graduate school studies. Senior Editor, Frank Meyer, has volunteered for the present as Acting Editor of our ISUS Journal. This is to insure prompt resumption of regular publication of RECIPROCITY and ISUS NEWS and to conserve and develop improvements of ISUS communication organs, initiated by Editor Sammer.

The theme of this issue is that the goal, thanks to the Reciprocal System of physics, now can be, is and should be, to unify the science of physics.

An excellent example of the theme is Dr. K.V.K. Nehru's paper in this issue on Precession of the Planetary Perihelia Due to Coordinate Time. Nehru shows in terms of the R.S. of physics that 43 arc seconds/100 Julian years of the observed rotational rate (575 arc seconds/100 Julian years in an inertial frame) of Mercury's perihelion is due to co-ordinate time. It is, like clock time, an essential component of total time, quite neglected by conventional physics. In terms of Newton's theory of gravitational motion LeVerrier in 1845-1846 is able to calculate Mercury perihelion rotation rate to be 532 seconds arc length/100 Julian years. Fortunately for LeVerrier the effect of co-ordinate time on Uranus perihelion precession is negligible (.002 arc sec./century) or he may not have discovered that the discrepancy between the observed orbit and the orbit of Uranus, calculated from Newton's gravitational theory, was an unknown planet. Since astrophysicists customarily assume that perihelion precession too must be purely a gravitational effect, they are non-plussed that Newton's theory cannot and does not predict all 575 arc sec./century of Mercury perihelion precession. They are especially frustrated, since Newton's theory does something right: with its aid in a purely theoretical study of the orbit of Uranus, LeVerrier is able to discover a new planet, Neptune, nobody ever even saw before he discovered it thus in September, 1846. Gropping to account for the excess 43 arc sec./century rotation rate of Mercury's perihelion in purely gravitational terms, Einstein in the 1916, 42 Annale Der Physik invented and published a new ad hoc mathematical theory of gravitational motion, the general relativity theory, with which, using the last of 75 equations he also calculates the excess 43 arc sec/century of Mercury's perihelion rate.

SCALAR MOTION will be the theme of the WINTER 1985-86 issue of RECIPROCITY. This next issue will be a double issue out in December, 1985. It will feature an article by Dewey B. Larson about Gravitation and the Galaxies. How fine and splendid the issue will be depends on the cooperation of members and subscribers in producing it.

Acting Editor Frank Meyer solicits comments, however brief, from each and everyone of you about the scalar motion theme to follow the Larson article, pointing out areas in which the verification of the existence of scalar motion makes a contribution to scientific knowledge. Contributors are encouraged to select your own topics. However, you may wish to refer to an earlier article, SCALAR MOTION, in Vol. XI, Number 3, Autumn, 1981 RECIPROCITY by D.B. Larson and/or to his following suggestions, for the benefit of anyone who may want to make use of them:

1. The general acceptance of a definition of motion that excludes scalar motion explains why previous attempts to construct a theory of a universe of motion have failed. Without the phenomena that we have now identified as scalar motions, the scope of the "motion" concept is too limited.
2. Recognition of scalar motion adds two more dimensions of motion to the one that can be represented in the reference system (the only one recognized by present-day science). This simplifies a number of physical problems.
3. Einstein's assumption, in his general theory of relativity, that mass distorts space, thus accounting for the shape of the gravitational force field, is now seen to be wrong. The radial force field is a direct result of the scalar gravitational motion.
MINUTES OF THE BUSINESS MEETING OF THE 10TH ANNUAL CONVENTION
OF THE INTERNATIONAL SOCIETY OF UNIFIED SCIENCE

Saturday, August 2, 1985, at the Jade Tree Hotel, Portland,
Oregon. The business meeting of the International Society of
Unified Science was called to order at 9:45 by Frank Meyer,
president. Four members were present (Frank Meyer, Rainer Huck,
Ronald Satz, Robin Sims); one additional member, Jan Sammer, was
in contact by phone, so that the quorum of 5 was met.

1. The secretary read the minutes of the business meeting of the
ninth annual convention, held in Salt Lake City, Utah. They were
approved.

2. Next, treasurer Rainer Huck presented his report. The
current net balance, as of the convention date, was $400.00.
The treasurer's report was approved.

3. The president then asked for Old Business.

   a. Reciprocity Journal

      The following was agreed upon:

      1) There will be a statement of policy in each issue.
      2) There will be a list of books available from ISUS in
each issue, on the advertisement page.
      3) A set of double issues of Reciprocity will be
published, so as to catch up to schedule. Frank Meyer will
continue with Vol. 14, but use the current date and provide an
editorial explanation for the delay in publishing.
      4) The most up-to-date mailing list, from members Jan
Sammer and Rainer Huck, will be used for mailing the journal.
Member Huck agreed to be in charge of the master mailing list.
      5) The serialization in Reciprocity of Volume II of
Larson's revised The Structure of the Physical Universe will
continue.
      6) Members Frank Meyer, Jan Sammer, and Robin Sims have
agreed to generate an up-to-date set of mailing labels.
      7) The forthcoming schedule for Reciprocity is as
follows:

          September 15, 1985
          November 1, 1985
          December 30, 1985

      8) A dues notice will be put in the next issue; member
Huck suggested putting in a substantial appeal. Member Sims
suggested using our present contribution system (regular,
contributing, sustaining).
      9) If necessary, president Frank Meyer will put up his
own money to keep Reciprocity being published.
     10) Member Satz moved, and member Huck seconded, to move
the mailing permit to Utah at the beginning of next year, if we
obtain 100 paying members or subscribers. The motion carried.
     11) Member Satz moved, and member Huck seconded, to allow
each officer of ISUS to receive multiple copies of Reciprocity (3
to 5 or more, if necessary for promotion of the Reciprocal
System). The motion carried.
12) Member Huck agreed to rewrite the advertising page of Reciprocity to bring it up-to-date. Member Sims moved, and member Huck seconded, to raise the price of Studtmann's book to $35. The motion carried.

13) Editor Meyer agreed to put out a special issue of Reciprocity on scalar motion. Member Satz agreed to work with Dewey Larson to produce the articles.

b. ISUS News

The next issue of ISUS News will cover this convention. The one following will present the plans for the 1986 convention.

c. Advertising

North Pacific Publishers reported that our joint magazine ads did not succeed. It was agreed to go back to direct mail. The next brochure to be sent is entitled "After 3000 years."

4. The president then called for new business.

a. Member Sims moved, and member Huck seconded, to have the 1986 convention at Columbia University, under the guidance of members Sammer and Satz. The proposed time would be August 15—August 17, subject to availability of facilities at Columbia. The motion carried.

b. Member Huck moved, and member Satz seconded, that the keynote address of the 1986 convention be given by member Roy Curtin. The motion carried.

c. The basic schedule for the convention will be as follows:

1) Friday morning—papers
2) Friday afternoon—papers
3) Friday evening—keynote address
4) Saturday morning—any remaining papers; first business session
5) Saturday afternoon—second business session
6) Saturday evening—party

d. The course on the Reciprocal System will be given by member Satz, for the four days preceding the 1986 conference. The price will be $60. It was agreed to advertise the course at the surrounding local colleges and in ISUS News. A forthcoming issue of ISUS News will contain the course outline.
5. The president then called for elections.

   a. Board Members
   Member Huck moved, and member Satz seconded, that the 5 board members with expiring terms be reelected, along with former board member, Richard Long. The motion carried. So, the 1985-1986 board consists of the following individuals: Anderson, Huck, Meyer, Satz, Studtmann, and Long (with 2 years to go at end of next year); Sims, Nehru, Sammer, and Gilroy (with 1 year to go); and Curtin, Halprin, Blackburn, Porter, and Schumacher (up for reelection next year).

   b. Officers
   Member Huck moved, and Satz seconded, to reelect the present officers. The motion carried.

6. The president then asked for other business.

   a. Recruitment
   1) Member Huck moved to have ISUS present an award to the first developer of a calculus of scalar motion and for the first individual to mathematize the postulates of the Reciprocal System. The motion was tabled, so as to allow member Huck to present a more formal proposal to the board.
   2) Member Sims volunteered to create a Canadian organization to study the Reciprocal System. The group will seek chapter status with ISUS.
   3) Member Sims also agreed to put the ISUS mailing list on a computer data base system.
   4) All members present agreed to promote gift subscriptions to Reciprocity, as a recruitment tool.
   5) Member Sammer agreed to post flyers on New York City campuses to attract interest in the 1986 convention.

   b. Editorship
   Member Sims moved, and member Huck seconded, that member Frank Meyer be formally appointed Editor of Reciprocity and member Jan Sammer appointed Senior Editor. The motion carried.

7. Member Sims moved, and member Huck seconded, to adjourn the meeting. The motion carried. The meeting was adjourned at 4:45.

Ronald W. Satz
Secretary, ISUS
MOTION AND THE SCHISM IN PHYSICS

Frank H. Meyer

(In abbreviated form this lecture was contributed to the Autumn Meeting of the Minnesota Area Association of Physic Teachers, Saturday, October 22, 1963 on the campus of the University of Minnesota-Minneapolis.)

INTRODUCTION

The schism in modern physics splits about the question how to unify physics.

Because the goal of most physicists now is to unify physics and not simply to discover isolated new facts, the schism has widened and deepened. Decades ago, Einstein announced the new goal in these words:

"New theories are first of all necessary when we encounter new facts which cannot be 'explained' by existing theories. But this motivation for setting up new theories is, so to speak, trivial, imposed from without. There is another, more subtle motive of no less importance. This is the striving toward unification and simplification of the premises of the theory as a whole (i.e. Mach's principle of economy interpreted as a logical principle)."

Einstein personally tried to achieve the goal of unifying physics. The verdict is in from friends, himself and critics alike: that he failed.

Einstein and his followers tried to achieve the unification of physics on the basis of relativistic physics, nuclear physics, quantum mechanics, quantum electrodynamics, etc. However, the fact that the relativity physicists and their allies, particularly in the U.S.A. & the U.S.S.R., have not achieved their goal does not mean that the goal is forever unattainable.

On the contrary, the goal is and must be attainable, since and because it is being attained now on the basis of the Reciprocal System of physics(1,2).

OVERCOMING THE SCHISM IN PHYSICS

Physics presently is disunited more by what physicists know that isn't so than by what we do not know.

No science can be united on a foundation of error.

The contemporary situation in physics is analogous to that which prevailed in sixteenth century and seventeenth century Europe. The general run of natural philosophers then knew that heaven, earth and the rest of the physical universe are centered about an immovable planet. Physicists then were referred to as 'natural philosophers'. To-day's philosophers of Nature 'know' that all which exists on earth, in heaven and beyond is centered about moving matter.

Nevertheless, the physical universe and the human universe are no more centered about moving matter than all of existence is or ever was centered about an immovable earth.

As Larson(1,2) has shown, the physical universe actually is the universe of motion.

Contrary to what Einstein, the relativity physicists, quantum mechanists and dialectical materialists have affirmed it to be, the physical universe is NOT a universe of matter. Furthermore, Time, Space, MOTION and Energy, etc. are NOT AT ALL mere properties and/or forms of matter.
According to Larson(1,2), the material sector of the physical universe is but one-half of the physical universe as a whole. This sector is the half in which everything moves in space and nothing moves with a speed in excess of the unit speed of space-time progression. This rate is one natural space unit per one natural time unit, equal in magnitude to the speed of light in vacuo.

In the other half, which Larson calls the 'cosmic sector', everything moves in time. A condition of stability of this cosmic sector is that all things move with speeds in excess of unit speed of space-time progression.

Furthermore, a model of the physical universe, premised on moving matter, contradicts itself. Because motion is presumed to be a property of matter, this model implies that motion without something moving is impossible. Of course, this rules out any independent progression of time and space. What has to be recognized also is that if matter is the exclusive source of motion, that is, if motion is a property of matter, then matter is self-moving. In consequence, perpetual motion of the first kind not only is not prohibited, and perpetual motion of the second kind not only is not prohibited, but can and does occur. However, no one has yet demonstrated perpetual motion of any kind in the physical universe. Until someone does demonstrate it, the hoary hypothesis that motion is nothing but a property of matter had better be discarded. In favor of the postulate that motion is identical with space-time.

HOW SCHISM IN PHYSICS HAS ARISEN

This is the foundation of scientific method: we are not to suppose and invent but to discover what Nature does and/or can be made to do.

In the twentieth century physicists generally have chosen to take the contrary course. Ernest Rutherford, Niels Bohr, Werner Heisenberg, Albert Einstein, Hans Bethe, etc., have believed that by the 'free invention' of their minds, they and their associates have formulated the truth, the whole truth and nothing but the truth about the nature of motion, space-time, light, heat, electricity, magnetism, energy, matter, gravitational motion, the structure of the atoms of matter and the sky.

Rutherford and Bohr invented the nuclear atom model of the atom of matter. Yet the atom of matter, unlike a living cell or the solar system, has no nucleus and is not a compound of nucleons and electrons.

Heisenberg and Bohr invented radical indeterminism as the foundation principle of physics. But the actual existing physical universe is really no more radically undetermined than it is scientifically determined. Contrary to the Copenhagen school of metaphysics, there is room in Nature and particularly in the physical universe for both cause and chance.

Without identifying the nature of space or time, Newton found them to be quite unrelated. Without identifying the nature of their relation, Einstein found them to be quite inseparable. Both Einstein and Newton ruled out the possibility that space and/or time have to do with motion. Both agreed with Barrow's reply to the question: "But does not time imply motion? Not at all." Both disagreed with Aristotle, for whom 'time is an aspect of motion'.

In reality time and space are the two necessary and sufficient conditions or aspects of all physical phenomena of motion. According to Larson(1,2), motion invariably is a reciprocal or multiplicatively inverse relation between time and space. In their turn, space and time together depend for their very existence on the existence of motion.

Mass and energy are not identical. Energy and mass as discrete quantities of diverse compounds of motion can be and are equivalent or equal.

As claimed by Larson(1,2), the physical universe is composed entirely of one component, motion, existing in 3 dimensions, in discrete units and in 2 reciprocal forms, space and time.
Also, the physical universe conforms entirely to the relations of finite mathematics, its magnitudes are absolute, and its geometry is Euclidean. The finitude of the physical universe as a whole implies that each and every part of it is less than the whole and only the sun of its parts can and does equal the whole. No part of it can be or is equal to or greater than the whole. For example, the mass of an electron cannot be infinite and greater than the total finite mass of the whole physical universe, even when by moving in time it travels with an inverse speed in excess of unit speed.

The ultimate aim of the relativity theory is to include both electromagnetic and gravitational motions in its immovable 4-dimensional space-time continuum geometry. This was not done and has not yet been achieved. The reason is that space-time is NOT a simple immovable 4-dimensional continuum, but rather a 3-dimensional space-time scalar progression.

Bethe and others have thought that the sun and other stars generate stellar energy from nuclear atoms of hydrogen and helium. Specifically, 4 hydrogen 'nuclei' are believed to fuse to a helium 'nucleus'. No experimental evidence supports this theory and evidently no atomic 'nuclei' of any kind exist in the sun, other stars, galaxies, etc.

Herein the present schism in physics originated and arose. Some of the very scientists who who prepared and executed the revolution in physics at the start of the 20th century wished to believe that now at last physics has just about reached the end-of-the-truth road. They have concluded that in exposing and correcting some old errors of their predecessors, contemporary physicists entertain no new fundamental mistakes. Too much physical research to-day is conducted to save appearances.

WHAT IS TO BE DONE

As a consequence of all this pragmatic and positivistic 'free' invention of scientific minds, modern physics is disunited and tilts at numerous windmills of a non-existent physical universe-Big Bang, nuclear atoms, quarks, neutron stars, black holes, gravitational collapse of the universe as a whole and in all its parts, Warmer Tod, etc.

Bizarre and grotesque innovations do not necessarily and invariably represent progress of a science. In order to overcome the yawning schism of modern physics, criticism of these and related innovations becomes a pertinent function to be performed by physicists. As Popper(3) has done, it is surely in order to question to where such pragmatic and positivistic innovations are leading:

"We may well be on the wrong way even when — and especially when we think we are progressing. Even Einstein seems to have been on the wrong way.........with his own research program of unifying electromagnetic and gravitational field theories."

It is not the aim of unifying physics that is wrong nor Einstein's faith that the aim is achievable. However, the conventional ways of the physics of this century do not begin to achieve the aim. It is true that these ways have produced atomic and hydrogen bombs. Unfortunately, these products of physics cannot be used actually to remedy the ineradicable defects of the nuclear atom model of the hydrogen atom and/or the atom of any other chemical element of the Periodic Table.

INNER MOTION OF SCIENCE

By upholding the canard that the nuclear atom model, quantum mechanics, relativity physics, etc. are above and beyond criticism, the physics profession of the U.S.A. & U.S.S.R. generally ignore by this abhorrence of criticism, the positive role played by honest criticism in accelerating the inner motion of science towards its goal of truth, including physical truth. Bernal(4) has described adequately the arrest of science, resulting from the complacent belief that science is a self-contained product of a consensus of scientists who already have travelled the end-of-the-truth road:

"The inner motion of science changes as much as its outer scope. Its, however, a mistake and one which is more prevalent now than at any other time, to imagine that this inner motion of science is an autonomous system completely insulated from the social world; that it is intrinsically pure knowledge—a unique approximation to an absolute truth, to be achieved by a sure method and guarded by a rejection of alternative ways of looking at things. The history of science is full of examples which show that the adoption of this attitude is the surest way of arresting science, often while giving the appearance of the greatest profundity and generality."

B 14.1-8
'Give me matter and I'll build a world.' For two hundred years since the philosopher I. Kant uttered it, many physicists, chemists, astronomers and others have striven to make good that boast.

Neither Kant nor anyone else before or since could make the boast good. The finite physical world as a whole and/or in part, including matter, can be produced only if motion or space and time is given. Without time and space not even Nature can make space-time progress. Without space and time even Nature cannot produce the slightest motion of any kind. And without motion physical nature itself would cease to exist at all in any shape or form. Without motion Nature produces no physical entity whatsoever, not even light photons, the simplest compound form of motion. Neither electrons nor magnetic particles nor atoms nor cosmic particles are or can be produced prior to photon production by Nature. No motion, no light, no matter to build of physics with.

DEEP ROOTS OF THE SCHISM IN PHYSICS

The main root of the present schism in physics centers about the question of the constitutional unity of the physical world. Does the unity of the world lie in its mobility? Is motion prior to matter? Does the unity of the world lie in its materiality? Is matter prior to motion?

No doubt matter and motion are as inseparable as time and space. The reason is not that motion is a property of matter. Matter never separates from motion. Motion can and does separate from matter. This is because matter, like any other physical entity, is nothing but a particular compound or structure of motion. While less familiar, motion without a thing moving is a daily happening: space-time progression is one of the most neglected facts of science, beginning with conventional physics.

Other roots of the schism in physics are established about the following questions: Whether space and time are infinitely or finitely divisible? Whether time is 1-dimensional or time has as many dimensions as space? Whether time is asymmetrical with space or time is symmetrical with space?

The Reciprocal System of physics affirms that space and time are as finitely divisible as matter and energy are; that time has and must have as many dimensions as space; that for the same reason space and time are completely symmetrical, not asymmetrical, because time and space as motion are reciprocally related, that is, multiplicatively inverse.

The scalar space-time progression is an essential discovery and inclusion of the Reciprocal System. It ranks with the discovery of the scalar gravitational motion of matter as a quite important feature of the physical universe in all its parts and as a whole. Three-dimensional space progresses with three-dimensional time at the equable scalar rate of one discrete space unit per one discrete natural time unit. This is Nature's own unit speed, an absolute constant. Its magnitude equals the speed of light, whether or not a photon occupies any particular space-time location. Hence the true physical zero is not the mathematical zero, but the mathematical unity, unit speed.

Like gravitational motion, the space-time progression manifests itself as a physical force in a diverse number of ways. The space-time progression force together with the gravitational force plays a leading role in the total motional force behavior of the hypothetical universe of the Reciprocal System. Both gravitational and space-time progression are scalar forces. Gravitational force invariably acts toward unity; space-time progression force invariably acts away from unity. Outside unit space toward unity (unit speed) makes gravitational force act as an 'attractive force'. Inside unit space toward unity causes gravitational force to behave as a 'repulsive force'. Outside unit space away from unity makes space-time progression act as a 'repulsive force'. Inside unit space away from unity causes space-time progression force to behave as an 'attractive force'.

Thus, instead of the conventional ad hoc hypothesis of 'Big Bang', the Reciprocal System invokes space-time progression force and gravitational force to explain the well-known recession of the galaxies, discovered by Hubble; and also to explain part of the red shift of quasars. And instead of invoking the dubious nuclear atom model to 'explain' solid cohesion, the Reciprocal System accounts for solid cohesion on the submicroscopic level as due to the attractive force of space-time progression and the repulsive force of gravitational motion.
The Discovery by D.B. Larson that gravitational motion has a repulsive side brings into serious question the gravitational collapse 'explanation' of certain well-known ultradense astronomical compact bodies: pulsars (neutron stars), quasars (black holes, naked singularities), etc.

The nuclear fusion theory of stellar energy generation now is questioned by the failure of the Raymond Davies' experiment to confirm it. The power of the Reciprocal System of physics to account for stellar energy generation in terms of radioactivity without invoking the nuclear fusion model also brings into question the nuclear atom model of the atom of matter, the chemical bond theory of solid cohesion, the entire associated electrical theory of atomic structure, etc. In the light of this development, our physics profession cannot afford to delay for outside critics, such as Jaynes (5), to revalue the cherished nuclear atom model of the atom of matter:

"The terms theory and model, incidentally, are sometimes used interchangeably. But really they should not be. A theory is a relationship of the model to the things the model is supposed to represent. The Bohr atom model of the atom is that of a proton surrounded by orbiting electrons. It is something like the pattern of the solar system, and that is indeed one of its metaphoric sources. Bohr's theory was that all atoms were similar to his model. The theory with the more recent discovery of new particles and complicated interatomic relationships has turned out not to be true. But the model remains. A model is neither true nor false; only the theory of its similarity to what it represents."

Finally, the shism in physics is further disclosed when considering the physical universe as a whole. Although Einstein found it as a whole to be finite, he invented an infinitely divisible space-time. Einstein likewise imagined space, time, and mass to vary, infinitely with material velocity approaching unit speed.

With his Reciprocal System Larson discovers the physical universe in all its parts to be finite and as a whole to be finite, cyclical and unchanging. Larson (6) says:

"Infinity is excluded from it, since we are defining motion as a relation between a time magnitude and a space magnitude, and we deduce that the quantity of motion is finite. Since all physical entities and phenomena are manifestations of motion, they are all measured in terms of 1/n or n/1, where n is finite. No infinities are possible. This is another of the many places where the Reciprocal System of physics has an advantage over conventional physical theory, in which infinities are a considerable source of embarrassment. As Richard Feynman puts it:

"If we get infinity, how can we ever say that this agrees with nature?"

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4. Bernal, J.D. THE PLACE AND FUNCTION OF SCIENCE
PRECESSION OF THE PLANETARY PERIHELIA
DUE TO THE CO-ORDINATE TIME

by

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Introduction

The first of the two Fundamental Postulates of the Reciprocal System from which Larson derives every aspect of the physical universe is:

"The physical universe is composed entirely of one component, motion, existing in three dimensions, in discrete units, and with two reciprocal aspects, space and time."[1]

The primary implication of the Postulate is that the properties of either space or time are the properties of both space and time, except that space and time are reciprocally related to motion. This means, inter alia, that space is a progression like time is, and that time is three-dimensional. While the space progression is observable as the recession of distant galaxies, the three-dimensionality of time is not so directly apparent.

It is essential to note that the three dimensions of time are not the spatial dimensions; nor is there anything space-like in them. In any situation, the total time comprises of two components: (i) the clock time, which is a uniform progression and (ii) the three-dimensional coordinate time (analogous to the three-dimensional coordinate space of a stationary reference system).

Besides other things, the concept of coordinate time in the Reciprocal System explains and derives the characteristics of supernovae, the white dwarfs, the pulsars, the quasars, the compact x-ray sources and the cosmic rays—without taking recourse to concepts like the degenerate matter, the curvature of space-time etc. All the so-called Relativistic effects come out, in the Reciprocal System, of the existence of this additional time component.

In fact, the effect of the excess advance of the perihelion of an orbiting planet arises out of the accumulation of the coordinate time from its orbital motion. "As long as the orbital velocity is low, the difference between the clock time and the total time is negligible, but the velocity of Mercury is great enough to introduce an appreciable amount of coordinate time and during this added time the planet travels through an additional distance."[2]

The Theoretical Evaluation

According to the Reciprocal System an independent motion (like gravitation) of speed \( v \) has associated with it an increase of coordinate time amounting to \( v^2/c^2 \) unit per each unit of clock time (\( c \) being the speed of light).[3] In order to calculate the excess orbital movement, Larson argues like this: "Since the gravitational motion is inward, the scalar space-time direction of the orbital motion is outward, and the computed time increase is radial. To obtain the circumferential space equivalent of this linear time increase, we multiply by \( \pi \)."[4]
Thus according to Larson the total coordinate time increase is $\Pi v^2/c^2$ sec/sec. In the quotation just cited what Larson states regarding the scalar direction of the orbital motion as being outward, is understandable. But what the expression "the computed time increase is radial" is expected to connote is difficult to see. For, "...no matter how many dimensions it may have, time has no direction in space."[5] To be sure, it is true that time has a property called 'direction in time,' but this is a purely temporal property and 'directions in time' are not in any way determined by directions in space. Consequently, the coordinate time increase associated with gravitation (or with any independent motion) is a scalar addition. The words "...to obtain the circumferential space equivalent of this linear time increase, we multiply by $\Pi$," do not, therefore, depict the truth, except pointing out that the necessity of having to include in the calculations a factor amounting to $\Pi$ has been recognized.

The true state of affairs can be understood if we recall that gravitation is a three-dimensional scalar motion. If $v$ is the gravitational speed, then the coordinate time increase per each scalar dimension is $v^2/c^2$. The total coordinate time increase, therefore, is $3 v^2/c^2$. The orbital motion of the planet is one-dimensional (scalar). As such, the effective coordinate time increase, as applied to the orbital motion, is $3 v^2/c^2$. The same is true in any other case where the motion is one-dimensional, like, for example, that of a photon grazing the sun. On the other hand, if we are considering the effect of the coordinate time increase due to gravitation on an atom situated in the gravitational field, the result is different. Since the atomic rotation is three-dimensional, the coordinate time increase effective per dimension is $(3 v^2/c^2)/3 = v^2/c^2$ only. This is the value which causes the gravitational redshift, for instance.

Thus the rate of coordinate time increase at any speed $v$ is given by

$$\frac{dt}{dc} = 3 \frac{v^2}{c^2} \quad \text{sec/sec} \quad (1)$$

where $t_c$ represents the coordinate time and $t$ the clock time.

Consider the elliptical orbit of a planet around the sun, with the sun situated at the focus. The equation of the ellipse in polar coordinates, with the center at the focus is given by

$$l = r \left(1 + e \cos e\right) \quad (2)$$

where $r$ = the radial distance of the planet, at any angle $e$ measured from the perihelion

$$l = \text{the semi-latus rectum} = a \left(1 - e^2\right) \quad (2-a)$$

e = the eccentricity of the ellipse, and

$$a = \text{the semi-major axis.}$$

In an earlier article [6] I have pointed out that the gravitational speed, $v$, at any distance $r$ outside of a mass $M$ is given by

$$v^2 = GM/r \quad (3)$$

where $G$ = the gravitational constant.

Using eqs. (1), (2) & (3), we have the rate of coordinate time increase at a given location on the orbit as

$$\frac{dt}{dt} = 3 \frac{GM}{rc^2} = (3 \frac{GM}{lc^2}) \left(1 + e \cos e\right) \quad (4)$$
\[ \frac{dt}{de} = (3 \frac{GM}{l c^2}) (1 + e \cos \theta) \text{ radians} \]  

\[ \text{Therefore, the total increase from } e = 0 \text{ to } 2 \pi \text{ radians (that is, one revolution) is} \]

\[ d = \int_0^{2\pi} \frac{dt}{de} = (3 \frac{GM}{l c^2}) \int_0^{2\pi} (1 + e \cos \theta) \text{ de} \text{ radians} \]

\[ = (3 \frac{GM}{l c^2}) 2\pi \text{ radians/revolution} \]

\[ = 3 \frac{GM}{l c^2} \text{ revolution/revolution} \]  

(Note that eq. (7) is applicable to parabolic, as well as, hyperbolic orbits with l as the semi-latus rectum.) Finally, using relation (2-a), the perihelion advance, according to the Reciprocal System, is given by

\[ d_{RS} = 3 \frac{GM}{a c^2} (1 - e^2) \text{ rev/rev} \]  

The corresponding formula from the General Relativity is

\[ d_{GR} = 12 \pi^2 \frac{a^2}{P^2} \frac{c^2}{c^2} (1 - e^2) \text{ rev/rev} \]

where \( P \) = the orbital period of the planet.

In order to compare the two formulae, we use the relation

\[ GM = 4 \pi^2 \frac{a^3}{P^2} \]

for the solar system. Then eq.(8) becomes identical to the Relativity expression, given in eq.(9)

References

4. D.B. Larson, Beyond Newton, op. cit., p. 126
5. D.B. Larson, Nothing But Motion, op. cit., p. 73

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MOTION, NOT A PROPERTY OF MATTER

Frank H. Meyer

(This lecture in abbreviated form was contributed to the 52nd Annual Spring Meeting of the Minnesota Academy of Science at the College of St. Thomas, St. Paul, April 28, 1984.)

INTRODUCTION

Conventional modern physics generally does not recognize that defining motion as a property of matter is not necessarily good physics. What if motion is temporally and spatially prior to matter? Has the modern physicist and classical natural philosopher demonstrated beyond a reasonable doubt that matter is logically and historically prior to motion? They certainly have NOT! Can even one atom of matter come into being in the absence of time, space and/or motion? Is matter actually prior to motion or is motion prior to matter?

The main aim of this essay is to disclose the proposition to be untenable, because physically false: that motion is a property of matter.

A second aim is to show that this false postulate is one of a number of plausible yet erroneous conjectures that presently stand in the way of the goal of the physics profession of the U.S.A. and the U.S.S.R. to revalue and unify modern physics.

WHAT IS MOTION?

Every physicist recognizes that motion is undoubtedly a physical phenomenon. Physicists are not agreed, however, about what kind of physical phenomenon motion is.

Because I like his reasons, I agree with Thomas Paine(1), who in 1797 in Paris rejected the claim that motion is a property of matter.

This Thomas Paine is the scientist, inventor, patriot, friend of Benjamin Franklin and Thomas Jefferson. He is the man who named our country: United States of America. This is the same man who, by writing and publishing the pamphlet, COMMON SENSE, aroused and led oppressed people to rise against and overthrow British monarchical rule over thirteen colonies on this continent in favor of establishing a democratic republic, premised upon the voluntary acknowledgement of human equality. Thomas Paine is the very man whom Mr. T. R., later to preside over the U.S.A. awhile, characterized 'that dirty, little atheist'.

Paine(1) in his address objected to the proposition that motion is a property of matter with a scientific argument and a theological argument. He pointed out that this believable proposition, if true, implies perpetual motion. It at least implies the possibility. Thomas Paine reasoned that the proposition remains suspect and certainly not proved 'scientifically' until the claimant demonstrates that perpetual motion can and does occur within the physical universe. In the light of T. R.'s picture of Paine, it is ironically interesting that Thomas Paine objected to the claim that motion is inseparable from matter for the reason that the claim implies atheism, another proposition that may be believable but that by any scientific test nevertheless remains unverified.

A corollary of the claim that motion belongs to matter is the dictionary and physics textbook definition of motion: 'the act or process of changing place; change of local position; change of distance between bodies'. This representation of motion is quite incorrect, implying that motion is a relation between a body and space or a relation of distance between bodies. But no body can change local position in space in zero time nor can a change of distance between bodies occur in no time.
If matter and space do not constitute the essence of motion, then what does constitute its essence, the essence of motion?

I think with Dewey B. Larson (2, 3) that the essence of motion is space-time, not matter and space. Larson defines motion as 'a reciprocal relation between space and time'. More briefly, Larson identifies space-time with motion. The two necessary and sufficient conditions of all physical phenomena and/or of all motion are time and space, both of which are prior to matter and energy.

**MOTION IDENTICAL WITH SPACE-TIME?**

The proposition that motion is identical with space-time is radically different from the proposition that motion is a property of matter. The latter is familiar; former, not.

It was not always quite so. The belief that motion can be defined adequately in terms of matter and space probably begins with Newton and his teacher, Isaac Barrow. Both of them may have learned this notion from Democritus, Leucippos, Epicurus and Lucretius, who think of the physical world being composed of atoms and the void. Newton is unable to discover any relation within space-time and/or between space-time and motion, because he makes the double mistake of assuming space and time each in its own way to be immovable and of assuming space and time themselves to be unrelated. Newton explicitly assumes space to be 'immovable'. While a scholium in the Principia reports time 'flows equably', Newton along with Barrow mistakenly believes that time nevertheless does not imply motion. Later Benjamin Franklin and earlier Aristotle do not commit this error. Franklin in his Autobiography counsels us not to 'squander time, because time is the stuff life is made of'. Aristotle thinks that 'time is an aspect of motion'. Aristotle makes his own mistakes when he disbelieves in atoms (finitely divisible matter) and when he believes that the planet Earth is immovably located at the center of the physical world. These mistakes did not preclude Aristotle from discovering that, of course, time is a condition of motion, since his common sense disclosed to him that no physical entity can move at all in no time. His mistakes did prevent Aristotle from recognizing that motion has only one other aspect or condition besides time and that is space. Whoever takes for granted that Earth is immovable is hardly likely to perceive that the space about our planet is and always has been a uniform scalar progression or part of the uniform scalar progression involved with the progression of time. It is not even probable that anyone could have noticed space-time progression before the Michelson-Morley Experiment. Before the physical existence and the physical meaning of space-time progression is understood, its uniform, finite speed has to be established by counting, measuring and computing. All this takes place and time. Before Aristotle or even Newton or Einstein would be able to anticipate that Nature has been built upon the identity of motion with space-time, he is rather more likely to fall into another error: that of believing space to be stationary, in a state of absolute rest and only a medium through which all physical entities move, like race horses over a race course track.

**SPACE-TIME PROGRESSION?**

Herman Minkowski is the mathematician and scientist who perhaps more than anyone else has formulated the four-dimensional space-time geometric coordinate framework of the Einstein relativity theory. Minkowski also is one of the few scientists who may be able to aid interested relativity physicists to learn three things: 1. to become conscious that motion is NOT unrelated to and separated from space-time; 2. to become aware that space-time progression is not merely a figment of the imagination of Dewey Larson and his supporters; 3. to learn that while Albert Einstein performs a valuable service to science by alerting physicists to the inseparability of space and time, he goes down this earthly scene without discovering just HOW space and time are essentially related. For Minkowski is one of the few
scientists who comprehends the possibility that time progression involves the progression of space. In his famous address about Space and Time, Minkowski(4) poses but does not resolve the issue of how "we may overcome the difficulty of never being able to decide, from physical phenomena, whether space, which is supposed to be stationary, may not after all be in a state of uniform translation".

By overcoming the difficulty of learning that space can be and is in a state of three-dimensional (scalar) translation, another previously unanswerable and unanswered question of physics is easily answered: With reference to what does time progress? All motion and all physical entities come into being with scalar progression of three-dimensional time with space progression. Thus, time progression implies space progression, refers to it. Time cannot be reduced to space nor space to time. Space has no dimensions in time and time has not one dimension in space. As motion, space and time are symmetrical in dimension, etc., because of the multiplicative inverse or reciprocal character of their relationship. Space-time progression is a particular consequence of this reciprocal relation: the equivalence of the natural finite time unit (.152068 x 10^-15 second) and the natural finite space unit (.455884 x 10^-5 centimeter). In conventional English units this equivalence implies that 1 second of time = 186,000 miles.

Space-time progression is the primordial motion of the physical universe. This original, pervasive and simplest motion is a scalar motion of nothing and is prior to the scalar gravitational motion of matter.

The standard of all speed in the physical world is unit speed of the space-time progression. Unit speed is measured by the ratio of unit space and unit time. Larson(2,3) for this reason refers to this gauge speed as unit speed or unity. He identifies unit speed as the objective origin of the physical world's own natural reference system. Mathematical zero speed corresponds to a physically non-existent state of absolute rest. Mathematical unity replaces mathematical zero as the true zero of physical measure. There is no room in the Reciprocal System for the immovable space and unmoving time of Newton and Einstein.

The reciprocal character of the space and time relation implies much more than equality of their respective natural units and more than unit speed.

All physical entities come into being out of law-governed speed displacements from unit speed. Between 1/1 are the ratios 1/n and n/1, where n is an integer. This range of displacements divides the physical world into two main sectors: the familiar material sector and the much less familiar cosmic sector. This sector, inverse to the material sector, is denoted by Larson the cosmic sector, because the presently most available evidence for this sector are the well-known phenomena of cosmic radiation.

These primary data and propositions of the Reciprocal System of physics, the discovery of its author, the 83-year young engineer, Dewey E. Larson, provide a challenging and exciting verification and revaluation of conventional modern physics. Einstein was right to criticize Newton's free invention of the unrelated and separate character of space and time. Einstein himself was wrong to acquiesce in and approve the Newtonian and pre-Newtonian free invention of the unrelated and separate character of motion, space and time. The canard that space-time's involvement with motion is is only relative to the motion of matter must be relinquished for the good of the goal of unifying physics in the 20th century in terms of the R.S. of physics.

REFERENCES
Special Scalar Motion Issue

Recent changes in the astronomers' interpretation of the recession of the distant galaxies now permit us to show this recession to be a scalar motion. This confirms one of the basic premises of the Reciprocal System, and underscores the need for a fundamental change in the accepted structure of physical theory. In this special issue we examine some of the implications of this development.

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Special Issue of *Reciprocity* on Scalar Motion: Some Principles

1. The general acceptance of a definition of motion that excludes scalar motion explains why previous attempts to construct a theory of a universe of motion have failed. Without the phenomena that we have now identified as scalar motions, the scope of the “motion” concept is too limited.

2. Recognition of scalar motion adds two more dimensions of motion to the one that can be represented in the reference system (the only one recognized by present-day science). This simplifies a number of physical problems.

3. Einstein's assumption, in his general theory of relativity, that mass distorts space, thus accounting for the shape of the gravitational force field, is now seen to be wrong. The radial force field is a direct result of the scalar gravitational motion.

4. The finding that the electric charge is a motion gives us an explanation of a phenomenon that is without any explanation in conventional science. We are told that the charge has to be accepted as a given feature of the universe, not capable of explanation.

5. The “expansion of the universe” that the astronomers talk about is essentially the same thing as the progression of the natural reference system that our theory requires. However, the astronomers assume that space is expanding, whereas we see an outward movement of individual masses. The demonstration that gravitation is also a scalar motion shows that our version is correct, as the same general principle must apply in both cases, and a “contraction” explanation of gravitation would not be feasible.

6. The existence of scalar motion emphasizes the limitations of spatial reference systems. Instead of being a framework in which all motion can be represented, as seen in present-day theory, these spatial reference systems can only represent one-dimensional motion at speeds less than one unit.

7. All objects with mass are in motion from the scalar standpoint, even if they are stationary in the reference system. The gravitational force is the force aspect of this scalar motion.

8. The discovery of scalar motion solves the action-at-a-distance problem, which has been a bone of contention in physics for centuries.

As the foregoing items indicate, verification of the existence of scalar motion is the key to a greatly improved understanding of physical relations. The objective of the present issue of *Reciprocity* is to bring this point to the attention of the scientific community as forcibly as possible.

—The Editors
Gravitation and the Galaxies

Dewey B. Larson

Today, three centuries after Newton, gravitation is still one of the enigmas of science. "It may well be the most fundamental and least understood of the interactions," says Robert H. Dicke. In all of the efforts that have been made to formulate a unified physical theory the big challenge has always been to bring gravitation within the theoretical framework. One of the most basic problems is to define the nature of the phenomenon. According to Einstein's general theory of relativity, the theory that is currently accepted (often with some reservations), gravitation is equivalent to a motion. This assertion implies that, while it has some of the characteristics of motion, it is actually not a motion. The objective of the present discussion is to examine the validity of this conclusion.

Let us consider a dispersed system of gravitating objects isolated in space. From our present knowledge of the gravitational effects, we can deduce that each of these objects will move toward all of the others. In this particular case, then, gravitation is a motion, not merely the equivalent of a motion. It is a motion that differs in some respects from the motions with which we are familiar, but it is by no means unique. The motions of the galaxies, for example, have the same characteristics, except that these objects are moving outward away from each other, rather than inward toward each other. All of the distant galaxies are observed to be receding from our Milky Way galaxy at high speeds. Unless we make the assumption that our galaxy is the only stationary object in the universe, an assumption that was repudiated by science long ago, our galaxy is likewise receding from all others. Thus the galactic system is one in which all individuals are moving outward away from each other.

A small scale example of the same kind of motion can be seen in the motion of spots on the surface of an expanding balloon, often used as an analogy by those who undertake to explain the nature of the motions of the galaxies. Here, too, each individual is moving outward from all others. If the expansion is terminated, and succeeded by a contraction, the motions are reversed, and each spot then moves inward toward all others, as in the gravitational motion.

In each of the examples cited, the inward or outward motion of the individual points or objects takes place in all directions, which means that the motions have no specific, or inherent, directions. It follows that these are scalar motions, defined by magnitude and sign (positive or negative, represented as outward or inward in the reference system). Here, then, we observe three different examples of a type of motion, the existence of which is not recognized by present-day physical science.

This lack of recognition is due to the fact that in current practice motion is defined in a manner which excludes scalar motion. The prevailing view is that motion is a change of position relative to some identifiable point or object, and it is assumed that this change can be represented in a coordinate reference system. On this basis, the magnitude and direction of the change are specified by a vector, which occupies a definite position in the reference system. But it is evident that a system of scalar motions cannot be represented in its true character in this spatial reference system, as the system of coordinates has no way of representing simultaneous motion in all directions. In order to make representation possible, the scalar system must be coupled to the reference system at some particular point, the reference point, as we will call it. This point, or the object at that location, is then seen as stationary, or moving vectorially independently of the scalar motion, while all other points are moving inward toward, or outward away from, the reference point.

In the case of the galaxies, we take our galaxy as the reference object, and view all of the distant galaxies as moving radially outward from our location. But it can easily be seen that the directions thus imputed to the galactic motions are determined by the coupling to the reference system, and are not inherent in the motions themselves. For example, if we denote our galaxy as A, the direction of motion of galaxy X, as we see it, is AX. But observers in galaxy B see it
moving in the very different direction BX, those in galaxy C see the direction as CX, and so on.

In this particular case, the reference point is the location of the observer, because we assume that we are stationary in the spatial reference system that we are using. But in the more general situation, the observer is outside the scalar system of motions, and the reference point is determined by whatever influence dictates the coupling to the reference system. The expanding balloon, for instance, may be resting on the floor of a room, in which case the point that touches the floor is motionless in the reference system, and is therefore the reference point for the scalar motion.

Before this balloon was placed in the reference system, points A and B on the balloon surface were moving outward away from each other, and their separation was increasing at a specific rate. Immobilization of point A, the reference point, in the reference system did not change the rate of increase in the separation between A and B. But the reference system now shows point A as motionless. In order to maintain the correct rate of separation between A and B, it is now necessary for the reference system to attribute the motion of point A to point B, giving that point an additional motion component, over and above its own motion. It can easily be seen that this is a general property of the representation of scalar motion in a spatial reference system. The scalar motion of the reference point or object has to be attributed to the points or objects with which it is (apparently) interacting.

With the benefit of this understanding of the relation between scalar motion and the reference system, we can return to the gravitational problem, and consider the situation in which the gravitating object is not free to move in the reference system. Here, the present-day physical science is faced with a contradiction. The behavior of gravitating objects that are free to move shows that gravitation is a motion. But there are gravitating objects that do not change their positions in the reference system, and therefore are not in motion, as motion is currently defined. The reaction of the theorists to the situation has been to evade the issue by treating gravitation as a force rather than as a motion.

At this time, therefore, we need to give some consideration to the relation between force and motion. For application in physics, force is defined by Newton's second law of motion. It is the product of mass and acceleration: \( F = ma \). Motion is measured on an individual mass basis as velocity, or speed (that is, each unit moves at this rate), or on a collective basis as momentum, the product of mass and velocity, or speed. Momentum was formerly called "quantity of motion," a term that more clearly expresses the true nature of the quantity. The time rate of change of motion is \( \frac{dv}{dt} \) (acceleration, a) in the case of the individual units, and \( m \frac{dv}{dt} \) (force, ma) when measured collectively. Thus force is a property of a motion, in exactly the same way as acceleration. It is the time rate of change of the total quantity of motion, the "quantity of acceleration," we could call it.

It follows from this that a force cannot be autonomous. Every force is, by definition, a property of a motion. Thus a force cannot originate in a motionless object. The problem of the motionless gravitating objects is therefore not solved by the introduction of the force concept. What is needed is a recognition that gravitation is a scalar motion, and that the apparently motionless gravitating object is actually moving inward in all directions just as it is when it is moving in free space. But, like the spot on the balloon surface that is resting on the floor, and like our Milky Way galaxy, it is coupled to the reference system in the location which it occupies, and it is therefore stationary in the context of that reference system.

The effect of a negative (inward) scalar motion is to decrease the separation between the individual members of the scalar system. Inasmuch as the reference object is actually in motion, even though it is represented in the reference system as motionless, the gravitational motion of this object contributes to the magnitude of the decrease in separation between it and any distant object. And since the reference system cannot attribute this contribution to the object that is represented as motionless, it has to attribute the entire decrease in separation to motion of the distant object. In the gravitating systems with which we are most familiar, one member of each system (the earth, for example) is much more massive than the objects with which it is interacting and becomes the reference object because it is immobilized by its own inertia. The contribution of this reference object to the motion of the other objects of the gravitating system (falling bodies) is clearly evident.
and the reference object is therefore credited with exerting a force of attraction on each of these other objects. When it is recognized that gravitation is a scalar motion, it can be seen that the motion component, or force, apparently acting against the distant object is actually the motion of the reference object itself, misrepresented by the reference system, which is incapable of representing scalar motion correctly.

The transfer of the motion of the reference object to the objects with which it is interacting explains the presence of a "force field" in the space surrounding the reference object. This field is not a tangible physical reality. Nor is it a strain in the hypothetical ether, or in space, as asserted in some theories. In fact, if there is no other mass within the effective gravitational range of the reference object, the force field does not correspond to anything at all, other than potentially. But if a mass is introduced into this region, a portion of the gravitational motion of the reference object is transferred to this mass by the manner in which the scalar motions are represented in the reference system. Since the reference object is moving in all directions, the force field due to its motion is radial, and there is no need for the kind of a distortion of space that Einstein's general theory calls for.

When gravitation is recognized as a scalar motion it becomes evident that the forces due to electric charges and the corresponding magnetostatic phenomena (magnetic charges, we may call them) are likewise properties of scalar motions. Observationally, these forces differ from the gravitational forces only in those respects in which scalar motions are variable; that is, in magnitude and in sign. Here, again, the absence of observable motion at the points of origin is due to the fact that the locations of the motions (the locations of the charges) are the reference points at which the motion is frozen by the coupling of the moving scalar system to the reference system.

This explanation of the origin of the forces that appear to be exerted on the distant objects provides the answer to the long-standing problem of action at a distance. Newton's gravitational law appears to call for direct action of one mass on another, regardless of their spatial separation, but many scientists are strongly opposed to the idea that a force can be exerted without a physical contact of some kind. The prevailing opinion has therefore been that the force must be transmitted through some kind of medium, even though there is no actual evidence to support this assumption. The first hypothesis called for transmission through a medium, the ether, which was assumed to exist in space, but this hypothesis encountered difficulties because of the contradictory properties that the ether would have to possess in order to meet the requirements. It has therefore been succeeded by the concept of space itself as the medium, with various kinds of fields located in this space. The need for speculative constructions of this kind is now eliminated by the finding that the apparent action at a distance is merely an illusion due to the inability of the spatial reference system to represent scalar motion as it actually exists. In reality each object in a scalar system is pursuing its own course, independently of the other objects in that system.

The foregoing discussion of the scalar motion situation should be sufficient to demonstrate that by failing to give consideration to the scalar form of motion modern science has made a serious error. It is no doubt difficult for most scientists to believe that there could be a major defect in the foundations of present-day physical theory, but the facts are clear. The existence of scalar motion is incontestable. As pointed out earlier, it is readily observable in several different phenomena. The properties of this kind of motion can easily be deduced. Knowledge of these properties then enables identifying additional phenomena, including some of the most fundamental features of physical activity, as motions of the scalar type. The need for a thorough reconsideration of basic physical theory to take the various manifestations of scalar motion into account is therefore clearly indicated.
The Inter-regional Ratio

K.V.K. Nehru

Introduction

The inter-regional ratio is an important concept discovered in the development of the Reciprocal System of theory. The works of Larson, notably Nothing But Motion and The Structure of the Physical Universe are to be referred to for an explanation of the origin and significance of this ratio. This paper only attempts to clarify the factors involved in its calculation, as applied to the basic properties of matter.

At the outset, I feel that the word “orientation” that we have been using in this context does not seem appropriate because of its strong connotation of direction in space. The word “possibility” might seem preferable, since in evaluating the inter-regional ratio we are inquiring as to how many possibilities are there for a motion unit to exist—the intrinsic existential possibilities, we might say. Another word that comes to mind is “eigenstate.” But “degrees of freedom” seems very much suitable, provided we refrain from smuggling in some of its spatial connotations.

The Reciprocal System shows that there are several types of regions or domains in the structure of the physical universe and that there are interactions across the regional boundaries. During the interactions it is not always the case that the effect of a unit of motion transmitted across the boundary is also one unit. For example, if there are \( f \) number of equipossible alternatives within the region for a unit of motion, then by probability laws we know that there is \( 1/f \) chance of the unit effect being transmitted, or what is tantamount, only \( 1/f \) part of the unit motion gets transmitted. The number of possibilities or degrees of freedom, \( f \), is called the Inter-regional Ratio.

Rotational Degrees of Freedom in Three-dimensional Time (or Space):

Let us examine rotation in space in order to draw conclusions that are equally applicable to rotation in time. “One-dimensional” rotation means that one magnitude (or parameter) is required to fully specify the rotation. A one-dimensional rotation occupies two-dimensional space. Similarly, a two-dimensional rotation requires two magnitudes for its full specification and occupies three-dimensional space. Now a unit of one-dimensional rotation has two possible directions, \(+1\) and \(-1\), within the framework of three-dimensional space, as shown in fig. 1.

![Fig. 1. The Two Possibilities of a One-dimensional Rotation](image)

As a result, the total number of possibilities—the degrees of freedom, as we will call them—in a
three-dimensional space with two possibilities in each dimension is $2^2 = 8$. Notationally we can express the eight possibilities as

$$
(+1,+1,+1), (+1,+1,-1), (+1,-1,+1), (+1,-1,-1),
(-1,-1,+1), (-1,-1,-1), (-1,+1,+1), (-1,+1,-1)
$$

}\)  \) \) \) \)

In fact, if $n$ is the number of (vector) dimensions and $p$ the number of possibilities per dimension, then $f$ the number of degrees of freedom available in the $n$-dimensional (vectorial) space (or time) is given by

$$
f = p^n
$$

(2)

As such, a unit of one-dimensional rotation has eight degrees of freedom (that is, intrinsic existential possibilities) in three-dimensional space (or time).

The question is sometimes raised as to whether the two possibilities in each of the three dimensions do not make up a total of six rather than of eight. This would indeed be true if we were considering three one-dimensional spaces instead of one three-dimensional space. If the three dimensions are independent, then the total possibilities are

$$2 + 2 + 2 = 6$$

(3)

In fact, this is what we have in the case of space-time dimensions—the dimensions of scalar motion—in distinction to the dimension of space (or time)—which we have called the vector dimensions. Since the three space-time dimensions, being scalar, are independent, the possible number of degrees of freedom is six.\(^{1}\) So if $n$ is the number of scalar dimensions and $p$ the number of possibilities per dimension, we can write down the formula for the number of degrees of freedom available in the scalar dimensions as

$$f = n^p$$

(4)

On the other hand, if the three dimensions are interrelated, the total number of degrees of freedom, as given by eq.(2) is

$$2 = 2 = 2 = 8$$

(5)

Another question that is sometimes raised is why two possibilities per dimension and three dimensions do not imply $3^2 = 9$ possibilities rather than $2^3 = 8$. But it is not difficult to see that this would be the case only if we had three possibilities in each of the dimensions of a two-dimensional motion, and not otherwise.

As the degree of complexity of the motion increases, the existential states possible to it decrease. The two-dimensional rotation, it is also remarked, requires two magnitudes to specify it fully. So the possible degrees of freedom for a two-dimensional rotation in three-dimensional space (or time) are $8/2 = 4$. This can easily be understood with the help of the diagrams shown in fig. 2.

The two-dimensional rotation is a coupled rotation of two one-dimensional rotations. This coupling causes a "degeneracy." In fig. 2(a), the directions of the two component rotations are indicated by two plus signs. The characteristic of the two-dimensional rotation is that if the directions of both of the one-dimensional rotations are reversed, as in fig. 2(b), the net effect is to leave the sense of the two-dimensional rotation unchanged, in view of the fact that
\[(+1) \times (-1) = (+1) \times (-1)\]

and
\[(+1) \times (-1) = (-1) \times (+1)\]

\[(6)\]

\[\text{Fig. 2 The Degeneracy of a Two-dimensional Rotation}\]

Due to this feature, the eight possibilities listed in statement (1) above reduce to four, for the case of the two-dimensional rotation, because each of the possibilities listed in the upper line of statement (1) turns out to be the same as the one listed immediately below it, in the second line. For example, for the coupled rotation
\[ (+1, +1, -1) = ((+1, +1), -1) = ((-1, -1), -1) = (-1, -1, -1) \]

\[(7)\]

Therefore if \(d\) is the vector dimensionality of the motion, then eq.(2) is modified to give \(f\), the number of degrees of freedom available in vector space (or time) as
\[ f = p^d/d \]

\[(8)\]

We finally arrive at the total number of degrees of freedom available for a unit of motion in the atom which comprises two two-dimensional (magnetic) and one one-dimensional (electric) rotations, as
\[ (2^{3/2}) \times (2^{3/2}) \times (2^{3/1}) = 4 \times 4 \times 8 = 128 \]

\[(9)\]

There is another point of relevance that needs to be mentioned at this juncture before turning attention to the inquiry of the vibrational degrees of freedom. We have already distinguished between the dimensions of space–time (the scalar dimensions) and the dimensions of space (or time) (the vector dimensions). If we have an instance of motion existing in two or three space-time dimensions, then motion in only one of these space-time dimensions can be represented in either three-dimensional space (or time)\(^{(2)}\). This is depicted in fig. 3.

Gravitation (atomic rotation) is three space–time dimensional. The two space-time dimensions which cannot be represented in three-dimensional time (or space) are fully occupied by scalar motion and therefore leave no more degrees of freedom than calculated by eq.(9).
Vibrational Degrees of Freedom in Three-dimensional Time:

While a one-dimensional rotation has two possibilities (clockwise and counter-clockwise, as shown in fig. 1), a one-dimensional vibration has only one possibility, since both the directions (forward and backward) in any dimension constitute one oscillation. This is true of both one-dimensional linear and rotational vibrations. In view of this, the possible number of degrees of freedom of a one-dimensional vibration in three-dimensional time (or space), as calculated by eq. (2), with \( p = 1 \) and \( n = 3 \), is

\[
f = 1^3 = 1
\]  
(10)

However, this number is increased by an additional factor, the freedom available in the three space-time dimensions, only one of which is occupied by the single unit of photon vibrational motion. This leaves the remaining two space-time dimensions vacant (unlike in the case of atomic rotation). Consequently the one unit of vibrational motion has three possible choices as far as the space-time dimensions are concerned. Notationally we can list these possibilities as

\[
(1,0,0), (0,1,0), (0,0,1)
\]  
(11)

Thus the number of degrees of freedom of the one-dimensional vibrational unit becomes, by eq.(3) or (4)

\[
1^3 \text{ or } 1^3 \text{ or } 1^3 = 1 + 1 + 1 = 3
\]  
(12)

At this juncture we recall that that we are not so much interested in the degrees of freedom available to the one-dimensional vibration on its own right, but rather in the additional degrees of freedom, if any, that this one-dimensional vibration makes available to the rotational unit that is built on it. Since the atomic rotation is a time-displacement while the basic photon vibration is is a space-displacement, both belong to different "regions." As a result, by applying probability laws, we see that \( N \) degrees of freedom of the space-displacement of the photon is equivalent to \( 1/N \) degrees of freedom from the point of view of the time-displacement of the rotation.

The three degrees of freedom calculated by eq.(12) are specifically applicable to the case of a one-dimensional rotation founded on a one-dimensional vibration, giving the rotational unit an additional \( 1/3 \) degree of freedom. But the rotation basic to the atomic or subatomic structure is two-dimensional and not one-dimensional.\(^3\) Therefore, with \( p = 3 \) and \( n = 2 \), by eq.(2), we obtain the total vibrational degrees of freedom from the point of view of the two-dimensional rotation as
\[ 3^2 = 9 \]  

(13)

This means that for every rotational degree of freedom in three-dimensional time there is an additional 1/9 degree of freedom due to the underlying vibration. However, since that the atomic structure consists of two two-dimensional rotational systems—this is what distinguishes the atom from subatomic particles, the latter having only one two-dimensional rotational system in its structure—the additional degree of freedom due to the vibrational contribution is 2/9 (being 1/9 for each of the rotational systems) in the case of atoms, whereas it is only 1/9 in the case of the subatoms. The inter-regional ratio, which is simply the number of total degrees of freedom, is

\[ 128 + (128 \times \frac{2}{9}) = 156.44 \]  

(14)

in the case of the atomic rotation, and is

\[ 128 + (128 \times \frac{1}{9}) = 142.22 \]  

(15)

in the case of the subatomic rotation.

Summary

1) Scalar motion (that is, space-time) can at maximum be three-dimensional. These dimensions of scalar motion are referred to as "scalar dimensions."

2) The scalar dimensions are independent. If there are \( n \) number of scalar dimensions and \( p \) number of degrees of freedom per dimension, the total degrees of freedom, \( f \), are \( n \times p \).

3) The stationary reference frame we call space is three-dimensional, these being called the "vector" dimensions.

4) If a multi-dimensional scalar motion exists, motion in only one of these multiple scalar dimensions can be represented fully in a three-(vector) dimensional space or time.

5) The three vector dimensions of space (or time) are not independent but interrelated. If there are \( p \) number of possibilities per dimension, then the total number of degrees of freedom, \( f \), in the three-dimensional vector space (or time) is given by: \( f = p^3 \).

6) That the maximum number of degrees of freedom in three-dimensional space or time is \( p^3 \) does not mean that a particular motion can have \( p^3 \) degrees of freedom. If the number of dimensions of this motion (as against the number of dimensions of the vector space (or time) in which it exists) is \( d \), then the available number of degrees of freedom for this motion is \( f = p^3/d \).

References

2. Ibid., p. 19.
The Nature of Scalar Rotation

K.V.K. Nehru

An article by Maurice Gilroy in a recent issue of *Reciprocity* (1) clearly brings into focus the fact that more fundamental theoretical work needs to be done on the rotational motions of atoms. A few years ago, studying the electric ionization characteristics of the elements in the context of the Reciprocal System, I came to the same conclusion with regard to the non-conformist nature of the lanthanides. Presently I have made a more detailed examination of the mathematical structure of the scalar rotational motion with a view to obtain some insight into these fundamentals. In this paper I am reporting on the results of this study. My conclusions are by no means final. However, it is felt to be desirable, in view of the maiden nature of the exploration, to invite comments and discussion before bestowing further efforts on it.

1. Introduction

The basic features of scalar rotational motion that constitutes atoms are described in chapters 9 and 10 of Larson's book, *Nothing But Motion*.(2) The rotation that is basic to the material atoms is a two-dimensional rotation, involving a coupled rotation about two mutually perpendicular axes (in three-dimensional time). Larson reminds us in this connection that "...there are not two one-dimensional rotations; there is one two-dimensional rotation...The combined magnitude of two one-dimensional rotations of n displacements each is 2n. The magnitude of a two-dimensional rotation in which the displacement is n in each dimension is n^2."(3) Before passing further it is to be noted that this is true only for a spherically distributed two-dimensional rotation. On the other hand, if the displacements in the two dimensions are unequal, say, m and n, the rotation is distributed in the form of a spheroid and its magnitude would be neither n^2 nor m^2 but m*n.

Larson adopts a notation of the form a-b-c to designate the various rotations involved, with "...c [as] the displacement of the one-dimensional reverse rotation, and a and b...the displacements in the two dimensions of the basic two-dimensional rotation."(4) A little later he demonstrates that "a magnetic displacement n is equivalent to 2n^2 electric displacement units."(5) At this juncture a question arises. Suppose the respective displacements in a certain case are given by a-b-c. The electric equivalents of the magnetic displacements a and b are calculated, according to Larson, as being 2a^2 and 2b^2 respectively. This means only one thing: that a and b represent two separate spherically distributed two-dimensional displacements—they are not, as Larson describes in the above-cited quotation,(4), the displacements in the two dimensions of the basic two-dimensional rotation. If the latter were true, they ought to represent a spheroidally distributed rotation with magnitude equivalent to 2*a*b electric displacement units (See Appendix). This, therefore, is a point that needs to be straightened out.

A second factor concerns the way the successive increments in the magnetic rotations take place. Unlike the case of electric displacement, the increment in the magnetic displacement is not one by one. The first increment in the magnetic displacement is 2*1^2 = 2 electric units long. The second increment, however, is 2*2^2 = 8 electric units long. It is quite understandable, in view of the 2n^2 relation between the magnetic and electric units, why there can be, for example, no such thing as a magnetic equivalent of 6 electric units (since √6/2 is not an integer) and consequently the 8(=2*2^2) units do not represent the total after the second increment but the second increment itself—the total being 10 (=2+8). But this does not explain why 2*2^2 = 8 units should succeed 2*1^2 units: why should the successive increments not be of 2*1^2 units size each (since √2^2 is an integer). Here, too, a further theoretical clarification of the fact that the successive increments of the magnetic displacement are equivalent to 2, 8, 18 and 32 electric units is in order.
2. The Mathematical Pattern of the Two-Dimensional Rotation

The most important factors that are relevant to our present study can be listed as follows:

(i) Motion occurs in discrete units.
(ii) Smaller number of displacement units is relatively more probable than a larger number.
(iii) The scalar rotation that constitutes the atom takes place inside unit space (the "time region," as it is called).

Before we begin our discussion, perhaps a word of caution is in order. We often find the insights and conclusions obtained through the Reciprocal System difficult to comprehend. This is only because, despite repeated admonitions, we continue to view them from a frame of thought based essentially on the matter concept of the universe and not on the motion concept. Nothing impedes progress in the study of the Reciprocal System more than the inability to look at the new concepts in their own right.

2.1 Successive Increments of Displacement

We begin our discussion by a consideration of the time region, the region inside unit space. Because of the discrete unit postulate, we see that in the time region, space cannot progress on its own right and is constant at one unit. Therefore, Larson points out, "... The additions in the time region follow a different mathematical pattern, because in this case only one of the components of motion progresses, the other remaining fixed at the unit value. Here... the sequence is 1/1, 1/2, 1/3... 1/n. The quantity 1/n is the final term, not the total."(6)

This requires some elucidation. We recall that all units of space (or time) are alike, since each is equivalent to a unit of time (or space). "Alike" strictly means indistinguishable from each other. Normally, when two entities are alike in all respects we, nonetheless, can distinguish them by position in three-dimensional space. The two entities, if they happen to occupy different units of space, can be distinguished by means of these different locations. However, when the entities under consideration are the units of space themselves, there is prima facie no way of distinguishing between them. Since space cannot be a background or "setting" to itself, the possibility of discriminating by virtue of the occupancy of different locations in space does not exist in this case. The full implication of the identity of all space units, together with the repudiation of the "setting" concept is that we are not justified in conceiving of the juxtaposing of two single units of space, and consequently can never get started beyond the one unit space (or time) magnitude.

I can foresee that the point I am trying to make above might not readily be apprehensible, and rather look like denying the obvious. But this would be so only because of the subtle conceptual impasse (a result of our mental vantage point) that naturally besets any endeavor to understand the unmanifest from the standpoint of the manifest. The fact is that when we commence our inquiry (of the basic space unit) we already start with the conceptual background of an extension space in which we picture one unit of space "adjacent" to another unit of space. This, of course, is the fatal mistake that had been perpetrated by all the previous scientific thinkers, as Larson points out.(7)

Considerations such as the above lead to the conclusion that each succeeding space unit or increment is one unit greater in magnitude than the previous. That is, the first increment is of one unit magnitude, the second increment is of two units of magnitude, and so on. This, of course, follows from the fact that the progression is continuous and ubiquitous. Thus if we consider a line segment AB as the given unit of space, it is not legitimate to envision the progression as the growing of this line AB to ABC, with the original segment AB intact and BC as the newly added portion. In reality there is growth at every point of the segment, with AC supplanting AB.

Further, we note: (i) there is no space progression divorced from a concomitant time progression and (ii) an increase in time magnitude is equivalent to a decrease in space magnitude.
If we take A to be the reference point, then it becomes the starting point and B the ending point of the first space unit AB. However, since the progression of time nullifies the progression of space, the ending point in space-time always coincides with the starting point and point A will be the starting point from which the second unit (increment) of space "extends." Thus AC (not BC) becomes the second space unit. Though the second unit (AC) is of two units magnitude, since the first (AB) has been supplanted, the total up to the end of the second is also two units and there is an effective increment of only one unit (BC).

Inside the time region (or space region) this process is the same: namely, the first increment is of one unit magnitude, the second increment is of two units magnitude, and so on. However, in this region only one of the components of motion (either time or space) progresses. Consequently, the progression of one component is not nullified (from the point of view of space-time) by the progression of the reciprocal component, and the starting point of the next increment is not the same as the starting point of the earlier increment, as it was in the outside region. Instead, the end point of the previous increment will be the starting point of the next.

Summarizing: in the outside region where both components of motion progress, the successive increments would be 1, 2, 3, 4, ... etc., though the successive effective increments would be

\[
2-1, 3-2, 4-3, \ldots \text{ etc.} \tag{1}
\]

This is the same thing as saying that there is first one effective unit increment followed by another effective unit increment and so on and on. In a similar fashion, the successive increments in the time region (or the space region) would be

\[
1, 2, 3, 4, \ldots \text{ etc.} \tag{2}
\]

(What the successive effective increments would be will be discussed in a moment.) Thus the nth increment of the displacement is n units in magnitude. The corresponding successive increments of the speed (above the neutral point of one unit) are 2, 3, 4, 5, ... etc. in the case of space displacement, and 1/2, 1/3, 1/4, 1/5, ... etc. in the case of time displacement. It may be added that the above is true irrespective of whether the displacement is one-dimensional or two-dimensional. The pattern of increments indicated in (2) above doubtless looks quite unfamiliar. The fact is that this has not been found earlier because nobody knew about the time region before the advent of the Reciprocal System.

The next point of crucial importance that emerged in the investigation was the result of operation of the probability principle mentioned at the beginning of this section. Referring to fig. 1(a), let BA represent n displacement units, shown to the left of the neutral axis NN, but extending toward NN. NN represents the "zero-datum" of the natural reference system, which is unity. As such, BA represents a displacement of n units toward unity, that is, an inward scalar speed. In fig. 1(b) is shown what could be the result of adding the next increment of the displacement which, by conclusion (2) above has to be n+1 units in magnitude, bringing the total to 2n+1 units. However, the state of affairs depicted in fig. 1(b) never obtains for the following reason. At point B, where the previous increment comes to an end, an option is open to the next increment either to continue the previous direction (as in fig. 1(b)) or to reverse it as shown in fig. 1(c). In the latter case, like in the former, there is a continuity between both the incremental stretches. In the case shown in fig. 1(c), where the next increment of n+1 units extends from E to B, the orientation of the displacement is still inward (that is, toward NN) from E to D, whereas it is outward for the portion from D to B. Since the latter portion (DB) coincides with the outward (away from NN) scalar progression of space-time, it is not effective from the point of view of physical phenomena. Consequently, the effective displacement is from E to D only. Since the orientation shown in fig. 1(c) ensues in a net displacement of smaller magnitude than that shown in fig. 1(b), the probability principles ensure that only the former exists in practice.

At this juncture I shall introduce some new terminology both to facilitate further discussion and
to avoid bringing the old frame of thinking into the new situation. Since it is now apparent that each further increment of the displacement reverses the direction of the previous orientation I shall refer to those increments as folds. Thus, in fig. 1(c), BA represents a fold and EB the next fold with ED as the effective portion of the second fold.

Summarizing our findings so far we can say that (i) each successive fold reverses its direction while maintaining continuity with the previous, and (ii) the nth fold is of n displacement units magnitude.

2.2 The Two-Dimensional Displacement

With the benefit of the above discussion, we are in a position to examine the pattern of the successive increments of the two-dimensional rotational displacement on which the atomic structure is based.

Referring to fig. 2, we have the first fold BA of one displacement unit magnitude. The arrows indicating the scalar direction are omitted; but it must be understood that the direction of the unit is always inward, that is, toward the neutral axis NN as in fig. 1.

The second fold is two units in magnitude and extends from C to B. However, only one unit of this fold is effective, the other being ineffective since its direction coincides with that of the space-time progression. The effective portion of the fold is shown cross-hatched in the figure. The magnitude (in number of displacement units) of the effective portion is shown circled adjacent to the cross-hatched side of the rectangle representing the fold.

The third fold is of three units magnitude and extends from D to C. In this case the effective displacement is of two units magnitude.

Continuing the pattern we find that on the seventh and the eighth folds (HG and IH respectively) a net (effective) displacement value of four magnetic units each. This brings the displacement value to the maximum that is possible for a two-dimensional rotation. (8)

Thus, though the successive folds are of magnitudes 1, 2, 3, 4, 5, 6, 7 & 8, the order of the effective increments is 1, 1, 2, 2, 3, 3, 4 & 4 units. Converting the magnetic units into the equivalent electric displacement units by the $2n^2$ relation, we now see that the possible series of successive increments of the two-dimensional rotational displacement has to be

\[ 2, 2, 8, 8, 18, 18, 32 & 32 \text{ units in magnitude} \]

The magnetic displacement units we are talking of, it may be reminded, are double magnetic units since we are considering them in connection with the double rotating systems of the atom (see Appendix). As such they represent the magnetic contribution of both the rotating systems. Therefore, in the notation a-b-c, a or b (respectively $2a^2$ or $2b^2$ electric displacement units) represents the motion in the two dimensions of the two-dimensional rotation of both the rotating systems. It is not that a represents the displacement in one dimension and b that in the other, of the two-dimensional rotation.

The necessity of two parameters, a and b, follows from another reason. We have seen that the successive folds of the two-dimensional rotations are in mutually opposite directions when seen from the point of view of the stationary reference frame, although their scalar direction relative to the datum of the natural reference system is always inward. Since rotation is a continuous motion, there is no possibility of representing these directional reversals as oscillations of a vibration in the stationary reference system. Therefore the representation in the stationary reference system of the true scalar relationship between the successive folds takes the shape of interpreting the effective portions of the alternate folds (which are coparallel) as belonging to a separate two-dimensional rotation. The sets of alternate folds, one on each side of NN, therefore, are depicted as belonging to different two-dimensional rotation, a and b in the notation a-b-c.

It must further be noted that neither a nor b represents the entire motion in that dimension of time but each gives only the magnitude of the largest fold of that motion. If we identify the
effective magnetic displacements 1, 2, 3 and 4 indicated on the right side of NN with the dimension represented by a, the increments 1, 2, 3 and 4 shown on the left side of NN are to be identified with the dimension represented by b. Considering that there is an initial magnetic unit in one of the dimensions, say that of a, which is utilized to equilibrate the negative displacement of the basic photon, we see that the successive values taken up by a are 2, 3, 4 and 5 while those taken up by b are 1, 2, 3 and 4.

It will be of interest to note that the following behavior patterns directly result from the fold structure of the atomic rotational displacement:

(i) The effective displacement magnitude of each fold acts independently. This is the reason why the calculation of the net total equivalent displacement, in any instance, proceeds as

\[ 2 \times 1^2 + 2 \times 2^2 + 2 \times 2^2 + 2 \times 3^2 \ldots \]  

but not as

\[ 2 \times (1 + 2 + 2 + 3 \ldots)^2. \]

(ii) Because of the above, in many of the atomic interactions only the final fold, with the largest magnitude in each dimension, is alone able to enter into the relationship. (Examples occur in the determination of the interatomic distances, the ionization potentials, etc.)

(iii) Also because of (i) above, the limitation of the 4-unit maximum for the two-dimensional rotation applies to the individual folds and not to the net total. Were this not the case, the theoretically possible number of elements would turn out to be far less than 117.

3. The Mathematical Pattern of the Electric Displacement

With the exception of the modifications introduced by the characteristics of the one-dimensional rotation, the general pattern of the successive increments (folds) of the displacement in the electric dimension (represented by c in the notation a-b-c) is the same as in the case of the two-dimensional rotation.

Fig 3(a) depicts this situation. First there is a one-unit increment BA; then there is the second fold CB, of 2-unit magnitude, with an effective magnitude of one unit, and so on.

The important point that we should now recognize is that, in the context of the one-dimensional rotation, one unit really represents eight possibilities or degrees of freedom (see ref. 8). Consequently, for all practical purposes we can treat this one "unit" as comprising eight electric displacement units. This results in the increment pattern depicted in fig. 3(b).

However, there is another possibility that is available to the one-dimensional electric displacement units by virtue of which the pattern depicted in fig. 3(b) gets modified. The eight-unit limitation, it may be recalled, on the one-dimensional rotation was arrived at on the basis of three-dimensional distribution in the time region. But if the number of one-dimensional units is not more than two, they could be distributed either one-dimensionally or three-dimensionally. Consequently, the first fold in the increment pattern of the one-dimensional rotational displacement would be of two electric displacement units magnitude as shown by BA in fig. 4(a), and not of eight units magnitude as depicted in fig. 3(b). At this point the limitation of distribution on the one-dimensional basis is reached and the subsequent units of electric displacement will have to be added on the basis of three-dimensional distribution. The second fold, of eight electric displacement units magnitude, reverses the relative direction, as indicated by CB in fig. 4(a). It may be noted that the effective portion of the second fold is only of six units magnitude.

The third fold is of two 8-unit increments in magnitude, extending from D to C (fig. 4(a)). The effective portion, however, is only of ten electric units magnitude. In a similar manner, the effective magnitude of the fourth fold can be seen to be of fourteen electric units. The successive
folds of the one-dimensional rotation, therefore, form the series

\[ 2, 6, 10 & 14 \text{ electric displacement units.} \]  \hspace{1cm} (5)

We may pause here to comment that those who have wondered at the similarity between the \(2n^2\) relation of the magnetic and electric displacement units of the Reciprocal System and the \(2n^2\) relation of the "principal quantum number" of a "shell" and the maximum number of "electrons" the "shell" is supposed to holpdl in the matter concept of the universe would not have failed to notice the similarity between the series 2, 6, 19, 14 of the electric displacement units of the Reciprocal System and the "electron capacities" of the "s, p, d, f subshells" of the matter concept theory! But I believe that the similarity ends there. For the further possibility in the case of the one-dimensional rotation of the atoms that the electric displacement could be either positive (time displacement) or negative (space displacement) modifies the pattern of the folds in another way.

It is seen that the folds subsequent to the first, in the case of the one-dimensional rotation, are in stretches of multiples of eight units. At the end of an 8-unit stretch, there opens up before the rotation a possibility to switch from a positive displacement to a negative displacement or vice versa. This would be tantamount to the effect of reversing the relative direction that occurs when one fold ends and the next one begins. The probability principles indeed favor this switching as it reduces the net effective magnitude of a fold. The actual pattern of the successive increments of the one-dimensional rotation of the atom is therefore as shown in fig. 4(b).

We have two positive electric displacement units in the first fold. The second fold is really the continuation of the first fold as the three-dimensional limit of eight units is not yet reached. As such, it is to be expected that the first fold should continue up to eight units magnitude instead of the two. Indeed this would have been the case but for the additional possibility that is available to the electric displacement, namely, to switch from the positive to the negative displacement (or vice versa). The dimensional difference in the distribution is sufficient to increase the probability of reversing the direction of the first fold after the 2–unit increment is accomplished and starting the second fold. The increment pattern has to meet the two contradictory conditions of having to reverse the relative direction at the end of the 2–unit stretch as required by the change in the dimensional distribution and of having to continue the same direction since the 8–unit maximum is not yet reached. This is achieved by the expediency of starting the second fold with negative displacement (fig. 4(b)). We have in the effective portion of the second fold room for six negative electric displacement units.

At the end of the second fold, relative reversal of direction takes place and the third fold begins. It is to be noted that in order to retain the effect of directional reversal at this juncture the displacement must continue to be negative. However, only two of the eight negative units are effective and show up in the third fold. The remaining eight units of the third fold are positive displacement units. Similar reasoning shows that in the effective portion of the fourth fold there is room for six negative units and eight positive units.

We now see that in none of the folds the maximum limit of eight units for the one-dimensional rotation is exceeded. The increments form the series

\[ +2, -6, -2, +8 \text{ and } -6, +8 \text{ electric displacement units} \]  \hspace{1cm} (6)

There are several points that require amplification here:

(i) As in the case of the magnetic displacement, the displacement in each fold acts independently.

(ii) Also as in the case of the magnetic displacement, in most of the atomic interactions the final fold, alone or in conjunction with the prefinal fold, seems to enter into relationship. This factor can be seen to account for the non-conformist nature of some element groups, like the lanthanides, in the otherwise regular structure of the Periodic Table.
(iii) Also because of item (i) above, the limitation of the 8-unit maximum for the one-dimensional rotation applies to the individual folds and not to the net total of all the folds. This explains the possibility of occurrence of more than eight displacement units in the electric dimension without having to introduce the vibration-two level.

(iv) There is no reason why the series has always to be as indicated in (6) above. It is equally possible for it to be

\[-2, +6, +2, -8 \text{ and } +6, -8 \text{ electric displacement units (7)}\]

if a net space displacement is required in a particular situation (as in the electronegative series of elements).

4. The Series of the Elements

It is now possible to consider how the series of the elements builds up, with increasing atomic number. The general principles are the same as have been laid down in the earlier development of the Reciprocal System. The only modification that is introduced is that arising out of the fold structure of the electric displacement.

For ease of reference I shall designate the successive folds of the electric displacement as f1, f2, f3, and f4. Since a net positive electric displacement is required in Divisions I and II (the electronegative elements) the increments follow the pattern of series (6) above. In the case of Divisions II and IV (the electronegative elements) the alternative shown in series (7) is followed.

In Table I is listed the sequence of electric displacement units with the most probable fold arrangements. As usual the negative displacements are shown in parentheses. The first column in Table I, designated \(c\), gives the net electric displacement, in increasing order, up to the maximum of 16 (found in Groups 4A and 4B). Thereafter the negative displacements are given, in decreasing negative values. The next four columns, designated \(f1, f2, f3\) and \(f4\), list the displacements in each of the corresponding folds. Columns 6 through 9 list any alternate fold structure that might be of commensurate probability and hence occur in appropriate cases.

It can be seen from the Table that by the time we come to \(c = 3\), both the displacement units belonging to \(f1\) are present and further addition has to be in the next fold. However, the next fold that can "house" a positive displacement is the third and not the second. The detailed calculations regarding the probability of occupation of a particular fold have not yet been worked out. However, it appears that, in the electronegative series, in order that the further building up of positive units can continue on the third fold it is not necessary that all of the six negative units be present on the second fold. The presence of not more than one negative unit on the second fold seems to be adequate for this purpose.

By the time we come to \(c = 9\), the positive displacement quota on fold \(f3\) is all filled up. Therefore, further building up of positive units has to start on fold \(f4\). The negative displacement quotas available on \(f3\) and \(f4\) do not seem to have any significance as far as the element building process is concerned.

The alternate fold structure shown for \(c = 3\) to 5 is found to be more probable in the elements of Groups 2A, 2B, and 3A.

The alternative under \(c = 2\) only appears in Group 4 elements. The alternate structure shown for \(c = (15)\) appears only in an all-positive arrangement that might sometimes be taken up by an element. Lutetium with \(z = 71\) is an example which assumes the all-positive rotations, 4–3–17, instead of the normal pattern, 4–4–(15), under certain conditions.

8. Summary

The main conclusions of this study may be gathered up as follows:

1) The successive increments of scalar rotational motion (herein referred to as "folds") in the
time region are of 1, 2, 3 . . ., n displacement units magnitude (that is, the nth fold is n
displacement units in magnitude).
2) Each succeeding fold reverses the orientation relative to the previous.
3) As a result of conclusions (1) and (2) above, the effective magnitudes of the successive
folds of magnetic (two-dimensional) rotation form the series 2, 2, 8, 18, 18, 32 and 32
equivalent electric displacement units.
4) Each of the magnitude in this series represents the combined effect of two (double)
two-dimensional rotating systems which form the atom.
5) Further, because of the limitations inherent in the scope of the stationary reference frame,
though the terms in the above series constitute the consecutive effective increments of one
double two-dimensional rotation, the alternate members of the series appear in such a
reference frame as two distinct subsets, each apparently pertaining to a different
dimension of the three-dimensional time.
6) The effective magnitudes of the successive folds of electric (one-dimensional) rotation in
the time region form the series 2, –6, –2, 8, –6 and 8 electric displacement units.
7) The above fold structure of the one-dimensional rotation in the electric dimension of the
atoms gives rise to a further modification in the behavior characteristics of the elements.

References

1. Maurice Gilroy, “A Graphical Comparison of the Old and New Periodic Tables,” Reciprocity XIII(3),
3. Ibid., pp. 122-123.
4. Ibid., p. 127.
5. Ibid., p. 129.

Appendix

Larson discovers that the rotational system that constitutes atoms is really a double rotating system. As such,
any increase in the displacement involves two natural units, one for each system. Hence he defines the unit of
electric displacement as the equivalent of two natural units—a double unit. Now the relation between the double units
of magnetic (two-dimensional) displacement and the double units of electric (one-dimensional) displacement is as
follows.

First consider the case where the magnetic rotation is spherically distributed, with b natural (single) displacement
units in each of the two dimensions. Its natural unit equivalent is $b^*b - b^2$. However, in the case of atomic
rotational systems we deal with double units. Therefore,

b magnetic double units = 2b magnetic single units
= $4b^2/2$ or $2b^2$ one-dimensional double units,
that is, $2b^2$ electric units.

If the magnetic rotation is spheroidally distributed, with displacements a and b (natural units) in each dimension
respectively, then its magnitude = $a^*b$ natural units. In the case of double units, the relation would be

$2a^*2b$ or $4ab$ one-dimensional single units
= $4ab/2$ or $2ab$ one-dimensional double units
that is, $2ab$ electric units.

It is easily seen that the rotation becomes spherical if $a = b$ and $2ab$ would reduce to $2b^2$.
### Table I. The Fold Structure of the Atomic Electric Displacement

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Fig. 1  
The Successive Increments of Displacements in the Time Region

Fig. 2  
The Pattern of the Successive Folds (increments) of the Magnetic Displacement in the Time Region

Reciprocity  19
Fig. 3  The Successive One-Dimensional Increments

Fig. 4  The Pattern of the Successive Folds of the Electric Displacement in the Time Region
A New Taxonomy for Scientific Knowledge

Ronald W. Satz

This paper describes the organization, production, and use of knowledge. In it I present an outline of a new universal axiomatic system, with the Reciprocal System as its core, and propose long-range goals for the International Society of Unified Science.

I. Organization of knowledge

A. Present Methods

The past and present methods of organizing knowledge are described in Fritz Machlup's *The Branches of Learning.*1 The attached summary tables present nine of the dozens of systems that have been proposed so far, i.e.,

1. Dewey Decimal System
2. Library of Congress System
3. Auguste Comte's System
4. Rudolf Carnap's System
5. Soviet Union's System
6. *Encyclopedia Britannica*'s System
7. *Random House Encyclopedia*'s System
8. American Philosophical Society's System
9. American Association for the Advancement of Science's System

B. New Method

Each of these current methods of classification appears to have serious shortcomings. My proposed organization is shown in Table 10. This is a hierarchical scheme like Comte's, but more modern. It is based on the nature of existents, going from the most simple to the products of the most complex. It is in theoretical harmony with the Reciprocal System. Unlike the Dewey Decimal System and the Library of Congress System, the new system is philosophically sensible. Unlike Carnap's System, it contains a proper position for the human sciences. Unlike the system of the Soviet Union, it has a separate section for the technological sciences. Unlike that of the *Encyclopedia Britannica*, it does not separate history, the humanities, and philosophy from science. Unlike that of the *Random House Encyclopedia*, it does not have a separate section called "Man and Science"—rather, it has science distributed throughout the organization. Unlike that of the American Philosophical Society, it has a separate section for the technological sciences. And unlike that of the American Association for the Advancement of Science, it does not separate out sections for statistics, dentistry, and atmospheric and hydrospheric science.

The courses in our present college catalogs seem almost randomly placed. Students are not being taught the unity of organization of knowledge, but the fragmentation and disarray of knowledge. Were a course of study based on my new organization of knowledge to be offered as an option by universities, each major section of the outline would be studied for one year (although half a year would probably suffice for metaphysical science, at the present state of our knowledge). One additional year would be used for advanced study of one of the sections and another year would be devoted to research on an original thesis.
II. Production of Knowledge

A. Past and Present Methods

The past and present methods of producing knowledge include the use of oracles, experiment, and logical deduction from axioms.

1. Oracles

Julian Jaynes, in *The Origin of Consciousness in the Breakdown of the Bicameral Mind*\(^2\) contends that the "Greek oracles were the central method of making important decisions for over a thousand years after the breakdown of the bicameral mind." His general bicameral paradigm consists of the following:

- the collective cognitive imperative, or belief system, a culturally agreed-on expectancy or prescription which defines the particular form of a phenomenon and the roles to be acted out within that form;
- an induction or formally ritualized procedure whose function is the narrowing of consciousness by focusing attention on a small range of preoccupations;
- the trance itself, a response to both of the preceding, characterized by a lessening of consciousness or its loss, the diminishing of the analog 'I', or its loss, resulting in a role that is accepted, tolerated, or encouraged by the group; and
- the archaic authorization to which the trance is directed or related, usually a god, but sometimes a person who is accepted by the individual and his culture as an authority over the individual, and who by the collective cognitive imperative is prescribed to be responsible for controlling the trance state.

Corresponding to this in modern times are the mystifications of gurus and the nonsensical statements of schizophrenics. According to Jaynes, there is really no transfer of knowledge from some outside god or being, but rather transmissions of neural impulses from the right neocortex to the left neocortex. (However, just in case there does exist a metaphysical realm, I have included metaphysical science in my organization of knowledge.)

2. Experiment

The scientific method requires a number of successive operations:

a. a problem is recognized
b. observations are collected which are relevant to the problem
c. based on these observations a hypothetical solution to the problem is formulated
   
   d. predictions of other phenomena are deduced from the hypothesis
   e. the validity of the predictions is tested by experiment
   f. the hypothesis is accepted, modified, or rejected in accordance with the results of the experiment.

This technique has resulted in the vast amount of scientific knowledge that we have today. The only critique I have of it is that the hypotheses used generally are extremely narrowly formed, resulting in a fragmentation of knowledge. And since inductive reasoning is used, absolute physical certainty cannot be obtained.
3. Logical deduction by humans

This is the method used in logic and mathematics to produce new theorems of form. It is different from the inductive reasoning used in the scientific method discussed above. But to have a truly unified science we must have a system based on axioms from which we can deduce the nature and interrelationship of all existents. This is what the Reciprocal System provides, at least for physical science. Of course, empirical checking is still necessary. Table 11 shows the characteristics of a formal system.

B. New Method

The new method of producing knowledge that I propose simply extends the capability of logical deduction from humans to machines. Right now, experts in artificial intelligence are designing machines that can make logical deductions from universal axioms. Table 12 shows my proposed outline for a universal axiomatic system, based on the proposed new organization of knowledge, which would be used by a theorem-deducing machine to generate a complete theoretical universe. One would hope that such a machine would be much faster, more reliable, and more accurate than any single human could be at the task. Of course, if any deduction proved to be inconsistent with experimental data, one or more axioms would have to be changed and the process repeated.

The outline does not explicitly give the specific axioms of the system. They will include at least the axioms of logic and mathematics and the Reciprocal System. Perhaps one or two more will be needed to cover the biological, human, and technological sciences.

The organizational beauty of this outline should be evident. Form is separated from content. Each existent, from the lowest to the highest, is logically arranged. And the interaction of each existent with the others is displayed clearly.

Of course, much more detail could be provided. Such work will, however, be left for future papers.

III. Goals of Knowledge

The goal of logic and mathematical science is to derive all the theorems of form that may be used in the deductions of theorems of content.

The goal of metaphysical science is to determine whether or not any sector or being or universe exists outside our own known physical universe and if so, whether or not any interaction between the sector or being or universe and our universe can take place. A full scientific description is required, together with observations or experiments. If possible, instruments should be used.

The goal of physical science is the complete description of all physical existents: types, amounts, compositions, combinations, sizes, speeds, distributions, life-cycles. We would like to know the size, mass, composition, origin, and natural frequency of the universe (the time for matter development in the material sector, transfer to the cosmic sector, development of cosmic matter in the cosmic sector, and transfer back to the material sector).

The goal of biological science is the complete description of all biological existents—to such a degree that knowing a genotype (that is, the exact sequence of bases in the DNA) we can deduce the phenotype and its behavior. Ultimately, we would like to know the complete atomic description of cells.

The goal of human science is the complete description of human existents and the construction of optimal patterns of human interactions—including the optimal economic and political systems. Methods to optimize each aspect of an individual's life should be established and used.
The goal of technological science is the optimal control of physical and biological existents for the optimal welfare of human beings. Optimization techniques must be developed and applied in all areas of engineering science and medicine.

IV. Goals of the International Society of Unified Science

A. Starting with the Reciprocal System, we should develop a comprehensive axiomatic system, based on the one given above.
B. To accomplish task A, we should design and use a practical theorem-deducing machine, one that is really capable of deducing all theorems from the universal axiomatic system. It should be capable of proving or disproving any conjecture involving any class of existent.
C. We should publish a quantitative handbook or encyclopedia giving the most important theorems in systematic presentation. Also, the Society should publish a series of high-quality journals.
D. We should use the new theoretical system for the advancement of mankind.
E. Finally, we must increase the public knowledge and appreciation of science and our work.

References

Table 1. Dewey Decimal System

000  General Works
100  Philosophy and Related Disciplines
200  Religion
300  Social Sciences
400  Languages
500  Pure Sciences
600  Technology
700  The Arts
800  Literature
900  General Geography and History

Table 2. Library of Congress System

A  General Works
B  Philosophy, Psychology, Religion
C  Auxiliary Sciences of History
D  History, general and Old World
E-F  History, America
G  Geography, Anthropology, Recreation
H  Social Sciences
J  Political Science
K  Law
L  Education
M  Music
N  Fine Arts
P  Language and Literature
Q  Science
R  Medicine
S  Agriculture
T  Technology
U  Military Science
V  Naval Science
Z  Bibliography and Library Science

Table 3. Auguste Comte’s System

I.  Mathematics
II.  Astronomy
III.  Physics
IV.  Chemistry
V.  Biology
VI.  Social Science
Table 4. Rudolf Carnap’s Unified Science System

| I-II | Foundations of the Unity of Science |
| III  | General Problems and Procedures of Unification of Science |
| IV   | Logic and Mathematics               |
| V    | Physics                              |
| VI   | Biology and Psychology               |
| VII  | The Social and Humanistic Sciences   |
| VIII | History of the Scientific Attitude   |

Table 5. The Soviet Union’s System

| I    | Physical-Technical and Mathematical Sciences |
| II   | Chemistry and Biological Sciences           |
| III  | Earth Sciences                              |
| IV   | Social Sciences                             |

Table 6. Encyclopedia Britannica’s System

| I    | Logic                                       |
| II   | Mathematics                                |
| III  | Science                                    |
| 1    | history and philosophy of science           |
| 2    | the physical sciences                       |
| 3    | the earth sciences                          |
| 4    | the biological sciences                     |
| 5    | medicine and affiliated disciplines         |
| 6    | the social sciences and psychology          |
| 7    | the technological sciences                  |
| IV   | History and Humanities                      |
| V    | Philosophy                                  |

Table 7. Random House Encyclopedia’s System

| I    | The Universe                                |
| II   | The Earth                                   |
| III  | Life on Earth                               |
| IV   | Man                                         |
| V    | History and Culture                         |
| VI   | Man and Science                             |
| VII  | Man and Machines                            |

Table 8. American Philosophical Society’s System

| I    | Mathematical and Physical Sciences          |
| II   | Biological Sciences                         |
| III  | Social Sciences                             |
| IV   | Humanities                                  |
| V    | Miscellaneous                               |
Table 9. American Association for the Advancement of Science's System

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Table 10. Proposed New System

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Table 11. Formal System

I. Formal Language $L$
   A. Elements of the language
      1. variables $x_1, x_2, \ldots$
      2. individual constants $a_1, a_2, \ldots$
      3. predicate letters $A^n_1$
      4. punctuation symbols $<), (>, and <,$
      5. the connective I (nand)
      6. the quantifier $\forall$
   B. Combinations of the elements
      1. atomic formulas
      2. well-formed formulas $wfs$
         a. open $wfs$
         b. closed $wfs$
c. prenex form
3. defined symbols
C. Interpretation I and valuations \( v \) of \( L \)

II. *Formal Deductive System* \( K_L \)
   A. Axioms or axiom schemes
   B. Rules of deduction
   C. Proof and valid arguments
   D. Sample theorems of \( K_L \)
   E. Models of \( K_L \)

III. *Metatheorems about* \( K_L \)
   A. Method of proof for metatheorems
   B. Independence of axioms of \( K_L \)
   C. Consistency of \( K_L \)
   D. Completeness of \( K_L \)
   E. Decidability of \( K_L \)
   F. Method of Extending \( K_L \)

Table 12. The New Universal Axiomatic System

I. *The Universal Axiomatic System: Axioms and Theorems*
   A. Axioms and Theorems of Form
      1. Logic
      2. Mathematics
         a. deterministic mathematics
            1) finite quantities: algebra
            2) infinitesimal quantities: calculus
         b. stochastic mathematics
            1) probability
            2) statistics
   B. Axioms and Theorems of Content
      0. Non-space-time (metaphysical existents, if any)
      1. Space-Time
         a. individual units of space-time
         b. collection of units of space-time (geometry)
      2. Physical Existents
         a. individual physical existents and space-time
            1) material displacements
               a) photons
               b) subatoms
               c) atoms
            2) cosmic displacements
               a) photons
               b) subatoms
               c) atoms
         b. interaction of physical existents
            1) material displacements
a) interaction of photons  
b) interaction of photons and subatoms  
c) interaction of photons and atoms  
d) interaction of subatoms  
e) interaction of subatoms and atoms  
f) interaction of atoms  
g) interaction of large collections of atoms: stellar systems  
2) cosmic displacements  
3) interaction between material and cosmic sectors
3. Biological Existent
a. subcells  
b. cells  
c. interaction of cells with each other  
1) interaction of independent individual cells  
2) interaction of dependent individual cells: multicellular organisms  
3) interaction of independent individual cells with multicellular organisms  
4) interaction of multicellular organisms  
a) with same species  
b) with different species
4. Human Existent
a. individual humans  
1) physiology and development  
2) behavior: ego states  
b. interactions of humans  
1) spoken and written transactions  
2) rituals, pastimes, games, activities, intimacy  
3) marriage, family, and kinship  
4) social, political, and economic organization
5. Technological Existent
a. interaction of humans with physical existents  
1) photonics: control of photons  
2) subatomics: control of electrons, neutrons, protons, etc.  
3) atomics: control of atoms  
a) microatomics  
(1) chemical/materials synthesis  
(2) atomic power generation  
b) macroatomics  
(1) structural design  
(2) motion control (dynamics)  
(3) energy generation/transformation  
4) systematics (combined photonics, subatomics, and atomics)  
b. interaction of humans with biological existents  
1) genetic manipulation  
2) agriculture  
3) medicine

II. The Universal Axiomatic System: Meta-Axioms  
A. Independence of Axioms of the Universal Axiomatic System  
B. Consistency of Axioms of the Universal Axiomatic System  
C. Completeness of the Universal Axiomatic System  
D. Decidability of the Universal Axiomatic System
A New Mathematics for Scalar Motion?

Jan N. Sammer

In his proposal for "A New Taxonomy for Scientific Knowledge," Ronald Satz has reiterated the need for a rigorous mathematical formulation of the fundamental postulates of the Reciprocal System, and of the logical consequences that they entail. It appears to me that before embarking on this ambitious endeavor, we should determine whether the mathematical tools that we have chosen might not require some modification.

It is a fact, often stressed by Larson, that physical reality is a subset of the many possibilities implicit in various mathematical systems. Larson ascribes much of the confusion in which present-day physical theory is mired is to the lack of distinction between the mathematically possible and the physically real. To avoid such pitfalls, Larson advocates strict adherence to conceptualization at every step of the mathematical development. But if we are to proceed toward automating the development of the consequences of the postulates, as envisaged by Satz, we will need a more restricted mathematics that will not require human intervention to determine whether what is mathematically possible is also physically real.

In first formulating the assumptions on which the Reciprocal System was to be based, Larson chose explicitly to assume the validity of "ordinary commutative mathematics" and "Euclidean geometry." But he also made it clear that this mathematical and geometric apparatus cannot be used to directly describe physical reality: it is subject to further restrictions, as defined in the postulates. The postulates define the reciprocal relation between space and time in purely mathematical terms—in fact, space and time are defined only as the reciprocal aspects of scalar motion. Anyone attempting to build on this concept in order to formulate a rigorous mathematical structure for the theory will need to use the verbal restrictions of the postulates as a guide for defining a mathematical set more restricted than "ordinary commutative mathematics." At the same time, he will need a geometry that is less restricted than the Euclidean.

The mathematics whose validity is accepted in the postulates include a continuum of real numbers. This continuum, which was formalized by Dedekind and Cantor between 1870 and 1880, could be used to describe the space-time progression of the Reciprocal System, with real numbers representing the units of motion; however, the application of this concept would lead to erroneous conclusions unless it were qualified by the restriction of the second postulate that motion exists only in discrete units. Ideally, we would want a modified Dedekind-Cantor continuum that would incorporate the restriction of the second postulate directly. Our mathematics should also be capable of representing the three dimensions of scalar motion and no more. By using "ordinary commutative mathematics" to develop the consequences of the postulates of the Reciprocal System, we need at each stage of the development to ascertain that our mathematical development has not led to a contradiction of the discrete-unit postulate, or to a violation of the three-dimensionality of scalar motion. A procedure of this kind involves a large number of logical operations, especially when we are dealing with phenomena that are distanced from the postulates by a long chain of reasoning, and thus has the obvious disadvantage of being error-prone. If we were to use a mathematical system in which (a) real numbers were not part of a continuum, but rather contiguous discrete units (corresponding to the units of motion of the second postulate), and (b) no more than three dimensions of scalar motion could be represented, our logical derivations would become simpler, and the Reciprocal System more amenable to rigorous mathematization.

We meet a different problem in the assumption of the universal validity of Euclidean geometry in the first postulate. This postulate also assumes the existence of three dimensions of motion, two of which, it turns out, are not capable of being represented in our reference system defined by Euclidean geometry. Euclidean geometry is certainly useful in describing motions in our reference frame with its three spatial dimensions, but it becomes a conceptual hindrance when we wish to
describe three dimensions of motion, or space-time. Larson has stated, most recently in *Reciprocity* XII(3), that the dimensions he has in mind are mathematical, in the sense that three numbers are necessary to define three-dimensional scalar motion, whereas one number adequately describes motion in three-dimensional space. But we may not need to confine ourselves to a purely mathematical understanding of the dimensions of motion if we make use of non-Euclidean geometry, such as the system known as phasar geometry. I must stress at this point that I am not advocating any modification of the postulates; I am arguing that greater economy could be achieved in their formulation by a rigorous definition of the geometry and mathematics that we wish to employ. In fact, a specific type of non-Euclidean geometry is implied once it is decided that we must transgress the boundary of the three-dimensional spatial reference system.

While geometrical representation of all three dimensions of motion is not possible in a Euclidean geometrical scheme, an independent measurement, such as the red-shift, tells us what is happening in the other, otherwise hidden, dimensions. Although to a casual observer the universe does appear to be Euclidean, this is belied by such observations as the excess red-shift of quasars. The reference system that humans are wont to introduce into the actual system of scalar motions is an arbitrary one; it should therefore be amenable to change. Our task should be to devise a manifold defined by three dimensions of motion, i.e., three dimensions of space linked to three dimensions of time.
Can Gravitation Collapse Stars?*

Frank H. Meyer

The question of gravitational collapse

Oppenheimer and Snyder\(^1\) assert, on the basis of Einstein's General Relativity theory, that gravitational collapse of stars, and even of the entire physical universe, is a natural, universal, and inevitable process. Most astrophysicists accept gravitational collapse as a proven fact, evidenced by white dwarf stars, pulsars and quasars. While neutron-star and black-hole models for these objects have been invented in the effort to substantiate this phenomenon, actual neutron stars and black holes remain undiscovered in physical nature. General Relativity has also led astrophysicists to conclude that, prior to the alleged Big Bang, the entire physical universe was in an extreme state of gravitational collapse. This initial state is believed to have been one of infinite curvature and infinite density, a state which is called a "singularity."

General Relativity predicts the actual existence of singularities in space-time. But whether or not gravitational collapse is in fact possible depends on the physical universe being characterized by non-Euclidian space curvature as the General Relativity theory asserts. Technical consequences of General Relativity theory, such as the Schwarzschild radius and the Chandrasekhar limit, likewise depend on the validity of explaining the motion of gravitating objects by space-time curvature and non-Euclidean geometry. The question of gravitational collapse as an actual process can thus be reduced to the following question: Are singularities, infinite space-time curvature, and infinite density, actual features of the physical universe?

In the Reciprocal System of physical theory, discovered by Dewey B. Larson\(^2,3\) the physical universe is found to be finite in all its parts, and as a whole to be finite, cyclical, and unchanging. Like Descartes, Larson has concluded that the totality of its motion is constant. Hence Larsonian physics has no room and no need for the arithmetic of the infinite to describe the physical nature of things.

The Incompleteness of Relativity Theory

The Special and General theories of relativity, formulated by Albert Einstein\(^4,5\), today command the support of nearly all physicists. Supporters of the principle and theories of relativity, like natural philosophers of Europe before the time of Copernicus, believe that the physical Universe can be understood only in terms of models that, although incomplete, can be made to predict the observations with ever greater accuracy by means of further and further refinements. Just as pre-Copernican astronomers, by increasing the number of epicycles, were rather successful at constructing models that saved the phenomena, the moderns have built models of degenerate matter and quark behavior that account for the observations remarkably well. The modern theories are just as successful as the pre-Copernican ones at saving the phenomena—and just as wrong. The nuclear atom, solar fusion, and gravitational collapse of the physical universe are as inadequate representations of the physical world as were the crystalline spheres of the pre-Copernican era.

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*This article is based on a lecture contributed to the 53rd annual spring meeting of the Minnesota Area Association of Physics Teachers, held jointly with the Minnesota Academy of Science at the College of St. Catherine, St. Paul, on April 27, 1985.
Scalar Motion

Einstein questioned Newton's assumption that distance and duration (space and time) are independent, and asserted that they are inseparable; but his attempt at discovering the nature of the relation (four-dimensional space-time) must be considered a failure, since it leads to physical consequences that are untenable: hypothetical objects of arbitrarily great density and arbitrarily small volume, and a universe that in its original state was “smaller than an atomic nucleus.” As Larson has pointed out, the one relation between space and time of which we have any definite knowledge is motion—space per unit time. Motion is a multiplicatively inverse, or reciprocal, relation of space to time. Motion and space-time are not merely equivalent—they are identical. The observed three-dimensional nature of space can be extended to time. The observed progression of time can be extended to space. Thus there is a progression of space-time that is of necessity three-dimensional, and scalar. Its rate has been measured as approximately 300,000 km/second, the speed of light.

The existence of a space-time progression is one of the first consequences of the postulates of the Reciprocal System. The space-time progression is the most fundamental feature of the physical universe, a three-dimensional scalar uniform progression at unit speed, one finite natural space unit/one finite natural time unit. It is in fact the reference frame for the physical universe, the true physical zero. With zero set at unity, the problem of infinities and singularities implicit in General Realativity disappears. What is more, the finite extension of the units of space-time has as a consequence a scalar directional reversal at the unit level, so that, within unit distance, gravitation acts in the outward scalar direction and the force of the space-time progression acts inward. The equilibrium thus established accounts for the remarkable stability of matter in the solid state, which has withstood experimental pressures of millions of atmospheres. It is up to those claiming gravitational collapse to be a reality to show that it is not in violation of the laws of physics.

References

Bookshelf:

Dewey B. Larson’s *The Universe of Motion*

This book extends the physical principles and relations developed in *Nothing But Motion* and Larson’s other publications to the astronomical and cosmological fields. As in the earlier work, all of the conclusions that are reached are derived entirely by development of the necessary consequences of the postulates that define the universe of motion, without introducing anything from any other source. This book therefore gives us a purely physical view of the astronomical universe, completely independent of any information from astronomical sources. The relevant observational results are described, but they are not used in the development of the theoretical picture of the universe; they are employed only for the purpose of showing that the theoretical results agree, item by item, with the observations.

As could be expected in a field where factual information is scarce, and existing theory is largely speculation, this new development, based on physical principles that have been positively verified, explanations for such phenomena as quasars and pulsars, the galactic recession, the white dwarf stars, the supernovae, eliminate the need for the fantastic products of the imagination—degenerate matter, singularities, black holes, etc.—that the astronomers are now calling upon to provide answers to the problems posed by the latest observational discoveries. In addition to returning these more recently discovered phenomena to the land of reality, the new, fully integrated, and solidly based theoretical development uncovers some serious errors in the currently accepted concepts of the evolutionary paths of stars and galaxies. Correction of these errors eliminates many of the long-standing astronomical problems.

This clarification of the astronomical situation is not only an important addition to scientific knowledge, but also has a major significance in relation to the physical laws and principles derived from the postulates that define the universe of motion, because astronomy is the great testing ground for physical theories. If a theoretical proposition is wrong, or incomplete, its shortcomings become apparent when they are greatly magnified by the extremes of size, speed, temperature, and pressure to which astronomical objects are subjected. The fact that the answers to the major astronomical questions emerge easily and naturally from this theoretical development, even in those cases, such as the quasar situation, where the astronomers have been completely baffled, thus adds another dimension to the already strong confirmation of the validity of the postulates of the theory of the universe of motion.

If you are interested in astronomy, either as such, or because of its relevance to physics, we believe you will want this book sooner or later.

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Publication Policy

The editors of Reciprocity welcome papers, especially from new contributors. The requirements that a contributed paper must meet in order to qualify for publication are clarified below. Editorial assistance is available in those cases where a limited amount of revision will enable a paper to meet the requirements.

As stated in the by-laws of the International Society of Unified Science, the objective of the Society is the advancement of the Reciprocal System of physical theory. This theory, as it is defined, consists of two fundamental postulates, together with everything that can be derived from those postulates by logical or mathematical processes, without introducing anything from any other source.

The unitary character of the theory, resulting from the derivation of all of its conclusions from the same set of premises, is its most essential feature. It is this status of the theory as a general physical theory—the only thing of its kind—that enables proof of its validity by the probability method, and enables extension of the theory into areas inaccessible to observation.

The purpose of Reciprocity is to contribute toward the accomplishment of the objective of the organization. Acceptance of items for publication shall therefore be determined by the following criteria:

1. All items must have relevance to the stated objective of the International Society of Unified Science.
2. Original technical articles must deal with the Reciprocal System of theory, as defined above, or aspects thereof; that is, the propositions supported must purport to be derived from the postulates of the Reciprocal System, or from previously published conclusions reached on that basis, without introducing further assumptions.
3. Arguments advanced against previously published material must be similarly based.

Papers should be sent to one of the editors. All published papers become property of ISUS, Inc.

A Note from the Editors

With this double issue of Reciprocity, we enter our fifteenth year. The patience of our subscribers when technical difficulties delayed the appearance of the journal is appreciated. We are happy to report that these difficulties have in most respects been overcome, and that we foresee a regular quarterly publication schedule from now on.

We have had numerous requests for back issues. In general back issues are not available, with the exception of Volume XI, No. 3 (Autumn, 1981), and Volume XIII, No. 1 (Autumn 1983), which can be obtained from the Senior Editor at the cost of $3.50 ea. We appreciate the need to make available some of the major papers from past issues, and are in the process of preparing a series of offprints, eventually to be collected into a reader that is being planned in connection with the annual course on the Reciprocal System. The Spring 1986 issue of Reciprocity will carry further details. The course, which is being taught by Ronald W. Satz, will be held this year on the campus of Columbia University in New York City, August 11-14, 1986. The Annual Convention is scheduled for August 15-16 at the same location.
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An Intensive Course on the Reciprocal System

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The Dimensions of Motion

Dewey B. Larson

Now that the existence of scalar motion has been demonstrated, it will be appropriate to examine the consequences of this existence. Some of the most significant consequences are related to the dimensions of this hitherto unrecognized type of motion. The word "dimension" is used in several different senses, but in the sense in which it is applied to space it signifies the number of independent magnitudes that are required for a complete definition of a spatial quantity. It is generally conceded that space is three-dimensional. Thus three independent magnitudes are required for a complete definition of a quantity of space. Throughout the early years of science this was taken as an indication that the universe is three-dimensional. Currently, the favored hypothesis is that of a four-dimensional universe, in which the three dimensions of space are joined to one dimension of time.

Strangely enough, there does not appear to have been any critical examination of the question as to the number of dimensions of motion that are possible. The scientific community has simply taken it for granted that the limits applicable to motion coincide with those of the spatial reference system. On reviewing this situation it can be seen that this assumption is incorrect. The relation of any one of the three space magnitudes to a quantity of time constitutes a scalar motion. Thus three dimensions of scalar motion are possible. But only one dimension of motion can be accommodated within the conventional spatial reference system. The result of any motion within this reference system can be represented by a vector (a one-dimensional expression), and the resultant of any number of such motions can be represented by the vector sum (likewise one-dimensional). Any motions that exist in the other two dimensions cannot be represented.

Here again we encounter a shortcoming of the reference system. In our examination of the nature of scalar motion we saw that this type of motion cannot be represented in the reference system in its true character. The magnitude and direction attributed to such a motion in the context of the reference system are not specifically defined, but are wholly dependent on the size and position of the object whose location constitutes the reference point. Now we find that there are motions which cannot be represented in the reference system in any manner. It is therefore evident that the system of spatial coordinates that we use in conjunction with a clock as a system of reference for physical activity gives us a severely limited, and in some respects inaccurate, view of physical reality. In order to get the true picture we need to examine the whole range of physical activity, not merely that portion of the whole that the reference system is capable of representing.

For instance, gravitation has been identified as a scalar motion, and there is no evidence that it is subject to any kind of a dimensional limitation other than that applying to scalar motion in general. We must therefore conclude that gravitation can act three-dimensionally. Furthermore, it can be seen that gravitation must act in all of the dimensions in which it can act. This is a necessary consequence of the relation between gravitation and mass. The magnitude of the gravitational force exerted by a material particle or aggregate (a measure of its gravitational motion) is determined by its mass. Thus mass is a measure of the inherent negative scalar motion content of the matter. It follows that motion of any mass $m$ is a motion of a negative scalar motion. To produce such a compound motion, a positive scalar motion $v$ (measured as speed or velocity) must be applied to the mass. The resultant is $mv$, now called momentum, but known earlier as "quantity of motion," a term that more clearly expresses the nature of the quantity. In the context of a spatial reference system, the applied motion $v$ has a direction, and is thus a vector quantity, but the direction is imparted by the coupling to the reference system and is not an inherent property of the motion itself. This motion therefore retains its positive scalar status irrespective of the vectorial direction.

In the compound motion $mv$ the negative gravitational motion acts as a resistance to the positive
motion. The gravitational motion must therefore take place in all three of the available dimensions, as any one of the three may be parallel to the dimension of the reference system, and there would be no effective resistance in any vacant dimension. We may therefore identify the gravitational motion as three-dimensional speed, which we can express as \(s^3/t^3\), where \(s\) and \(t\) are space and time respectively. The mass (the resistance that this negative gravitational motion offers to the applied positive motion) is then the inverse of this quantity, or \(t^3/s^3\). Since only one dimension of motion can be represented in a three-dimensional spatial coordinate system, the gravitational motion in the other two dimensions has no directional effect, but its magnitude applies as a modifier of the magnitude of the motion in the dimension of the reference system.

We now turn to a different kind of "dimensions." When physical quantities are resolved into component quantities of a fundamental nature, these component quantities are called dimensions. The currently accepted systems of measurement express the dimensions of mechanical quantities in terms of mass, length, and time, together with the dimensions, in the first sense, of these quantities. But now that mass has been identified as a motion, a relation between space and time, all of the quantities of the mechanical system can be expressed in terms of space and time only. For purposes of the present discussion the word "space" will be used instead of "length," to avoid implying that there is some dimensional difference between space and time. On this basis, the "dimensions," or "space-time dimensions" of one-dimensional speed are space divided by time, or \(s/t\). As indicated above, mass has the dimensions \(t^3/s^3\).

The product of mass and speed (or velocity) is \(t^3/s^3 \times s/t = t^2/s^2\). This is "quantity of motion," or momentum. The product of mass and the second power of speed is \(t^3/s^3 \times s^2/t^2 = t/s\), which is energy. Acceleration, the time rate of change of speed, is \(s/t \times 1/t = s/t^2\). Multiplying acceleration by mass, we obtain \(t^3/s^3 \times s/t^2\), which is force, the "quantity of acceleration," we might call it. The dimensions of the other mechanical quantities are simply combinations of these basic dimensions. Pressure, for instance, is force divided by area, \(t^3/s^4 \times s^2 = t^3/s^2\).

When reduced to space-time terms in accordance with the foregoing identifications, all of the well-established mechanical relations are dimensionally consistent. To illustrate this agreement, we may consider the relations applicable to angular motion, which take a different form from those applying to translational motion, and utilize some different physical quantities. The angular system introduces a purely numerical quantity, the angle of rotation \(\theta\). The time rate of change of this angle is the angular velocity \(\omega\), which has the dimensions \(\omega = \theta/t = 1/t\). Force is applied in the form of torque, \(L\), which is the product of force and the radius, \(r\). \(L = Fr = t^2/s \times s = t/s\). One other quantity entering into the angular relations is the moment of inertia, symbol \(I\), the product of the mass and the second power of the radius. \(I = mr^2 = t^3/s^3 \times s^2 = t^3/s\). The following equations demonstrate the dimensional consistency achieved by this identification of the space-time dimensions:

- energy \((t/s) = L\theta = t/s \times 1 = t/s\)
- energy \((t/s) = 1/2I\omega^2 = t^3/s \times 1/t^2 = t/s\)
- power \((1/s) = L\omega = t/s \times 1/t = 1/s\)
- torque \((t/s) = 1/2I\omega^2 = t^3/s \times 1/t^2 = t/s\)

The only dimensional discrepancy in the basic equations of the mechanical system is in the gravitational force equation, which is expressed as \(F = Gm^2/d^2\), where \(G\) is the gravitational constant and \(d\) is the distance between the interacting masses. Although this equation is correct mathematically, it cannot qualify as a theoretically established relation. As one physics textbook puts it, this equation "is not a defining equation... and cannot be derived from defining equations. It represents an observed relationship." The reason for this inability to arrive at a theoretical explanation of the equation becomes apparent when we examine it from a dimensional standpoint.
the dimensions of force in general are those of the product of mass and acceleration. It follows that these must also be the dimensions of any specific force. For instance, the gravitational force acting on an object in the earth's gravitational field is the product of the mass and the "acceleration due to gravity." These same dimensions must likewise apply to the gravitational force in general. When we look at the gravitational equation in this light, it becomes evident that the gravitational constant represents the magnitude of the acceleration at unit values of m' and d, and that these quantities are dimensionless ratios. The dimensionally correct expression of the gravitational equation is then \( F = ma \), where the numerical value of a is \( Gm'/d^2 \).

The space-time dimensions of the quantities involved in current electricity can easily be identified in the same manner as those of the mechanical system. Most of the measurement systems currently in use add an electric quantity to the mass, length and time applicable to the mechanical system, bringing the total number of independent base quantities to four. However, the new information developed in the foregoing paragraphs enables expressing the electrical quantities of this class in terms of space and time only, in the same manner as the mechanical quantities.

Electrical energy (watt-hours) is merely one form of energy in general, and therefore has the energy dimensions, \( t/s \). Power (watts) is energy divided by time, \( t/s \times t = t/s \). Electrical force, or voltage (volts) is equivalent to mechanical force, with the dimensions \( t/s^2 \). Electric current (amperes) is power divided by voltage, \( t = s/t \times s^2/t = t/s \). Thus current is dimensionally equal to speed. Electrical quantity (coulombs) is current multiplied by time, and has the dimensions \( Q = It = s/t \times t = s \). Resistance (ohms) is voltage divided by current, \( R = t/s^2 \times t/s = t^2/s^3 \). This is the only one of the basic quantities involved in the electric current phenomena that has no counterpart in the mechanical system. Its significance can be appreciated when it is noted that the dimensions \( t^2/s^3 \) are those of mass per unit time. The dimensions of other electrical quantities can be obtained by combination, as noted in connection with the mechanical quantities.

As can be seen from the foregoing, the quantities involved in current electricity are dimensionally equivalent to those of the mechanical system. We could, in fact, describe the current phenomena as the mechanical aspects of electricity. The only important difference is that mechanics is largely concerned with the motions of individual units or aggregates, while current electricity deals with continuous phenomena in which the individual units are not separately identified.

The validity of the dimensional assignments in electricity, and the identity of the electrical and mechanical relations, can be verified by reducing the respective equations to the space–time basis. For example, in mechanics the expression for kinetic energy (or work) is \( W = 1/2mv^2 \), the dimensions of which are \( t^0/s^3 \times s^2/t^2 = t/s \). The corresponding equation for the energy of the electric current is \( W = I^2Rt \). As mentioned above, the product \( Rt \) is equivalent to mass, while \( I \), the current, has the dimensions of speed, \( t/s \). Thus, like the kinetic energy, the electrical energy is the product of mass and the second power of speed, \( W = I^2Rt = s^2/t \times t/s^3 \times t = t/s \). Another expression for mechanical energy is force times distance, \( W = Fd = t/s^2 \times s = t/s \). Similarly, electrical energy is voltage times quantity, \( W = VQ = t/s^2 \times s = t/s \). All of the other established relations of current electricity are likewise dimensionally consistent, and equivalent to the corresponding mechanical relations, when reduced to space-time terms.

Identification of the space-time dimensions of electrostatic quantities, those involving electric charge, is complicated by the fact that in present-day physical thought electric charge is not distinguished from electric quantity. As we have seen, electric quantity is dimensionally equivalent to space. On the other hand, we can deduce from the points brought out in the preceding article that electric charge is the one-dimensional analog of mass, and is therefore dimensionally equivalent to energy. This can be verified by consideration of the relations involving electric field intensity, symbol \( E \). In terms of charge, the electric field intensity is given by the expression \( E = Q/s^2 \). But the field intensity is defined as force per unit distance, and its space-time dimensions are therefore \( t/s^2 \times 1/s = t/s^3 \). Applying these dimensions to the equation \( E = Q/s^2 \), we obtain \( Q = Es^2 = t/s^3 \times s^2 = t/s \).

As long as the two different quantities that are called by the same name are used separately, their
practical application is not affected, but confusion is introduced into the theoretical treatment of the phenomena that are involved. For instance in the relations involving capacitance (symbol $C$), $Q = t/s$ in the basic equation $C = Q/V = t/s \times s^2/t = s$. The conclusion that capacitance is dimensionally equivalent to space is confirmed observationally, as the capacitance can be calculated from geometrical measurements. However, the usual form of the corresponding energy equation is $W = QV$, reflecting the definition of the volt as one joule per coulomb. In this equation, $Q = W/V = t/s \times s^2/t = s$. Because of the lack of distinction between the two usages of $Q$, the quantity $CV$, which is equal to $Q$ in the equation $C = Q/V$ is freely substituted for $Q$ in equations of the $W = Q/V$ type, leading to results such as $W = C/V^2$, which are dimensionally incorrect.

Such findings emphasize the point that the ability to reduce all physical relations to their space-time dimensions provides us with a powerful and effective tool for analyzing physical phenomena. Its usefulness is clearly demonstrated when it is applied to an examination of magnetism, which has been the least understood of the major areas of physics. The currently accepted formulations of the various magnetic relations are a mixture of correct and incorrect expressions, but by using those that are most firmly based it is possible to identify the space-time dimensions of the primary magnetic quantities. This information then enables correcting the existing errors in the statements of other relations, and establishing dimensional consistency over the full range of magnetic phenomena.

In carrying out such a program we find that magnetism is a two-dimensional analog of electricity. The effect of the added dimension is to introduce a factor $t/s$ into the expressions of the relations applicable to the one-dimensional electric system. Thus the magnetic analog of an electric charge, $t/s$, is a magnetic charge, $t^2/s^2$. The existence of such a charge is not recognized in present-day magnetic theory, probably because there is no independent magnetically-charged particle, but one of the methods of dealing with permanent magnets makes use of the concept of a "magnetic pole," which is essentially the same thing. The unit pole strength in the SI system, the measurement system now most commonly applied to magnetism, is the weber, which is equivalent to a volt-second, and therefore has the dimensions $t/s^2 \times t = t^2/s^2$. The same units and dimensions apply to magnetic flux, a quantity that is currently used in most relations that involve magnetic charge, as well as in other applications where flux is the more appropriate term.

Current ideas concerning magnetic potential, or magnetic force, are in a state of confusion. Questions as to the relation between electric potential and magnetic potential, the difference, if any, between potential and force, and the meaning of the distinctions that are drawn between various magnetic quantities such as magnetic potential, magnetic vector potential, magnetic scalar potential, and magnetomotive force, have never received definitive answers. Now, however, by analyzing these quantities into their space-time dimensions we are able to provide the answers that have been lacking. We find that force and potential have the same dimensions, and are therefore equivalent quantities. The term "potential" is generally applied to a distributed force, a force field, and the use of a special name in this context is probably justified, but it should be kept in mind that a potential is a force.

On the other hand, a magnetic potential (force) is not dimensionally equivalent to an electrical potential (force), as it is subject to the additional $t/s$ factor that relates the two-dimensional magnetic quantities to the one-dimensional electric quantities. From the dimensions $t/s^2$ of the electric potential, it follows that the correct dimensions of the magnetic potential are $t/s \times t/s^2 = t^2/s^3$. This agrees with the dimensions of magnetic vector potential. In the SI system, the unit of this quantity is the weber per meter, or $t^2/s^2 \times 1/s = t^2/s^3$. The corresponding cgs unit is the gilbert, which also reduces to $t^2/s^3$.

The same dimensions should apply to magnetomotive force (MMF), and to magnetic potential, where this quantity is distinguished from vector potential. But an error has been introduced into the dimensions attributed to these quantities because the accepted defining relation is an empirical expression that is dimensionally incomplete. Experiments show that the magnetomotive force can be calculated by means of the expression $\text{MMF} = nI$, where $n$ is the number of turns in a coil.

Reciprocity
Since \( n \) is dimensionless, this equation indicates that MMF has the dimensions of electric current. The unit has therefore been taken as the ampere, dimensions \( s/t \). From the discrepancy between these and the correct dimensions we can deduce that the equation MMF = \( nI \), from which the ampere unit is derived, is lacking a quantity with the dimensions \( t^2/s^3 \times s/t = t^3/s^4 \).

There is enough information available to make it evident that the missing factor with these dimensions is the permeability, the magnetic analog of electrical resistance. The permeability of most substances is unity, and omitting has no effect on the numerical results of most experimental measurements. This has led to overlooking it in such relations as the one used in deriving the ampere unit for MMF. When we put the permeability (symbol \( \mu \)) into the empirical equation it becomes MMF = \( \mu nI \), with the correct dimensions, \( t^2/s^4 \times s/t = t^2/s^3 \).

The error in the dimensions attributed to MMF carries over into the potential gradient, the magnetic field intensity. By definition, this is the magnetic field potential divided by distance, \( t^2/s^3 \times 1/s = t^2/s^4 \). But the unit in the SI system is the ampere per meter, the dimensions of which are \( s/t \times 1/s = 1/t \). In this case, the cgs unit, the oersted, is derived from the dimensionally correct unit of magnetic potential, and therefore has the correct dimensions, \( t^2/s^4 \).

The discrepancies in the dimensions of MMF and magnetic field intensity are typical of the confusion that exists in a number of magnetic areas. Much progress has been made toward clarifying these situations in the past few decades, but active, and sometimes acrimonious, controversies still persist with respect to such quantities as magnetic moment and the two vectors usually designated by the letters B and H. In most of these cases, including those specifically mentioned, introduction of the permeability where it is appropriate, or removing it where it is inappropriate, is all that is necessary to clear up the confusion and attain dimensional validity.

Correction of the errors in electric and magnetic theory that have been discussed in the foregoing paragraphs, together with clarification of physical relations in other areas of confusion, enables expressing all electric and magnetic quantities and relations in terms of space and time, thus completing the consolidation of all of the various systems of measurement into one comprehensive and consistent system. An achievement of this kind is, of course, self-verifying, as the possibility that there might be more than one consistent system of dimensional assignments that agree with observations over the entire field of physical activity is negligible.

But straightening out the system of measurement is only a small part of what has been accomplished in this development. More importantly, the positive identification of the space–time dimensions of any physical quantity defines the *basic physical nature* of that quantity. Consequently, any hypothesis with respect to a physical process in which this quantity participates must agree with the dimensional definition. The effect of this constraint on theory construction is illustrated by the findings with respect to the nature of current electricity that were mentioned earlier. Present-day theory views the electric current as a flow of electric charges. But the dimensional analysis shows that charge has the dimensions \( t/s \), whereas the moving entity in the current flow has the dimensions of space, \( s \). It follows that the current is *not* a flow of electric charges.

Furthermore, the identification of the space–time dimensions of the moving entity not only tells us what the current is not, but goes on to reveal just what it is. According to present-day theory, the carriers of the charges, which are identified as electrons, move through the spaces between the atoms. The finding that the moving entities have the dimensions of space makes this kind of a flow pattern impossible. An entity with the dimensions of space cannot move through space, as the relation of space to space is not motion. Such an entity must move *through the matter itself*, not through the vacant spaces. This explains why the current is confined within the conductor, even if the conductor is bare. If the carriers of the current were able to move forward through vacant spaces between the atoms, they should likewise be able to move laterally through similar spaces, and escape from the conductor. But since the current moves through the matter, the confinement is a necessary consequence.

The electric current is *a movement of space through matter*, a motion that is equivalent, in all but
direction, to movement of matter through space. This is a concept that many individuals will find hard to accept. But it should be realized that the moving entities are not quantities of the space with which we are familiar, extension space, we may call it. There are physical quantities that are dimensionally equivalent to this space of our ordinary experience, and play the same role in physical activity. One of them, capacitance, has already been mentioned in the preceding discussion. The moving entities are quantities of this kind, not quantities of extension space.

Here, then, is the explanation of the fact that the basic quantities and relations of the electric current phenomena are identical with those of the mechanical system. The movement of space through matter is essentially equivalent to the movement of matter through space, and is described by the same mathematical expressions. Additionally, the identification of the electric charge as a motion explains the association between charges and certain current phenomena that has been accepted as evidence in favor of the "moving charge" theory of the electric current. One observation that has had considerable influence on scientific thought is that an electron moving in open space has the same magnetic properties as an electric current. But we can now see that the observed electron is not merely a charge. It is a particle with an added motion that constitutes the charge. The carrier of the electric current is the same particle without the charge. A charge that is stationary in the reference system has electrostatic properties. An uncharged electron in motion within a conductor has magnetic properties. A charged electron moving in a conductor or in a gravitational field has both magnetic and electrostatic properties. It is the motion of physical entities with the dimensions of space that produces the magnetic effect. Whether or not these entities—electrons or their equivalent—are charged is irrelevant from this standpoint.

Another observed phenomenon that has contributed to the acceptance of the "moving charge" theory is the emission of charged electrons from current-carrying conductors under certain conditions. The argument in this instance is that if charged electrons come out of a conductor there must have been charged electrons in the conductor. The answer to this is that the kind of motion which constitutes the charge is easily imparted to a particle or atom (as anyone who handles one of the modern synthetic fabrics can testify), and this motion is imparted to the electrons in the process of ejection from the conductor. Since the uncharged particle cannot move through space, the acquisition of a charge is one of the requirements for escape.

In addition to providing these alternative explanations for aspects of the electric current phenomena that are consistent with the "moving charge" theory, the new theory of the current that emerges from the scalar motion study also accounts for a number of features of the current flow that are difficult to reconcile with the conventional theory. But the validity of the new theory does not rest on a summation of its accomplishments. The conclusive point is that the identification of the electric current as a motion of space through matter is confirmed by agreement with the dimensions of the participating entities, dimensions that are verified by every physical relation in which the electric current is involved.

The proof of validity can be carried even farther. It is possible to put the whole development of thought in this and the preceding article to a conclusive test. We have found that mass is a three-dimensional scalar motion, and that the electric current is a one-dimensional scalar motion through a mass by entities that have the dimensions of space. We have further found that magnetism is a two-dimensional analog of electricity. If these findings are valid, certain consequences necessarily follow that are extremely difficult, perhaps impossible, to explain in any other way. The one-dimensional, oppositely directed, flow of the current through the three-dimensional scalar motion of matter neutralizes a portion of the motion in one of the three dimensions, and should leave an observable two-dimensional (magnetic) residue. Similarly, movement of a two-dimensional (magnetic) entity through a mass, or the equivalent of such a motion, should leave a one-dimensional (electric) residue. Inasmuch as these are direct and specific requirements of the theory outlined in the foregoing paragraphs, and are not called for by any other physical theory, their presence or absence is a definitive test of the validity of the theory.

The observations give us an unequivocal answer. The current flow produces a magnetic effect, and this effect is perpendicular to the direction of the current, just as it must be if it is the residue of

Reciprocity
a three-dimensional motion that remains after motion in the one dimension of the current flow is neutralized. This perpendicular direction of the magnetic effect of the current is a total mystery to present-day physical science, which has no explanation for either the origin of the effect or its direction. But both the origin and the direction are obvious and necessary consequences of our findings with respect to the nature of mass and the electric current.

There is no independent magnetic particle similar to the carrier of the electric current, and no two-dimensional motion of space through matter analogous to the one-dimensional motion of the current is possible, but the same effect can be produced by mechanical movement of mass through a magnetic field, or an equivalent process. As the theory requires, the one-dimensional residue of such motion is observed to be an electric current. This process is electromagnetic induction. The magnetic effect of the current is electromagnetism.

On first consideration it might seem that the magnitude of the electromagnetic effect is far out of proportion to the amount of gravitational motion that is neutralized by the current. However, this is a result of the large numerical constant, $3 \times 10^{10}$ in cgs units (represented by the symbol $c$), that applies to the space-time ratio $s/t$ where conversion from an $n$-dimensional quantity to an $m$-dimensional quantity takes place. An example that, by this time, is familiar to all, is the conversion of mass ($t^2/s^3$) to energy ($t/s$). In that process, where the relation is between a three-dimensional quantity and a one-dimensional quantity, the numerical factor is $c^2$. In the relation between the three-dimensional mass and the two-dimensional magnetic residue the numerical factor is $c$, less than $c^2$ but still a very large number.

Thus the theory of the electric current developed in the foregoing discussion passes the test of validity in a definite and positive manner. The results that it requires are in full agreement with two observed physical phenomena of significant nature that are wholly unexplained in present-day physical thought. Together with the positively established validity of the corresponding system of space-time dimensions, this test provides a verification of the entire theoretical development described in this article, a proof that meets the most rigid scientific standards.
New Light on the Gravitational Deflection of Radiation Path

K.V.K. Nehru

In an earlier paper I have discussed the effect of gravitation on the bending of the locus of a photon.\(^{(1)}\) Even though the role played by the coordinate time associated with the gravitational motion in deflecting the path of light was correctly depicted therein, I believe that the mathematical implications were not correctly brought out. Especially, in the case of equation (6) there, though its existence was correctly recognized, its physical significance was misconstrued. The present paper, therefore, attempts to overcome these shortcomings and derives the mathematical expression for the angle through which the path of a light beam is deflected in the vicinity of a mass.

According to the Reciprocal System, an independent motion of speed \(v\) has associated with it an increase in the coordinate time amounting to \((v/c)^2\) sec/sec (\(c\) being the speed of light). In the case of a one-dimensional motion, like that of a planet orbiting the sun, or of a photon grazing the sun's limb, I have pointed out\(^{(2)}\) that the circumferential spatial effect arising out of the coordinate time amounts to \(3(v/c)^2\) sec/sec. It was further explained that, in the case of a photon this spatial effect manifests itself in the radially inward direction since no further circumferential effect is possible, as the photon is already moving at unit speed in the latter direction.\(^{(3)}\)

The gravitational speed \(v\) at any radial distance \(r\) from a mass \(M\) is shown\(^{(4)}\) to be

\[
v^2 = GM/r
\]

where \(G\) is the gravitational constant. Thus, we have the rate of coordinate time increase at a radial distance \(r\) outside a mass \(M\) as

\[
\frac{dt_c}{dt} = 3(v/c)^2 = 3 \frac{GM}{r c^2}
\]

where \(t_c\) represents the coordinate time and \(t\) the clock time.

![Diagram](Diagram_1)

As shown in Fig. 1, let the straight line ABC represent the locus of a photon passing the sun situated at \(S\). With \(SB\) perpendicular to \(AC\), \(B\) is the point of closest approach to the sun. Let \(SB = r_0\). The equation of the line ABC in polar coordinates, with the origin at \(S\), is given by

\[
r_0 = r \cos \theta
\]
where \( r \) is the radial distance at any angle \( \theta \) measured counterclockwise from SB. Substituting \( r \) from eq. (2) into eq. (1), we have

\[
\frac{dt_c}{dt} = (3 \frac{GM}{r_0 c^3}) \cos \theta
\]  

(3)

Now we note that the gravitational effect of any mass aggregate, according to the Reciprocal system, does not extend up to infinity, but becomes zero at a limiting distance, which Larson calls the "outer gravitational limit," \( d_1 \). As such, we need to compute the coordinate time increase in the case of the transiting photon, starting from the outer gravitational limit on one side (toward A, in Fig. 1), up to the outer gravitational limit on the other side (toward C, in Fig. 1). Larson worked out the value of the outer gravitational limit for the sun to be nearly 13350 light years. As this will be very large compared to \( r_0 \), we find that the limits on the two sides are given by \( \theta_1 = -\pi/2 \) and \( \theta_2 = +\pi/2 \).

Hence, using eq.(3), the average rate of coordinate time increase during this transit from \( \theta_1 \) to \( \theta_2 \) is given by

\[
\left. \frac{dt_c}{dt} \right|_{av} = \int_{\theta_1}^{\theta_2} \frac{dt_c}{dt} d\theta/(\theta_2 - \theta_1)
\]

\[
= (3 \frac{GM}{r_0 c^3}) \int_{-\pi/2}^{\pi/2} \cos \theta \frac{d\theta}{\pi}
\]

\[
= 6 \frac{GM}{\pi r_0 c^2} \ \text{sec/sec}
\]

(4)

Since the total distance traveled is 2 \( d_1 \), the total transit time is

\[
t = 2 \frac{d_1}{c} \ \text{sec}
\]

(5)

Therefore the total coordinate time gained during this clock time \( t \) is

\[
\frac{t_{c,tot}}{t} = \left. \frac{dt_c}{dt} \right|_{av} = (6 \frac{GM}{\pi r_0 c^2} \cdot (2 \frac{d_1}{c})
\]

\[
= 12 \frac{GM}{\pi r_0 c^3} \ \text{sec}
\]

(6)

\[\text{Fig. 2}\]

In Fig. 2 the directions of approach and departure of the light beam are shown as ABC' and Reciprocity.
BC respectively. CC' represents the spatial shift in the radial direction arising out of the coordinate time component and is given by

\[ x = c \times t_{c,\text{tot}} = 12 \frac{GM}{d_1/\pi r_0} c^2 \text{ cm} \]  

(7)

Finally, from Fig. 2 we can see that the angular deflection, according to the Reciprocal System is given by

\[ d_{RS} = \frac{x}{d_1} = 12 \frac{GM}{\pi r_0} c^2 \text{ radians} \]  

(8)

The corresponding expression from General Relativity is

\[ d_{GR} = 4 \frac{GM}{r_0} c^2 \]  

(9)

The discrepancy between the two formulae can be seen to be

\[ \frac{d_{RS}}{d_{GR}} = \frac{3}{\pi} \]  

(10)

The value calculated from the Reciprocal System formula, for the sun, is 1.67 arcsec, whereas the General Relativity value is 1.75 arcsec. The reported values vary from 1.5 to 1.8 arcsec.

References

4. Ibid., eq. (1), p. 28.
Calculation of the Dissociation Energy of Diatomic Molecules

Ronald W. Satz

This paper presents the first rational calculation of the dissociation energy of diatomic molecules. Quantum mechanics does not have such a calculation, even in principle. The importance of this calculation is that it provides additional quantitative verification of the molecular force and energy concepts of the Reciprocal System.

Dissociation energy is the change in energy (usually expressed in kcal per mole) at absolute zero temperature in the ideal gas state for the reaction

\[ \text{A-B} \rightarrow \text{A} + \text{B} \]  

(1)

the products (atoms A and B) being in their ground states and the reactant (molecule A–B) in the zeroth vibrational level. Note that dissociation energy is slightly different from bond energy, which is defined as the standard enthalpy change at 25°C for the ideal gas reaction given above. Calculating dissociation energy rather than bond energy frees us from having to consider molecular thermal energy.

Now let us proceed to the derivation of the expression for bond dissociation energy from the principles of the Reciprocal System. A diatomic molecule, as a unit, exists in the time–space region. However, the two individual atoms of the molecule, relative to one another, exist in the time region because the interatomic distance is less than one space unit; hence, time region expressions apply to the attributes of the bond. To quote Larson,

The motion in time which can take place inside the space unit is equivalent to a motion in space because of the inverse relation between space and time. An increase in the time aspect of a motion in this inside region (the time region, where space remains constant at unity) from 1 to \( t \) is equivalent to a decrease in the space aspect from 1 to \( 1/t \). Where the time is \( t \), the speed in this region is equivalent space \( 1/t \) divided by time \( t \), or \( 1/t^2 \) [Ref. 1].

Thus,

\[ v = 1/t^2 \]  

(2)

In the Reciprocal System, energy is the reciprocal of speed. Hence, in the time region,

\[ E = t^2 \]  

(3)

This energy equation gives the proper dimensional form of the expression for dissociation energy. It can be generalized to

\[ E = t_x \, * \, t_z \]  

(4)

In application to the problem at hand, \( t_x \) and \( t_z \) refer to the rotational time displacements of the atoms of the molecule, where \( t_x \) is the primary magnetic displacement or the secondary magnetic
displacement and \( t_z \) is the second magnetic displacement or the electric displacement. To justify this interpretation, let us recall that the two atoms of the molecule are in translational equilibrium; in the Reciprocal system this means that the scalar translational repulsion effect of the rotational force of the atoms is equal and opposite to the cohesive translational force of the space–time progression; the magnitude of the force is thus equal to the translational equivalent force of the rotational force of the atoms and so the required dissociation energy must equal the rotational energy. Because of the discrete unit postulate, less than this amount of energy would be ineffective.

As it stands, equation (4) expresses the energy in natural units of the time region. We have to convert the equation to an equivalent expression for the time–space region so that we can compare calculated to observed results. First of all we must apply the fourth power of the interregional ratio, \( 1/156.44 \), to the equation, just as is done in the atomic force equation.

\[
E = (1/156.44)^4 \times t_a \times t_z
\]  
(5)

This is the energy in natural units as would be observed in the time–space region. To convert this to conventional units of measurement we multiply by the value of the natural unit of energy expressed in conventional units, \( E_u \).

\[
E = (1/156.44)^4 \times t_a \times t_z \times E_u
\]  
(6)

The experimental values are expressed as kcal/mole so we must multiply the right side of the equation (6) by a conversion factor, \( k \), and by Avogadro’s number, \( N \).

\[
E = (1/156.44)^4 \times t_a \times t_z \times E_u \times k \times N
\]  
(7)

Next we must append a factor of \( 1/2 \) to the expression to account for the inherent vibrational nature of the time region motions and a factor of \( 1/3 \) to the expression to reduce the energy to one dimension. So now we have

\[
E = (1/156.44)^4 \times t_z \times E_u \times k \times N \times (1/6)
\]  
(8)

From Ref. 1, \( E_u \) is \( 1.49175 \times 10^{-3} \) ergs and \( N \) is \( 6.02486 \times 10^{23} \). \( k \) is \( 2.389 \times 10^{-11} \) kcal/erg. The final working equation is

\[
E = 5.9747 \times t_a \times t_z \text{ kcal/mole}
\]  
(9)

Displacement \( t_a \) can range from 1 to 4 and displacement \( t_z \) can range from 1 to 8. Table I lists the possible values of \( E \) for the various combinations of \( t_a \) and \( t_z \).

I have applied equation (9) to 18 diatomic molecules of the elements. The theoretical and experimental results are given in table II. Let \( t_1 \) symbolize the primary magnetic displacement of an element, \( t_2 \) the secondary magnetic displacement, and \( t_3 \) the electric displacement. It is clear from the table that

\[
t_a = t_1, \text{ or } t_a = t_1 + 1, \text{ or } t_a = t_1 - 1, \text{ or } t_a = t_2, \text{ or } t_a = t_2 + 1, \text{ or } t_a = t_2 - 1
\]  
(10)

And

\[
t_z = t_2, \text{ or } t_z = t_2 + 1, \text{ or } t_z = t_2 - 1, \text{ or } t_z = t_3
\]  
(11)

For electronegative elements, the \( 8-t_3 \) rule applies.
\[ t_z = 8 - t_3, \text{ or } t_z = 8 - t_3 + 1 \] (12)

Generally, only one (if any) of the two displacements has to be incremented or decremented by 1 to obtain a good fit with the experimental data; the other displacement equals the rotational displacement (or 8 minus the rotational space displacement) as the theory requires. Elements that require an increment of displacement usually have low atomic number; elements that require a decrement of displacement usually have high atomic number.

The values of \( t_a \) and \( t_z \) thus fit the normal variations in the elements that have appeared in other Reciprocal System calculations. This, together with allowance for experimental error, allows us to conclude that we have good agreement between theory and reality.

A future paper will apply equation (9) to diatomic molecules of unlike atoms.

References


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Table II: CALCULATED AND OBSERVED VALUES OF DISSOCIATION ENERGY

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<tr>
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<td>2</td>
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<td>35.85</td>
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<td>Au–Au</td>
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<td>35.55</td>
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<td>2</td>
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<td>5</td>
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<td>7</td>
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<tr>
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<td>2</td>
<td>4</td>
<td>47.80</td>
<td>46</td>
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Note: the observed values, E<sub>obs.</sub>, come from Reference 2.
On the Recent Evolution of Sirius

Jan Sammer

The evolution of Sirius from a red to a blue-white star since the sixth century A.D.(1) is a unique example of observed stellar transformation (other than the cataclysmic events of the nova or supernova type); in present-day astrophysical theory, the direction of stellar evolution is deduced from the theoretical stellar energy generation process. The observed change in the color (and hence the temperature) of Sirius presents an opportunity to put this theory to a test.

Sirius presently consists of a typical main sequence giant white (Population I) star of the A1V spectral type, and a white dwarf companion. Up until the sixth century A.D., or later, it would have been a bright red object—presumably a giant red (Population II) K or M star. According to the sequence of stellar evolution envisioned in currently accepted theory, young giant stars that begin their life in the blue-white O region on the upper left of the main sequence eventually swell up to become red giants, possibly collapsing later into white dwarfs. According to this scheme the main component of the Sirius system, Sirius A, could not have evolved from a red giant to a white giant, a change requiring a marked increase in energy output. It is therefore claimed that "the white dwarf Sirius B is the better candidate for such a change, since white dwarfs are thought to be the result of a collapsed red giant."(1) But this explanation runs into the difficulty that "the rapidity and smoothness of this transformation are quite unexpected, and its timescale is surprisingly short. Furthermore, no traces of catastrophic effects connected with such an event have been found."(1)

It should be noted, however, that "the details of the process by which the red giants evolve into white dwarfs are poorly understood."(2) It can hardly be claimed that accepted astrophysical theory has a satisfactory solution to the problem of the recent evolution of Sirius.

The following explanation of the change in the color of Sirius follows the stellar evolution sequence outlined in Dewey B. Larson's The Universe of Motion.(3) The theory of the universe of motion in fact predicts the evolution of red giant stars into white giants. The fact that Sirius is a binary system, identifies it as a second generation star which has undergone a Type I supernova explosion; the Sirius A component is now a star of the 2C type in Larson's terminology. The products of a Type I supernova explosion eventually consolidate into a red giant with a white dwarf companion (in this case Sirius B).(4) This was the condition of Sirius as recently as the sixth century A.D. As the red giant contracts due to gravitational forces and accretes interstellar dust and gas, its temperature rises, so that it gradually moves leftward on the C-M diagram, reaching the main sequence in the A spectral region (white). Region A on the main sequence is precisely where Sirius is presently located. The time-scale of the evolution is mainly dependent on the amount of interstellar gas and dust available for accretion. Meanwhile the white dwarf companion, at the lower left of the diagram, moves toward the main sequence from the opposite direction.

Thus the recent evolution of Sirius from a red giant to a white giant is in full agreement with the predictions of the theory of the universe of motion, and in conflict with the currently accepted scheme.

References

4. Since the authors of the report in Nature on the evolution of Sirius have introduced the Dogon myths into the discussion, I may point out that the Dogon traditions talk about two small companions of Sirius, whereas the theory of the universe of motion predicts a single one. The test of these two conflicting predictions should not be long in coming.
Ionization Potentials of Heavy Elements

To the Editor:

The Universe of Motion contains the statement that "atoms are fully ionized before the temperature limit is reached" (p. 41). Recently I did some calculations on the ionization potentials of heavy elements. A partial table follows:

<table>
<thead>
<tr>
<th>Element</th>
<th>Atomic No.</th>
<th>IP_2(eV)</th>
<th>Kinetic Temp. (°K)</th>
<th>Wavelength (Å)</th>
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<tr>
<td>Calcium</td>
<td>20</td>
<td>5440</td>
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<td>Iron</td>
<td>26</td>
<td>9192</td>
<td>71 x 10^6</td>
<td>1.7</td>
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<td>Lead</td>
<td>82</td>
<td>91,446</td>
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<td>Uranium</td>
<td>92</td>
<td>115,110</td>
<td>890 x 10^6</td>
<td>0.11</td>
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<tr>
<td>&quot;Endium&quot;</td>
<td>117</td>
<td>186,170</td>
<td>1439 x 10^6</td>
<td>0.067</td>
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</table>

IP_2 is the ultimate (full) ionization potential for the particular element. For calcium it is 5470 eV, according to the tables in the CRC Handbook of Physical and Chemistry. The table does not go beyond calcium, so I derived the formula for the whole periodic table from the first 20 elements: 

IP_2 = 13.6Z^2, where Z is the atomic number. Hence, calcium IP_2 = 5440 instead of 5470.

The kinetic temperatures were calculated from Boltzmann's relation: T = 2E/3k where k = 1.38 x 10^-23 J/K and 1eV = 1.6 x 10^-19 J so K = 8.625 x 10^-3 eV/K which reduces to T = 7729E where E is the average kinetic energy in electron volts and T is in degrees Kelvin.

The wavelength was calculated as \( \Lambda = h/c/E \) where \( h = 4.14 \times 10^{-15} \text{ eV-sec} \), \( c = 3 \times 10^{18} \) Å/sec, and E is in electron volts. This reduces to \( \Lambda = 12420/E \).

The table implies that if an atom has to be fully ionized and be in an environment of comparable energy (at least) before it can reach its thermal limit, then the coldest stars must have fantastically hot cores that are saturated with gamma radiation. For example, red giants, which probably power themselves with elements somewhere between 82 and 117, must have core temperatures in excess of 700 million K. It is hard to believe that a red giant has core temperatures anywhere near this range. (Our sun, with a surface temperature of 5800 K is believed to have a core temperature of about 15 million K.)

Moreover, one conventional atomic mass unit is equivalent to about 931 MeV. If an atom near its thermal limit is to be in equilibrium with its environment, then this again suggests enormous energies and temperatures for the conversion of one Moseley unit to energy (equivalent to 1.9 GeV).

All these figures suggest it would be very difficult to imitate the stellar power generation process in a laboratory apparatus. Yet it is taking place in the red giants. It is not a fusion process, so it could reasonably take place at the very low densities found in red giants. Red giants also have low energy kinetic and radiative internal environments which should not be hard to imitate artificially. Further, the reversion of a unit of three-dimensional rotational motion (mass) into translational motion (or its reciprocal, energy), is of itself, a clean process. This, however, may upset the ratio of vibrational to rotational mass and start a radioactive decay series. Still, I would expect it to be cleaner than a fission process.

In summary, actual stellar temperatures seem to be much too low for a star to power itself by the thermal limit process with its requirement of full ionization. On the other hand, Larson's explanation of stellar power generation accounts for many astronomical phenomena that are directly related to the power process. The process also has tantalizing implications for the generation of atomic power. To resolve these problems a table of the destructive thermal limits for all elements
would be very helpful. This should not be an inherently difficult task because thermal limits involve very fundamental entities. This implies simple relationships and simple mathematics.

A number of physical processes can be identified where the destructive thermal limit process might actually be occurring, and where it is possible to estimate the energies and temperatures involved. Two examples follow:

1. The May 1986 issue of *Science Digest* on page 9 has an impressive picture of spike-like ejecta (emissions) seen at the edge of the sun. It is very tempting to conclude that the ejecta are caused by incoming heavy elements that, due to their kinetic energy and contact with the hot solar material, quickly reach their thermal limit and explode, thereby blasting material out as far as 12,000 miles every few minutes. But is this really what happens? Could this instead be an unrelated phenomenon? Would the gamma rays released at the thermal limit result in this particular kind of an explosion? If the thermal limit process does seem to be taking place here, then the temperatures and energies could be estimated.

2. The explosion of atomic weapons produces very high temperatures. Does some of the uranium involved in these explosions reach its thermal limit?

Discussions with astronomers and solar, plasma, and high energy physicists would no doubt turn up more information and help resolve these problems. Enlisting the help of these professionals on such an interesting topic seems like an especially effective way to introduce them to the Reciprocal System.

Brian Fraser
EXISTENTS and INTERACTIONS

An Intensive Course

on the

Reciprocal System of Theoretical Physical Science

by

Ronald W. Satz

Place: Columbia University, New York City  Fee: $60.00  Syllabus: available on request

Monday, August 11

<table>
<thead>
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<tr>
<td>9:00</td>
<td>Course Overview</td>
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<td>9:15</td>
<td>Critique of Conventional Theories</td>
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<tr>
<td>11:00</td>
<td>Discussion</td>
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<td>2:00</td>
<td>The Space–Time Reference System</td>
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<tr>
<td>3:00</td>
<td>Existents: Photons</td>
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<td>11:00</td>
<td>Discussion</td>
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<td>2:00</td>
<td>Existents: Atoms</td>
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<td>Discussion</td>
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Wednesday, August 13

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<td>Interactions: Subatoms and Subatoms</td>
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<td>11:00</td>
<td>Discussion</td>
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Thursday, August 14

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<td>Interactions: Large Collections of Atoms</td>
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<td>11:00</td>
<td>Discussion</td>
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<tr>
<td>2:00</td>
<td>Interactions: Material and Cosmic Sectors</td>
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<tr>
<td>4:00</td>
<td>Discussion and Conclusion</td>
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Suggested reading: R. W. Satz’s *The Unmysterious Universe* (included in course fee); D. B. Larson’s *Nothing But Motion* and *The Universe of Motion*; papers from past issues of *Reciprocity*.
The XIth Annual Convention
of the
International Society of Unified Science

Our eleventh annual convention will be held on the campus of Columbia University, in New York City, on August 15–16th, 1986. The exact location will be announced. For up-to-date information, please contact Mr. Jan Sammer, 560 Riverside Drive, Apt. 3–Q, New York, NY 10027 tel. (212) 316–9072.

Accommodations will be available at the East Campus Hotel. The rates are $47.00/night for single occupancy; $59.00/night for double occupancy; $12.00/night for each additional person (rooms have two double beds). Reservations should be made at least one month in advance at the Conference Housing Office, 116 Wallach Hall, Columbia University, New York, NY 10027, tel. (212) 280–4962. A guarantee of one night’s payment is required two weeks in advance to confirm a reservation. Guarantees may be made by Mastercard or Visa, certified check or money order payable to Columbia University. Payment in full is due upon check-in.

Transportation: Buses from J.F. Kennedy, Laguardia, and Newark airports to mid-Manhattan run every 15–20 minutes (cost: $4.00–$6.00). From there it is recommended that members take a taxicab up to the Columbia University campus. The intrepid may take the #1 subway train to 116th Street and Broadway.

The Friday night banquet will be held in John Jay Dining Hall on the Columbia University Campus. The Saturday evening reception will be held at the home of Jan Sammer at 560 Riverside Drive, Apt. 3–Q.

Corrigenda

The following is a list of errors that occurred in K.V.K. Nehru’s article “The Nature of Scalar Rotation,” which appeared in Reciprocity XIV. 2–3 (Winter 1985/86):

<table>
<thead>
<tr>
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<tr>
<td>p. 7 line 1:</td>
<td>(+1)<em>(-1)=(-1)</em>(-1)</td>
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<tr>
<td>line 2:</td>
<td>(+1)<em>(-1)=(-1)</em>(-1)</td>
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<tr>
<td>p. 7  eq. 7:</td>
<td>(+1,+1,-1)=(-1,-1,-1)=(-1,-1,-1)</td>
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<td>p. 15, eq. 6:</td>
<td>+2,-6,-2,8 and -6,+8</td>
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<td>(+1,+1,-1)=((-1,-1),-1)=(-1,-1,-1)</td>
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In Appendix: from 9th line onwards it should read:

b magnetic double-units = 2b magnetic single units
                         = 2b * 2b or 4b^2 one-dimensional (natural) single units
                         = 4b^2/2 or 2b^2 one-dimensional double units,
That is, 2b^2 electric units
Just How Much Do We Really Know? by Dewey B. Larson

Electric Ionization by K.V.K. Nehru

Correspondence R.W. Satz and K.V.K. Nehru

Announcement

Available Literature
Just How Much Do We Really Know?

Dewey B. Larson

But it seems to me that our present theories, even the successful ones, are not yet constructed so completely in accord with sound principles, but that in this day and generation criticism is a most necessary and useful enterprise for the physicist.

—P. W. Bridgman

Physical science stands today in a highly anomalous position. On the one hand, no branch of knowledge has ever occupied a higher place in general public esteem. The spectacular way in which the abstract ideas of the theoretical scientist and the discoveries of his colleagues in the laboratories have been applied to the fashioning of ingenious devices that have drastically changed the whole world picture has made a profound impression on the man in the street, and the word "scientific" has acquired an unparalleled prestige. To some degree, at least, these sentiments are shared by the rank and file of the professional scientists, and the confident words "We know..." continually echo and reecho through the halls of learning.

But this unbounded confidence is completely lacking among the "insiders" of the profession, the relatively small group of theorists who bear the burden of keeping scientific theory equal to the growing demands upon it; demands which continually become more urgent as the pace of discovery quickens in the laboratories and in the observatories. These men make no secret of their dissatisfaction with present-day theory and their grave concern over the future of physical science. P.A.M. Dirac, for instance, tells us flatly that "after many years of intensive research" the efforts of "the world's physicists to find a satisfactory theory" have been a "failure."\(^2\) Coming as it does from one who has had a prominent part in the development of those modern theories which he characterizes as failures, this statement stands in marked contrast to the complacent attitude of the scientific profession in general with regard to the adequacy of the underpinnings of their theoretical structure.

Nor is Dirac alone in his opinion. Practically all of the most prominent leaders in theoretical science have expressed somewhat the same thought, explicitly or tacitly, at one time or another during recent years. Erwin Schrödinger, another of the developers of current theory, fervently hoped for some "upheaval of old beliefs which in the end will lead to something better than the mess of formulas which now surrounds our subject."\(^3\) P. W. Bridgman aimed many a sharp barb at the most cherished doctrines of modern science. "Is this honestly...a very impressive performance?" he asks, referring to wave mechanics, "Is it not exactly the sort of compromise that we should have predicted in advance would be the only possible one if it should prove that we were incapable of inventing any vitally new way of thinking about small-scale things?"\(^4\) And he sums up his impressions of the General Theory of Relativity in these words: "...It seems to me that the arguments that have led up to the theory and the whole state of mind of most physicists with regard to it may some day become one of the puzzles of history."\(^5\) Even Werner Heisenberg, whose attitude toward present-day theory is particularly sympathetic because of his close personal identification with some of the outstanding features of the system of thought currently in vogue, reveals his true appraisal of the existing situation when he admits, "It is obvious that at the present state of our knowledge it would be hopeless to try to find the correct theory of elementary particles."\(^6\) Such comments and admissions by some of the principal architects of currently
accepted theory are particularly significant, but there is no lack of confirmation from other sources. Some theorists are beginning to doubt whether an adequate theory can ever be constructed. C.N. Yang of Princeton, for example, was quoted in a recent news release as "expressing some doubts about the ability of the human brain in general, and his in particular, to accomplish this task."(7)

Truly, as Philip M. Morse characterized the existing situation, "It is an unhappy time for theory."(8)

The question "Why?" naturally suggests itself. Why do the acknowledged leaders in the field take such a pessimistic view of the theoretical structure that is regarded so highly by the rank and file of the scientific profession: a structure that enjoys an acceptance so complete that even the most extravagant claims in its behalf are received without demur? The answer to this question is not at all difficult to find; on the contrary, it is almost immediately evident that these leading theorists are appraising currently popular theory much less favorably because they are applying more rigid standards in judging the validity of current claims to knowledge. The scientist who attempts to clarify or improve the structure of theory cannot afford to follow the general practice of accepting today's best guess as the equivalent of fact; he has to do his best to make certain of the solidity of his foundation before he attempts to build anything upon it. All too often that foundation crumbles in spite of all of the care that is taken to check it thoroughly; anything less than this maximum care would simply invite disaster.

To those who look upon present-day scientific "knowledge" from this critical viewpoint it is obvious that much of it is not knowledge at all. Such a statement may seem incredible on first consideration, since it is generally understood that physical science is an "exact" science and that it draws a clear line of demarcation between factual and non-factual material. In theory this is true. Speculation and hypothesis play an important part in scientific research, but the products of such activity are not supposed to be considered in any way authoritative unless and until they are verified by experiment or observation. The most distinctive feature of science is its acceptance of the established facts as the ultimate authority. As it happens, however, scientists are not only scientists, they are human beings, and in this latter capacity they are subject to the ordinary weaknesses of the human race, including a strong bias in favor of familiar and commonly accepted ideas, a totally unscientific reliance on presumably authoritative pronouncements, and a distinct reluctance to admit ignorance. All of these add up to a marked tendency to regard general acceptance as equivalent to proof, a tendency that has the effect of diluting the firmly established factual material of science with a large admixture of matter of an unproved and uncertain character.

It is generally conceded that physical science is faced with a difficult and formidable task in readjusting its basic concepts to enable overcoming the obstacles that now stand in the way of further progress. Here are some of the recent comments on the subject: from J.R. Oppenheimer, "It is clear that we are in for one of the very difficult, probably very heroic, and at least thoroughly unpredictable revolutions in physical understanding and physical theory"(9); from Freeman J. Dyson, "For the last ten years it has been clear to most physicists that a basic conceptual innovation will be needed in order to come to grips with the properties of elementary particles"(10); from David Bohm, "Moreover, physics is now faced with a crisis in which it is generally admitted that further changes will have to take place, which will probably be as revolutionary compared to relativity and the quantum theory as these theories are compared to classical physics"(11); from Louis de Broglie, "...quantum physics has found itself for several years tackling problems which it has not been able to solve and seems to have arrived at a dead end"(12); from Norwood R. Hanson, "The whole [quantum] theory may topple; in places the foundations seem far from secure"(13); from Ernest Hutten, "Most physicists feel that the time is ripe, again, for a radical change in our ideas, and for a new theory."(14)

But what happens if the hopes of Schrödinger, Hutten, et al., materialize and the revolutionary new theory which they anticipate so eagerly actually does appear? As matters now stand, such a theory will be summarily rejected, as it will inevitably conflict with many of the ideas and concepts that we are not permitted to question because they are part of the basic dogma of present-day science, even though they may owe that standing merely to general acceptance rather than to any factual support. The fate of these new ideas is all the more certain because the task of appraising
them is normally left to a small group of individuals who, although they may be willing to concede the necessity for "radical changes" in principle, are strongly opposed to any change in the general lines of thought to which they are now committed. The average scientist does not normally feel that he can take the time to examine basic scientific concepts thoroughly. As Bridgman points out, many of the old ideas to which he subscribes "have not been thought through carefully but are held in the comfortable belief that some one must have examined them at some time."\(^{15}\)

The objective of this memorandum is to bring out that under present conditions the scientific profession cannot afford to rely on this indefinite "some one" to put its theoretical house in order; the situation is too acute for that. These pages will emphasize the astounding degree to which general acceptance has been substituted for proof in current scientific practice, and the almost incredible number of non-factual items which are masquerading as established facts. Obviously the new and better theory which is so greatly desired cannot be erected on any such dubious foundation, but if the debris is to be cleared away it will be necessary for the individual scientist to take a hand in the matter and arrive at his own conclusions, rather than to assume that "some one" will do it for him. It is not difficult for anyone to see how much of the scientific "knowledge" of the present day is merely pseudo-knowledge, once an effort is made to look the situation squarely in the face. Let us begin by pointing out that

**Extrapolations from established facts do not constitute knowledge.**

A substantial part of what now passes for knowledge in scientific circles actually consists of extrapolations from observed facts rather than true factual material. As Bridgman once observed, many of these are "perfectly hair-raising extrapolations." A good example is the almost universal belief that we now "know" the nature of the processes which furnish the energy supply for the stars. Even in a day when "hair-raising" extrapolations are somewhat commonplace, this one sets some kind of a record. In view of the gigantic extrapolation that is required to pass from the relatively insignificant temperatures and pressures obtainable on earth to the immensely greater magnitudes which we believe (also though extrapolation) exist in the stellar interiors, even the thought that the answers might be correct calls for the exercise of no small degree of faith in the validity of our processes; any contention that the extrapolated results constitute actual knowledge is simply ridiculous.

To make matters worse, this is not merely an extrapolation. It also involves the assumption that the isotope of hydrogen which is stable under terrestrial conditions will become unstable under stellar conditions: an assumption that has no factual support. It is popularly believed that the hypothetical hydrogen-to-helium conversion process attributed to the stars is simply another "atomic bomb" type of reaction; we often hear the statement that in using atomic power we are drawing on energy from the same source utilized by the stars. The truth is, however, that all of our known atomic energy-producing processes depend on the existence of unstable isotopes that will ultimately disintegrate of their own accord with the production of just as much energy if we let them follow their own course. All that we actually accomplish is to increase the rate of disintegration. The hypothetical conversion of the H\(^1\) isotope to helium is not another process of this same kind; it is a process that does not take place spontaneously on earth or anywhere else that we know of.

Many atomic reactions which do not occur naturally, including this hydrogen-to-helium reaction, can be forced to take place under appropriate conditions. Small-scale experiments in the laboratories have indicated that some of these reactions are exothermic (or perhaps we should say exoergic, to be more general). From this the conclusion has been drawn that if the temperature is raised high enough, the kinetic energy of the atoms themselves will be sufficient to "ignite" a fusion reaction that will be self-sustaining. This sounds very plausible, to be sure, especially since we are accustomed to thinking of atomic reactions in terms of an analogy with combustion, but if we examine the conclusion carefully it is apparent that it involves the assumption that an exothermic process is a naturally occurring process, and we know that this is not always true. If it were, we would not need atomic power—we could meet our power requirements by desalting sea water.
The currently popular theory of stellar energy generation is therefore not only a "hair-raising" extrapolation; it is also based on a very questionable assumption.

So far as the objective of this present memorandum is concerned, it is sufficient to show that the accepted ideas as to the nature of the stellar energy process are not necessarily true and that treating them as established facts is totally unjustified. It may be mentioned in passing, however, that there are actually several items of evidence which indicate that these ideas are not only open to question but are completely erroneous. For instance, it is a general rule in the laboratory experiments involving high energy impacts that the degree of fragmentation becomes greater as the incident energy increases. If this rule holds good at stellar temperatures and pressures, and we have no reason to think otherwise, it favors the existence of hydrogen atoms rather than helium atoms. Even the combustion analogy suggests this same conclusion. Extremely high temperatures do not favor exothermic chemical combinations; on the contrary, they dissociate the combinations that already exist. Furthermore, the hypothesis of a self-sustaining hydrogen reaction ignited by high temperature in a body consisting primarily of hydrogen introduces a problem of control for which there seems to be no answer. The steady and relatively slow generation of energy which we actually observe in most stars requires some kind of a definite limitation on the energy supply or on the process itself which is wholly incompatible with current concepts. Other lines of reasoning based on such evidence as the ratio of hydrogen to helium in the cosmic rays and many observed facts from the astronomical field lead to similar conclusions.

Conclusions based on extrapolations are not knowledge.

If a physical theory that has been generally accepted on the strength of faulty or inadequate evidence is actually valid in spite of these deficiencies, as we can expect will frequently be true, no harm has been done. On the other hand, if such a theory is not valid, the bad effects are not necessarily confined to the area directly affected; they may be multiplied manifold by the use of the original erroneous conclusion as a base for the erection of additional theories. A mistaken idea as to the source of the energy of the stars is not too serious in itself but, as it happens, the whole structure of stellar evolutionary theory has been based on this assumption as to the nature of the stellar energy generation process, and the net result has been a serious distortion of the entire astronomical picture.

The astronomer does his work under rather severe handicaps. He cannot experiment; all that he can do is to observe. Furthermore, the range of conditions within his field of observation is so much greater than the range existing on earth that much of what he observes can be related to familiar phenomena only by long extrapolations, and these, as has been brought out, are always subject to serious question as to their validity. Then also, the astronomer is, for the most part, limited to what is essentially an instantaneous picture, even though it encompasses a wide expanse of time as well as space. He sees astronomical objects in what are apparently various stages of evolution, but he cannot determine the direction of evolution from direct observation; he must draw his conclusions on this point from collateral evidence of some kind. In addition to these inherent and unavoidable handicaps of his profession the astronomer has voluntarily accepted another: a blind and unquestioning faith in the conclusions of the physicists with respect to the stellar energy process.

Some quite definite evolutionary direction signs are available in the astronomical field itself, but rather than take issue with the physicists, the astronomers have chosen to ignore these signs and to base their ideas as to direction solely on the hypothetical energy generation process. If this process is actually operative then it necessarily follows that the hot, massive stars, which are radiating enormous amounts of energy, must be comparatively young, as their supply of hydrogen could not maintain this tremendous energy output for more than a relatively short time. But this raises some very difficult questions. As Bart J. Bok states, "It is no small matter to accept as proven the conclusion that some of our most conspicuous supergiants, like Rigel, were formed so very recently on the cosmic scale of time measurement," and Cecilia Payne-Gaposchkin tells us that
the results of age calculations based on this hydrogen conversion process are "staggering."(17) However, the astronomers have, almost without exception, shrugged off the contradictory evidence from their own observations and have accepted this product of a "hair-raising" extrapolation by the physicists as an incontestable fact. Explanations of stellar evolution almost invariably begin with some such statement as this which introduces Payne-Gaposchkin's discussion of the subject: "The problem of the ages of stars is closely interwoven with the problem of stellar nutrition... A star can shine only so long as hydrogen is available"(18); or this from Struve: "...Our new insight into the age of the stars stems from our new knowledge of how these bodies produce their energy."(19)

Here is eloquent testimony to the serious consequences of the lack of adequate discrimination between factual and non-factual material in present-day scientific practice. The atomic physicists themselves are not deceived. They know that the concept of a self-sustaining process of conversion of the stable hydrogen isotope to helium is only a hypothesis, not a fact, and if we read the fine print, we will find them admitting that this is the case. For example, R.E. Marshak in an article entitled "The Energy of the Stars" makes this statement: "So we can safely assume that the stars produce energy by the combinations of light elements through the collisions of their swiftly-moving nuclei,"(20) and Louis Ridenour sums up Marshak's entire article in these words: "...As Robert E. Marshak explained in the previous article, there is excellent reason to believe that the energy source of most stars... is a rather complicated chain of nuclear transformations whose end result is to form one atom of helium out of four atoms of hydrogen."(21)

But unfortunately this concept of the energy generation process is not usually presented in its true light as something "we can safely assume" or something "there is excellent reason to believe." Because of the overwhelming confidence of the physicists in the validity of their hypothesis, a confidence based more on the prestige of the profession than on the merits of the hypothesis itself, there is a general tendency to talk in terms of positive knowledge, and by the time this hypothesis reaches the astronomers it becomes an article of faith against which factual evidence is powerless. E.J. Opik tells us: "This knowledge [of the conversion of hydrogen to helium] is so well founded that it furnishes a reliable basis for the calculation of time rates of stellar evolution."(22) The high estate to which the "assumption" and "belief" of the physicist has now risen is all the more remarkable since Opik admits on the very next page that this "reliable basis" is clearly unreliable. "The energy source of the giants remains a puzzle," he says, and hence "a more powerful source of energy must be assumed." A little later he further concedes that "some uneasiness may be felt" about the application of the theory to the white dwarfs. Otto Struve's confidence in the energy generation process, as reflected in the statement previously quoted, is equally remarkable in that it is apparently undisturbed by the fact that this "new insight" of which he speaks forces him to characterize factual knowledge from his own field as "apparent defiance of the modern theory of stellar evolution."(23)

The damaging effect of these unjustified claims to positive knowledge in basic physics is by no means confined to relatively distant fields such as astronomy. Even physics itself is highly compartmental in present-day practice, and the individual physicists are reluctant to cross boundary lines. Leprince-Ringuet describes the situation in these words: "A physicist bears the stamp imposed by the rigid and precise demands of his discipline. At meetings he rarely comments on anything that lies outside of his own well-defined specialty."(24) If the findings of each minuscule division of science are to be accepted without question by the rest of the scientific profession, this merely underlines the necessity of more accurate definition of the true nature of the conclusions that are reached, and some measures that will discourage the tendency to say "We know..." when the expression should be "We think..." Perhaps we have reached the point where we need some interdisciplinary agency to restrain the enthusiasm with which the various specialists overstate the case for the currently popular theories in their respective fields.

Extrapolations of negative results are not knowledge.

In addition to the type of extrapolation which has been discussed, there are also what we may
call extrapolations of the negative. Here we find through observation that certain things do not happen in regions directly accessible (the earth, primarily). We then generalize this observation by extrapolating it to the regions that are not accessible, and we say that such things never happen. There is nothing inherently wrong about such an extrapolation, or any other type of extrapolation; on the contrary, reasoning from the known to the unknown is sound practice. But it must not be forgotten that an extrapolation of an observed fact is something totally different from the fact itself, and conclusions reached by extrapolation cannot be more than tentative until they are confirmed in some way.

A good example of this type of extrapolation is provided by the question of isotopic stability. Under terrestrial conditions the isotope Fe$^{56}$ is stable. In the absence of any evidence to the contrary, we assume that stability is an inherent property and that Fe$^{56}$ is always stable. Similarly we assume that the neutron is always (with one curious exception) unstable because it is unstable in the region where we can observe it. These are natural and logical assumptions under the circumstances, but they are only assumptions, not established facts. Consequently they cannot be used to refute any theory which contends that isotopic stability is determined by the environment and that under appropriate conditions the neutron may be stable and Fe$^{56}$ unstable. If such a theory is to be attacked, it must be challenged on other grounds. The mere fact that it conflicts with an extrapolation of terrestrial experience is irrelevant, since that extrapolation has no factual standing, regardless of the unanimity with which it is currently accepted.

Conclusions based on extrapolation of the negative are not knowledge.

Here again we find the extrapolations serving as the basis for additional conclusions and again it should be emphasized that such conclusions are not facts and they cannot be used in lieu of positive knowledge. Much of the current thinking about the cosmic rays, for instance, follows along lines dictated by the belief that those particles which are short-lived in the terrestrial environment are likewise short-lived in interstellar and intergalactic space. The available factual information neither confirms nor denies this assumption. Certainly the burden of proof rests upon anyone who suggests that isotopic stabilities in free space differ from those which we find in the terrestrial environment, but if any evidence can be produced in support of such a suggestion there is nothing in the currently available data from experiment or observation that can refute such evidence. The mere fact that practically everyone believes that the stability or lack of stability is inherent does not make this true. Scientific questions cannot be settled by public opinion polls. However numerous its supporters may be, this is still nothing more than a conclusion based on an unsupported extrapolation of the observed facts, and as such it cannot qualify as knowledge. In this connection it is interesting to note that current ideas regarding stability are not consistent. The same physicist who reacts violently to the suggestion that stability may be a function of the environment and that his conclusions as to atom-building and similar processes in the extra-terrestrial environments may therefore be wide of the mark, does not hesitate to advance exactly the same hypothesis when he finds this necessary in order to fit the theory that the normally unstable neutron is a constituent of stable atoms.

Conclusions outside the scope of the observations are not knowledge.

Somewhat analogous to the practice of extrapolation, but of a more questionable character, is the practice of exaggeration; that is, claiming more than what the observations or measurements actually substantiate. A classic example is Einstein's theory that mass is a function of velocity. Throughout scientific literature this theory is described as having been "proved" by the results of experiment and by the successful use of the predictions of the theory in the design of the particle accelerators. Yet at the same time that a host of scientific authorities are proclaiming this theory as firmly established and incontestable experimental fact, practically every elementary physics textbook admits that it is actually nothing more than an arbitrary selection from among several
possible alternative explanations of the observed facts. The experiments simply show that if a particle is subjected to an unchanged electric or magnetic force, the resulting acceleration decreases at high velocities and approaches a limit of zero at the velocity of light. The further conclusion that the decrease in acceleration is due to an increase in mass is a pure assumption that has no factual foundation whatever.

As one textbook author explains the situation: “There seems to be no reason to believe that there is any change in the charge, and we therefore conclude that the mass increases.” Another says: “This decrease is interpreted as an increase of mass with speed, charge being constant.” Obviously an interpretation of the observed facts is not a fact in itself, and it is rather strange that the theorists have been so eager to accept this particular interpretation that they have not even taken the time to examine the full range of possible alternative interpretations. As these quotations from the textbooks indicate, it has been taken for granted that either the charge or the mass must be variable, but actually it is the acceleration that has been measured, and the acceleration is a relation of force to mass, not of charge to mass. The accepted interpretations of the observed facts therefore contain the additional assumption that the effective force exerted by a charge is constant irrespective of the velocity of the object to which it is applied. The possibility that this assumption is invalid cannot logically be excluded from consideration; on the contrary, there are some distinct advantages in maintaining both charge and mass as constant magnitudes. When we get down to bedrock it is clear that the theory of an increase in mass is not something that has been proved by experiment, as is so widely claimed; it is a pure assumption that goes beyond the scope of the experiment, and is only one of several possible alternatives. Any theory which leads to the observed decrease in acceleration at high velocities is equally as consistent with the observed facts as Einstein’s theory that the mass increases.

A principle of impotence is not knowledge.

One of the disturbing features of current scientific practice is the increasing tendency to rationalize failure to solve difficult problems by setting up postulates that solutions to these problems are impossible. As Alfred Lande puts it: “In short, if you cannot clarify a problematic situation, declare it to be ‘fundamental,’ then proclaim a corresponding ‘principle.’”(25) Herbert Dingle quotes a physicist who even goes so far as to contend that we are at last “firmly grounded on the principle of uncertainty.”(26) And these are no minor matters out of the periphery of physical theory; they are matters of vital importance to the foundations of the theoretical structure. Quoting R.B. Braithwaite: “Such propositions [principles of impotence] play a very large part at the present time in the fundamental theories of physics.”(27)

It should hardly be necessary to point out that from their very nature these principles of impotence are incapable of proof and are never entitled to the status of established facts. It is very doubtful whether they should even be recognized as legitimate scientific devices, to say nothing of being given any authoritative standing. Some of them should certainly be barred. The underlying concept upon which all scientific research is based, and without which the application of time and effort to this task would be wholly unjustified, is the conviction that the physical universe is essentially reasonable and operates according to fixed principles. Thus far we have never encountered any actual evidence to the contrary; as scientific knowledge has expanded one after another of the phenomena that were inexplicable to our early ancestors has been found to follow fixed and unchanging laws. But now there is a growing use of a practice which is not only questionable by nature, in that it is an easy way of avoiding the difficult task of solving complex problems, but also leads to conclusions which are in direct opposition to the philosophical premise which is our only justification for undertaking scientific research in the first place.

Conclusions such as this from Heisenberg: “...The idea of an objective real world whose smallest parts exist objectively in the same sense as stones or trees exist, independently of whether or not we observe them...is impossible,” or this from Bridgman: “...The world is not intrinsically reasonable or understandable; it acquires these properties in ever-increasing degree as we ascend.
from the realm of the very little to the realm of everyday things,"(29) or this from Herbert Dingle: "The 'real' world is not only unknown and unknowable but inconceivable—that is to say, contradictory or absurd."(30) are completely at odds with the underlying philosophy of scientific research. If we had some definite and positive evidence that they were true, we would have to accept them, however unpalatable they may be, but accepting them purely on the strength of principles of impotence, which means that they have no factual support at all, is totally illogical.

The bald truth is that these statements are simply efforts to avoid admitting failure. The theorists have failed in their attempt to discover the exact physical and mathematical properties of the component parts of the atom, and rather than admit that their abilities are unequal to the task, as C.N. Yang suggested in the interview previously mentioned, they prefer to postulate that these properties do not exist and that even the atom itself, as Heisenberg says, "has no immediate and direct properties at all."(31) The ironic part of it is that it is now beginning to become evident that the task at which the theorists have failed is not an impossible task, as they would like to have us believe, it is a meaningless task. As will be brought out later in this memorandum, a growing mass of evidence indicates that the atomic constituents whose properties have been so difficult to define simply do not exist at all: a possibility that should have been given serious consideration long ago. When the most strenuous efforts over a long period of years by the best minds in the scientific profession fail to clarify the properties of the hypothetical constituents of the atom, and finally lead to the conclusion that these entities have no definite properties and do not even "exist objectively," mere common sense certainly calls for a thorough examination of the obvious possibility that they do not exist at all. But this natural and logical explanation of the difficulties that have been experienced has been completely ignored while the theorists have gone on an uncontrolled excursion into a weird land of fantasy completely divorced from physical reality.

In this instance the great prestige of physical science, and physics in particular, has operated to its detriment by permitting it to transcend the limits of logic and common sense unchecked by those restraints which are applied to all less glorified branches of knowledge. As James R. Newman very aptly remarks: "In this century the professional philosophers have let the physicists get away with murder. It is a safe bet that no other group of scientists could have passed off and gained acceptance for such an extraordinary principle as complementarity, nor succeeded in elevating indeterminacy to a universal law."(32)

Since a principle of impotence is inherently incapable of proof, it is obvious that claims of proof of such propositions are fallacious. Ordinarily the fallacy is not difficult to locate. For example, the First Postulate of Relativity, the denial of the existence of absolute motion, is a principle of impotence. It is commonly presented in the guise of positive knowledge, not because it is contended that this postulate itself has been proved, but because the Relativity Theory is claimed to have been proved, and this is a part of that theory. The fallacy lies in the fact that the Relativity Theory has not been, and cannot be, proved as a whole, since it includes four independent postulates. Two of these, the constant velocity of light and the equivalence of gravitational and inertial mass, are supported by sufficient factual evidence to justify the contention that they have been proved. Actually these are not theories at all; they are experimental facts which most physicists were willing to concede even before they were incorporated into the Relativity Theory. But there is no logical justification for extending the evidence in favor of these two postulates to the First Postulate, which has no necessary connection with the other two, beyond the fact that it was wrapped up in the same package by the originator of that theory.

The First Postulate is simply one of the possible ways of getting around the contradiction introduced by the experimental discovery of the constant velocity of light, and it has won general acceptance by default, because no one has seen fit to develop a case in favor of any of the various alternatives. Within the framework of accepted theories of space, time, and motion, the constant velocity of light is definitely incompatible with the concept of absolute velocity, and Einstein chose to sacrifice absolute velocity. It is equally feasible to retain absolute velocity and to modify present space–time concepts instead, particularly since there are no great demands on this postulate; the only purpose that it serves is to evade the contradiction that would otherwise exist. It is rather
surprising that this possibility has not been explored, considering the tremendous amount of time and effort that has been devoted to research in theoretical physics. There is no obvious advantage in such a substitution of postulates, since it would not change any of the essential aspects of Relativity, but the mere fact that there is no definite purpose in plain sight does not ordinarily deter basic research. Exploration of the various alternatives would at least clarify the status of the so-called “paradoxes,” as these are consequences of the First Postulate and replacement of this postulate by one of the alternatives would either eliminate the paradoxes or substitute a new set for the ones now existing.

Theories that conflict with known facts are not knowledge.

The truth of this statement is self-evident and it may seem superfluous to mention it, yet some of the most important items of present-day physical “knowledge” fail to qualify as such under this rule. For example we know that positively charged particles repel each other with a force which becomes very great at short distances. On the basis of what we know, therefore, it is impossible for a number of protons to remain together in a unit such as the atomic nucleus. Likewise we know that the neutron is unstable in the local environment, and on the basis of what we know the existence of neutrons in a stable atom is impossible. This does not mean that the nuclear theory is necessarily wrong; there may be factors in the situation of which we are ignorant. But it does mean that the nuclear atom is not something that we know; it is a hypothesis, and one of a very dubious character. Yet the pressure for conformity to accepted ideas is so strong that the existence of the nucleus is not only accepted as an established fact; the positive knowledge that contradicts this hypothesis is considered proof of the existence of some unknown force: a “nuclear” force opposing the known force that would otherwise disrupt the hypothetical structure. The logical justification for this line of thought is certainly hard to detect.

It may be assumed, however, that these conclusions have been influenced to a considerable degree by the impression that the existence of an atomic nucleus was proved by the early experiments of Rutherford, who showed that fast-moving particles pass through thin sheets of solid matter without interference except in cases where they make direct hits on what is now identified as the nucleus. As a result of these and similar experiments it has been concluded that almost all of the mass of the atom is concentrated in this relatively small region. But here again we encounter the same curious failure to explore alternatives that has been noted earlier in this discussion. The experimental results are consistent with the conclusion that almost all of the mass is concentrated in a relatively small volume, to be sure, but they are equally consistent with the alternative conclusion that all of the mass is concentrated at this point; in other words, that this is the atom, not the nucleus of the atom. It seems to have been completely overlooked that while there is ample evidence of the existence of something massive at the center of the region in which the atom is located, there is nothing at all to confirm the existence of the hypothetical outer parts. The idea that the atoms are in contact in the solid state is pure guesswork; indeed the fact that the inter-atomic distance can be reduced very substantially by application of pressure, to less than half in some cases, strongly suggests that the spacing in the solid is simply the result of a force equilibrium. The conventional diagram of the NaCl crystal found in most elementary chemistry textbooks may be a fairly accurate representation of the physical facts.

The other mainstay of the present-day theory of the atom is the fact that electrons can be obtained from atoms, particularly as products of atomic disintegrations. This is the overriding point that has convinced the scientific world that electrons are constituents of atoms, and has made it easy for any additional finding which is consistent with the nuclear hypothesis to be accepted as proof of its validity. The argument may be summarized as follows:

(a) Under certain conditions atoms disintegrate.
(b) Electrons are found among the disintegration products.
(c) Therefore, electrons are constituents of atoms.
At first glance this argument may seem sound, and certainly it has been accepted without serious question, but its true status can be brought out clearly by stating the analogous argument concerning the photon:

(a) Under certain conditions atoms disintegrate.
(b) Photons are found among the disintegration products.
(c) Nevertheless, photons are not constituents of atoms.

Here we find that on the basis of exactly the same evidence, current practice arrives at diametrically opposite conclusions. Because preconceived ideas concerning the electron suggest that it could be an atomic constituent, the evidence from the disintegrations is accepted as proof that it is, whereas similar preconceived ideas concerning the photon suggest that it could not be an atomic constituent, and exactly the same evidence is therefore taken to mean that the photon was created in the process. Actually, of course, the physical evidence does not distinguish between these alternatives, nor does it preclude the possibility that some other explanation may be correct. What the evidence shows is that the electron either

(a) was a constituent of the atom, or
(b) was preexisting within, but not a part of, the atom, or
(c) was derived from the surrounding space, or
(d) was created in the disintegration process, or
(e) originated from some combination of the foregoing, or
(f) had some other origin consistent with the evidence.

The clear and positive picture of the atom set forth in the physics textbooks has long since been abandoned by the "front-line" theorists, as by this time it is evident that the concept of such a structure is untenable. What started out in the original nuclear atom conceived by Rutherford and developed theoretically by Bohr as the identifiable and physically observable entity which we know as the electron has now become a mysterious something which no one seems to be quite able to define. Heisenberg tries. "The indivisible elementary particle of modern physics," he tells us, "is not a material particle in space and time but, in a way, only a symbol on whose introduction the laws of nature assume an especially simple form."(33)

It is nothing short of ludicrous to find our elementary textbooks explaining the present-day "knowledge" of the structure of the atom in positive terms and in great detail, while at the same time Heisenberg and the Copenhagen school, who represent the "official" viewpoint of present-day theoretical physics, tell us that "the atom of modern physics can only be symbolized by a partial differential equation in an abstract multidimensional space."(34) The statements commonly found in the textbooks, such as this one: "There is so much physical and chemical evidence for the correctness of the modern atomic picture that there can be no reasonable doubt of its validity,"(35) become nothing but absurdities when the "modern atomic picture" explained in detail by the textbook authors is flatly repudiated by the leading theorists in the physical field.

The truth is that the "physical and chemical evidence" which is given so much weight by these authors is not actual evidence of the nuclear atom; it is evidence which is consistent with that hypothesis, but which is equally consistent with other hypotheses, and therefore is not a proof of any of them. Many physical and chemical phenomena, for example, are functions of the number of "valence electrons" which the atom presumably possesses, according to the nuclear theory, and these relations constitute a major part of the "evidence" to which the textbook authors refer. But if these relationships are examined critically it will be found that the electron, as such, plays no part in them. They are relations which involve only numbers, and whether these are numbers of electrons or numbers of something else is completely immaterial. We find, for instance, that Moseley's Law relates the X-ray frequencies of potassium to the number 19, and this is taken as a confirmation of
the hypothesis that the atom of potassium contains 19 electrons. But there is not the slightest evidence that electrons have anything to do with this situation. The relation is solely with the number 19 and any theory which leads to the existence of 19 units of any kind in the potassium atom is perfectly consistent with the experimental knowledge.

Much the same kind of a statement can be made about almost any experimental result that is now expressed in terms of the nuclear theory. The investigators who are busily engaged in measuring "nuclear cross-sections," for example, will probably be horrified at the suggestion that there is no such thing as a nucleus. But these investigators are measuring cross-sections, not nuclear cross-sections. The identification with the nucleus is theoretical, not experimental, and if the theory has to be changed this does not affect the experimental results—it simply changes the language in which they are expressed. We just substitute "atomic" for "nuclear" and everything else goes on just the same. The prevailing impression that the huge mass of experimental information of this kind accumulated in recent years constitutes evidence of the validity of the nuclear theory is entirely erroneous.

Summarizing the foregoing discussion, it is not necessary to assume the existence of an atomic nucleus to explain the results of Rutherford's experiments and Occam's Principle, one of the sound common-sense rules of science, tells us that we should not make unnecessary assumptions. Furthermore, the fact that electrons can be obtained from matter, as a result of disintegrations or other processes, is not a proof that the electron is a constituent of matter, nor does it even prove that the electron existed prior to the event that caused it to appear. This demolishes the two primary arguments in favor of the nuclear theory, the arguments which have been relied upon to offset the two definite and positive conflicts between this theory and known facts. At this point, therefore, it would appear that the nuclear theory is not only unproved, but is actually disproved. The question then arises, must the entire electrical theory of matter be discarded? But when we remember that the electrical theory antedated the nuclear atom by about one hundred years it is evident that this theory is not tied to the nuclear hypothesis; it simply goes back to where it was before Rutherford. However, this does not necessarily mean that it stands on solid ground, so let us take a look at the facts.

The electrical theory of matter originated from the observation that certain substances on being dissolved separate into two parts, or ions, one bearing a positive charge, the other a negative. Later, various phenomena such as the thermionic emission of electrons, the photoelectric effect, etc., which involve ejection of electrons from matter, were discovered. Since the experimentally observed electron is a negatively charged and highly mobile particle, it was concluded that the ionic charges were due to an excess or deficiency of electrons relative to the number which the atoms presumably should contain in the neutral condition. This is a plausible, and in many respects a rather attractive theory, but for present purposes these aspects are irrelevant. What we want to know is, does this theory constitute positive knowledge, as the textbooks contend? The answer to this question is definitely no; close scrutiny shows that here again we have nothing more than a very questionable hypothesis.

Looking first at the matter of ionization in solution, it is clear that this is the same kind of a situation that exists in the case of the electrons which appear among the atomic disintegration products. The theory that the electric charges existed prior to the time that the substance dissolved is only one of the possible explanations of the observed facts. It is not even the best of the readily available explanations, because if we accept it, we find it necessary to conclude that there are two different ionization mechanisms. The general chemistry textbook on the author's desk admits that ions are formed not only by the so-called "ionic" compounds but also by compounds that are definitely not ionic, and goes on to say: "If ions are not present in an electrolyte before it is dissolved, they must be formed from the molecules of the compound as it dissolves." But as long as we have to assume that some ionic charges are created in the process of ionization, it is clearly within the bounds of possibility that all ionic charges are thus created: an explanation that has a considerable advantage from the standpoint of simplicity. The existence of charged particles in solution is therefore far from being proof of the existence of electric charges in undissolved
matter. Similarly, everything that is known about the photoelectric effect, the thermionic emission of electrons, and other phenomena of this kind is entirely consistent with the hypothesis that the charged particles are created in the process. Obviously we cannot regard any theory as having been verified by experiment if the experimental results are equally consistent with some different hypothesis, and hence none of these results qualifies as a proof of the electrical theory of matter.

At the time the nuclear atom was originally conceived, the idea that electrons might be created in some physical process seemed so remote that it was probably never even given consideration, but today it is commonplace. Such creation is currently being observed in a great variety of processes, ranging all the way from the production of a single electron–positron pair by an energetic photon to the production of a shower of millions of particles by a cosmic ray primary. We now find that the electron with which we deal experimentally is something altogether different from the atomic building block envisioned by Rutherford; it is a tangible but evanescent particle that can be produced or destroyed with relative ease.

If we take a broad view of the entire picture of the electron, including both theory and experiment, it is apparent that there is a curious dichotomy in the usual concepts of this particle. The experimental electron is a definite and well-defined thing, notwithstanding its impermanence. We can produce it at will by specific processes. We can measure its mass, its charge, and its velocity. We can control its movement and we have processes by which we can record that path that it takes in response to these controls. Indeed, we even have such precise control over the electron movement that we can utilize it as a powerful means of producing magnified images of objects that are too small for optical magnification. In short, the experimental electron is a well-behaved and perfectly normal physical entity. On the other hand, the theoretical electron, which, according to currently accepted theory, is one of the constituents of the atom, is a very strange phenomenon. It presumably moves in an orbit around the atomic nucleus, but we cannot locate either the orbit or the position of the electron in the orbit; the best we can do, the experts say, is to compute a probability that it might be found at a certain location. Unlike the experimental electron, this theoretical electron does not follow ordinary physical laws, but has some unique and unprecedented behavior characteristics of its own, including a strange and totally unexplained ability to jump from one orbit to another with no apparent cause. Furthermore, as already mentioned, the leading theorists of the present day tell us that it cannot be accommodated within the three-dimensional framework of physical space; it must be regarded merely as a symbol rather than as an objectively real particle.

Under the circumstances it becomes pertinent to inquire whether there is actually any adequate justification for identifying the theoretical electron of the nuclear atom with the experimental electron. Once this question is asked, it clearly must be answered in the negative. Certainly we cannot logically contend that two entities that differ widely in practically every respect are actually identical. What has happened is that the theorists originally started out with the assumption that one of the constituents of the atom is a particle identical with the experimental electron, but as more and more information was accumulated it became clear that the properties of the experimental electron were incompatible with the requirements of the hypothetical atomic constituent. The assumed properties of the atomic electron have therefore been progressively modified to meet these requirements until they now bear no resemblance to those of the experimental electron. It is high time, therefore, that the pretense of identity should be abandoned and that the "electron" constituent of the nuclear atom should be recognized for what it actually is: a purely hypothetical concept which has no relation nor resemblance to any particle that has been observed experimentally.

Naturally the physicist is reluctant to take this step, in spite of the absurdity of claiming identity for two particles which have practically nothing in common, since the modern theory of the atom rests on the assumption that it is a composite structure built up by a combination of some of the smaller particles which have been observed experimentally. Once it becomes necessary to admit that the atomic electron is a purely hypothetical creation, unrelated to anything that has ever been observed, "an abstract thing, no longer intuitable in terms of the familiar aspects of everyday experience," as H. Margenau describes it, this basic concept of the atomic structure is
destroyed and the whole theory crumbles. After having been so confident for so long, the physicists find it very distasteful to face the realities of this situation and to admit that their concept of an atom constructed from known particles of sub-atomic size is no longer tenable. But this is exactly the kind of catharsis that we need in order to clear the way for a new physical theory adequate to meet present-day demands. After all, how can we expect a theory based on the assumption that matter is composed of permanent “indivisible elementary particles,” similar in all respects, other than size, to the atoms of Democritus, to give us the right answers in an age when it is admitted that “we do not really know how to define an elementary particle” but we do know that no particle is permanent; that all particles, large or small, material and non-material, are subject to exchange of identities in a bewildering variety of transformation reactions?

Actually we must go still a step further. Not only is it now clear that the constituent parts of the atom are not known particles such as electrons, it is also becoming apparent, as mentioned earlier in the discussion, that the atom has no constituent parts at all. Of course, the immediate reaction to this statement will be that it is preposterous, since we can readily break the atom into separate parts. But let us examine this situation a little more closely. Suppose we have a certain object moving with a high velocity, and we then detach the velocity by transferring it to something else. Must we then conclude that the original object consisted of two separate parts and that we have broken it into its two constituents? It is very doubtful whether anyone would ever support such a conclusion as this, but if we compare this situation with the break-up of the atom, it is evident that the only basis on which we can claim that we have done something different with the atom is by contending that the parts which are detached from the atom are inherently of a different character than the motion which was detached from our hypothetical object.

Can such a contention be justified? We have found that both the proton and the electron can be transformed into radiation simply by contact with their respective antiparticles. “All matter seems to be radiation,” says Morse and so far as we know, radiation is nothing more than a vibratory motion. Can we say that the proton is inherently different from motion when we can transform it into motion? Are we not forced to the conclusion that the atom could very well be an integral entity endowed with specific amounts of various kinds of motion (or something equivalent to motion) and that what we call breaking it up into parts amounts to nothing more than detaching portions of this motion (or the equivalent thereof)?

And is it not true that the trend of discovery in the sub-atomic field is driving us slowly but inexorably in this direction, toward just such a conclusion as the foregoing? Already it is evident that there must be some common denominator, not only for the particles, but for radiation as well. Particles are materialized from radiation and are “annihilated” back to radiation again, protons become neutrons and vice versa, mesons are created from kinetic energy and ultimately decay into electrons and neutrinos. The atomic reactors transform mass into energy, while at the same time the particle accelerators are busily engaged in converting energy back into mass. This interchangeability between the “elementary” particles, between the particles and radiation, and between mass and energy, has already administered the coup de grâce to the popular theory that the universe is constructed from different kinds of elementary “building blocks” even though the inertia of customary habits of thought and a strong attachment to familiar ideas are delaying general recognition of this fact. It is already evident that the raw material of atom building is more analogous to modelling clay than to building blocks.

This question of the structure of matter in general, and of the atom in particular, is a perfect example of the kind of thing with which this memorandum is concerned. Here we have a theory, the concept of the nuclear atom, which is accepted as positive knowledge on the strength of a number of supposedly incontestable items of experimental evidence. Yet when we examine each of these items carefully and critically, we find that all of them dissolve into thin air; there is no positive knowledge to be found anywhere. Even the supposed “discovery” of the atomic nucleus which originated the whole line of thought turns out to be fictitious. On critical analysis we see no reason to attribute any significance to this discovery other than that the atom itself is smaller than had been thought. Now, as a fitting climax, we see that it is quite unlikely that there is any such thing as a

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"part" of an atom. It is becoming increasingly evident that there are no "elementary particles" and that both both the atoms and the sub-atomic particles belong essentially to the same class, a class that should be called "primary" rather than "elementary," in that these are the entities which are formed directly from the basic substance of the universe: the permissible forms, we might say, into which the basic clay can be shaped. The difference between particles and atoms is one of degree only; we may appropriately look upon the particles as incomplete atoms.

"This entire theory is interesting today chiefly because it demonstrates how a false, almost ludicrous, hypothesis may explain a large body of facts, and how widely, if it is not subjected to the most rigorous experimental scrutiny, it may be accepted."[40] The foregoing comments were actually made about the phlogiston theory, but in the light of the points brought out in the preceding paragraphs it can be safely predicted that future physics textbooks will say essentially the same thing about the theory of the nuclear atom.

It is too much to expect that the raising of issues such as those covered in this memorandum will be greeted with any degree of enthusiasm. Old beliefs, like old shoes, are comfortable and they are given up only with great reluctance. But if the insistent demands for "radical changes" and "basic conceptual innovations" which emanate from our foremost theorists are to be met, many of these old beliefs must be sacrificed, no matter how distressing the parting may be. As Sir George Thomson expresses it: "There is some new item wanted to make these new pieces [mesons, etc.] fall into place in the puzzle...when the idea comes it may very probably involve a recasting of fundamental ideas and the abandonment of something that we now take completely for granted."[41]

This memorandum is not intended to specify which of the old beliefs should be abandoned, or what should replace them. Rather it is addressed to the prerequisite task of pointing out which of the old beliefs are vulnerable; that is, which of them have no sound factual basis and therefore could be erroneous. Of course, it has been necessary in some instances to go a step farther and show that some currently popular ideas, such as the nuclear atom and the conversion of hydrogen to helium in the stars, are almost certainly wrong, but the primary thesis of the discussion is that general acceptance is no guarantee of the validity of a theory; all too often this acceptance is based merely on the lack of anything better, rather than on the merits of the theory itself. The principal point which it is intended to emphasize is that the new and improved basic theory that is so fervently desired must conflict with some of these ideas that owe their present standing to general acceptance rather than to factual proof, and it may, indeed it probably will, conflict with many of them. It therefore follows that such conflicts, as long as they are confined to items of the categories herein enumerated, do not constitute valid arguments against any new theory that may be proposed, and they should not be allowed to block consideration of new theories. An open mind toward conceptual innovations is particularly important under conditions such as those that now exist: "...It must be recognized," says John A. Wheeler, "that the present situation calls for a certain daring in considering and testing new ideas."[42]
References

5. Ibid., p. 92.
12. de Broglie, Louis, Foreword to foregoing book by Bohm.
34. Ibid., p. 38.
38. Segre, Emilio, and Wiegand, C.E., Scientific American, June 1956.
40. Sisler, Vanderwerf and Davidson, op. cit., p. 7.
Electric Ionization
K.V.K. Nehru

1. Introduction

R. W. Satz discusses\(^1\) the fundamental motions of the physical universe from the point of view of the Reciprocal System of theory and derives their mathematical expressions. In a subsequent paper\(^2\) he shows how the work function, the ionization energy, and the magnetic resonance frequencies of the atoms and the subatoms can be theoretically derived from the fundamental postulates of the Reciprocal System. These two works form the starting point of the present paper.

Firstly we note some printing errors that are found in Ref. 2 cited above:

(i) In figs I and II, the direction of the arrow head on the outermost of the three circles should be reversed.

(ii) Table I, p. 22: in the column for “c/\(v_{mag}\)” for the element B, the entry should be 3 and not 4. In the first column, in the second line from bottom, it must be Ag and not As.

(iii) p. 29, 8th line from bottom: “(R/2\(\pi\))” must be there in place of “(2R/\(\pi\)).” (Note that it is mentioned in the text, in the line above it, that the cosmic neutrino rotation takes an inverse charge.) Only then does the combined energy add up to \(h * (2R/\pi) * (B/B_{nat})\) as indicated.

(iv) Table II, p. 32: In the column for “Displacement,” for the isotope \(3B^{11}\) the entry should be 2–1–3 and not 2–2–3.

The theory of the electric ionization and magnetization developed in Refs. 1 and 2 leaves certain unresolved difficulties:

1.1 The mass effect of an electric charge. Satz evaluates the energy necessary for creating a positive electric charge as 8.68 eV (eq. 7 of Ref. 2 and p. 8 of Ref. 1). Larson, calculating the individual masses of the subatoms, concludes that the electric charge produces a mass effect amounting to 0.00004494 amu.\(^3\) This is equivalent to nearly 41850 eV. How such a mass effect of 41850 eV is produced from an electric charge that came into being from an energy of 8.68 eV is not clear. Similarly, it can be seen that the energy associated with the unit isotopic charge is 2.17 eV since its rotational frequency is R/2\(\pi\) (p. 8, Ref. 1). It is once again not clear how this can compare with the mass effect of an isotopic charge, namely, 931.3 MeV. Further, I have shown\(^4\) that, following Larson’s line of argument, a unit magnetic charge gives rise to a negative mass effect equivalent to -243.19 eV, which also contrasts with the energy required to create a magnetic charge, namely, 2.17 eV as derived by Satz.

1.2 Under Table I (p. 23, Ref. 2), Satz mentions in a footnote: “…where value 3 appears in
magnetic rotation, this is the inverse of actual rotation," whereas in the work\(^5\) from which these values were taken, Larson was more careful, noting that "...where the value 3 appears as the magnetic rotation of one of the higher group elements, this is the inverse of the actual rotation, 5." However, what both these authors fail to make clear is how rotation 5 is the inverse of rotation 3, since in the magnetic dimension the two "zero points" are separated by 4 units and not 8.

1.3 The photoionization theory developed by Satz\(^2\) seems to give good results, but there are certain inadequate features. The first of these is the rather large discrepancy (16 to 19 %) between the calculated and the observed values of the ionization energy of some of the elements. See, for example, the cases of C, Zn, Cd, Hg, etc. (Table I, pp. 22–23, Ref. 2).

1.4 The appropriateness of taking the magnetic speed as 3 (see Table I, p. 23, ref. 2) when the magnetic displacement is 3, in the cases of Ni, Cu, Zn, Zr, Nb and Mo or that of taking the electric speed as 5 and 6 when the electric displacement is (4) and (3) respectively in the cases of Ge and As is not explained. This lapse occurs in the cases of Hf, Ta, W, Re, Os, Ir, Pt, Au, Hg, Tl, Pb, Bi, etc.

1.5 While Table I\(^2\) covers a good number of the elements for which the calculated values of the work function and the ionization energy are compared with the observed values, there is a considerable number of elements left out. conspicuous among the latter are all of the inert gases.

1.6 Similarly, while it was mentioned that the electron, the positron, the proton, and H\(^1\) can take an electric charge (p. 23, Ref. 2), no reason was given as to why the neutrino and the neutron do not do so.

1.7 In the case of H\(^1\) the Principle of Equivalence was invoked (p. 24, Ref. 2) to show that the ionization energy is 13.595 eV. However, no attempt was made to derive this value from the rotational speeds of H\(^1\), even though this was done in the case of the ionization energies of the free positron and proton (eq. 7, ref. 2), as well as atoms (eq. 9a, Ref. 2).

1.8 Developing the equation for the ionization energy of an atom, Satz writes: "From mechanical considerations it is obvious that the energy necessary to create a positive-negative charge pair is twice that needed to create the negative charge on the electron" (p. 24, Ref. 2). Thus he takes it as 2 * 2.1 = 4.34 eV. But it can be asked, why should not this energy be taken as twice the energy needed to create the positive charge on the atom (2 * 8.68 eV), or the sum of the energies required to create the negative and the positive charges (2.17 + 8.68 eV), instead of 4.34 eV?

2. Equation for the Ionization Energy

We will now attempt a refinement of the electrical ionization theory developed by Satz\(^2\) with a view to meet the difficulties mentioned in section 1 above.
We find that the best way to get an insight into the situation is to consider the ionization energies, E_t, of the atoms of the alkali metals, all of which have only one unit of rotational displacement in the electric dimension. From Ref. 6 we have the following data:

<table>
<thead>
<tr>
<th>Element</th>
<th>Displacement</th>
<th>E_t in eV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li</td>
<td>2–1–1</td>
<td>5.392</td>
</tr>
<tr>
<td>Na</td>
<td>2–2–1</td>
<td>5.139</td>
</tr>
<tr>
<td>K</td>
<td>3–2–1</td>
<td>4.341</td>
</tr>
<tr>
<td>Rb</td>
<td>3–3–1</td>
<td>4.177</td>
</tr>
<tr>
<td>Cs</td>
<td>4–3–1</td>
<td>3.894</td>
</tr>
</tbody>
</table>

It can be noted from the observational data that as the displacement in the magnetic dimension increases, there is a systematic decrease in the ionization energy. On the other hand, the value calculated by Satz (his Table I, Ref. 2) is the same, 4.34 eV, for all of these elements. From this it is apparent that there ought to be some missing factor that accounts for this discrepancy. This factor, whose existence has not been recognized hitherto, is what might be called the transverse effect of the rotations in the two dimensions other than the one considered in the Satz eq. 9a (p. 25, Ref. 2):

\[
E_{t,\text{atom}} = 4.34 \times (c/\nu_{\text{mag}})^{1/2} \text{ eV}
\]

\[
E_{t,\text{atom}} = 4.34 \times (c/\nu_{\text{elec}}-1)^{1/2} \text{ eV}
\]

That is to say, if u and v are the two magnetic speeds and w the electric speed, and if the ionization energy happens to be given by

\[E_t = 4.34 \times (c/u)^{1/2},\]

the speeds v and w in the orthogonal dimensions do have a transverse effect on E_t. Or if E_t happens to be given by

\[E_t = 4.34 \times (c/w - 1)^{1/2},\]

then the speeds u and v exert the transverse effect.

This transverse effect can be evaluated as follows. Firstly, we note from Satz' eq. 9-a(2) given above that the collinear effect of the atomic rotation on the electric ionization is arrived at by considering the inverse speed c/\nu_{\text{mag}} or c/\nu_{\text{elec}}. The transverse effect is the inverse of the collinear effect, and as such, is to be arrived at by considering the specific speeds, namely, \nu_{\text{mag}}/c and \nu_{\text{elec}}/c directly.

Secondly, since speeds in two different dimensions are simultaneously involved in the transverse effect, their net effect can be calculated by taking their geometric mean.(7) Incidentally, it may be noted that the reason for the geometric mean of the specific rotations to be the relevant quantity, as Larson(7) takes, is that the force effect of a specific rotation t is given by ln t (i.e., the natural logarithm of t), and that the average force due to the two rotations t_1 and t_2 is

\[1/2(\ln t_1 + \ln t_2) = \ln(t_1 \times t_2)^{1/2}.\]

That is, it is equivalent to the force effect of a rotation \(t_1 \times t_2)^{1/2}.\)
Finally, the square-root of the expressions is to be taken in order to convert the time region quantity into the time–space region quantity. Thus the factor responsible for the transverse effect can be written down as

\[(v_x/c \times v_y/c)^{1/2} = (v_x \times v_y/c^2)^{1/4}\]  

(1)

where \(v_x/c\) and \(v_y/c\) are the specific rotations in the other two dimensions.

It is necessary to consider one more item before we can set up the final expression for the ionization energy of the atom. This concerns the energy required to create a positive–negative charge pair, mentioned in section 1.8 above. This is not twice the energy needed to create the negative charge as Satz supposes (nor, of course, twice the energy needed to create the positive charge). In Ref. 1, Satz concludes that the natural frequency of electric charge is \(R/\pi\) Hertz (his eq. 23, ref. 1) and then shows that the frequency of unit negative charge is \(R/2\pi\), since the negative charge is one unit of time displacement and its speed is \(1/(1 + 1) = 1/2\). Similarly, he shows that since the unit of positive electric charge is a unit of space displacement, its speed is \((1 + 1)/1 = 2\), its frequency is \(2R/\pi\) (also see his eqs. 4 & 7, Ref. 2). Now, when a charge pair is created the relevant speed is the geometric mean (of the speeds of a positive and negative charge), that is, \((1/2 \times 2)^{1/2} = 1\). Hence the energy necessary to create the charge pair is twice \(h \times 1 \times R/\pi\) (where \(h\) is Planck’s constant), or 8.68 eV. Therefore, the energy for the first ionization level is given by

\[E_{1,\text{atom}} = 8.68 \times (c/v_{\text{mag}})^{1/2} \times (v_x \times v_y/c^2)^{1/4} \text{ eV}\]

or

\[E_{1,\text{atom}} = 8.68 \times (c/v_{\text{elec}})^{1/2} \times (v_x \times v_y/c^2)^{1/4} \text{ eV}\]  

(2)

3. Observational Validation

In Table I are listed the values of \(E_1\) calculated from eq. 2. In column 2 of the Table the displacements in the three dimensions are given for each element, and in the third column are given the rotations causing the collinear effect, namely, either \(c/v_{\text{mag}}\) or \(c/v_{\text{elec}}\). In those cases where these speeds are derived from any of the alternative orientations the atomic rotation is able to assume, as will be presently discussed, they are marked by an appropriate sign. In the fourth column are listed the two specific rotations that produce the transverse effect. In column 5 are listed the calculated values and the observed values according to Ref. 6.

The agreement with the observational values can be seen to improve very materially compared with that achieved by the Satz equation. (The correlation coefficient is 0.992.) There are several aspects to the computation:

3.1 The Neutral Particles. As pointed out in section 1.6 above, the neutrino and the neutron do not take any electric charge. I have shown elsewhere that the "1/2–1/2" type of effective displacement in both the magnetic dimensions of these particles is what makes the
acquirement of an electric charge impossible.

3.2 Hydrogen. One of the two intermediate type of particles, H\(^1\), has the following speeds in its two rotating systems:

\[
\begin{align*}
\frac{1}{3} - \frac{1}{2} - 2 \\
\frac{1}{2} - \frac{1}{2} - 2
\end{align*}
\]

Since the speeds in the two rotating systems in the primary magnetic dimensions are unequal, their geometric means, \(\sqrt{(1/3 \times 1/2)} = 1/\sqrt{6}\), is to be taken. This causes the collinear effect. The transverse effect comes from the two speeds 1/2 and 2 in the remaining two dimensions. Thus, from eq. (2) we have:

\[
E_{\text{IH}} = 8.68 \times (\sqrt{6})^{1/2} \times (1/2 \times 2)^{1/4} = 13.585 \text{ eV.}
\]

3.3 The Inert Gases. A typical case is that of the inert gases, all of which have zero electric displacement. It must be recalled that the positive and negative zero–points (from either of which the atomic rotation can be alternatively reckoned) are separated by 8 (or 16) displacement units in the electric dimension.\(^{(8)}\) Now for the purpose of taking on the electric charge the rotation in the electric dimension of the inert gases is able to assume the role of this alternative zero–point. We shall refer to this phenomenon by the term “zero-shifting.”

Both He and Ne, with their smaller atomic numbers (net total electric displacement), are able to take the double leap of 16 units (two 8–unit shift). This has been indicated in Table I by \(\|\|\). Kr, Xe and Rn, with higher atomic numbers, take on the 8–unit zero–shift (indicated in Table I by \(\|\)). Ar, the element next to Ne in the inert gas series, is also able to take on the 16–unit zero–shift like both of its predecessors. But its net total displacement being much higher than that of He or Ne, the probability of the 16–unit shift competes equally with that of the 8–unit shift resorted to by Kr and the higher members.

We will find in a number of instances where alternative atomic rotational orientations are possible, as will be seen below, the question of the relative probabilities plays a significant role in determining the value of the ionization energy observed macroscopically. Pending detailed study of the relative probabilities we will assume that the 16–unit shift and the 8–unit shift have equal probabilities in the case of Ar. Thus the ionization energy of Ar comes out to be the arithmetic mean of the two values resulting from the 16–unit shift and the 8–unit shift, namely, 15.92 eV.

3.4 Electro–negative Elements. From the principles of the Reciprocal System it is evident that positive ionization—that is, acquisition of a rotational vibratory space displacement—of the atom is not possible because of the space displacement in the electric dimension of these elements. The rotation in the electric dimension must assume an alternative orientation, thereby acting as an equivalent time displacement. This alternative orientation may be achieved by any of the following
three expedients.

3.4.1 The first expedient is to revert to the all-positive equivalent displacement. Thus, for example, Ni, with the usual displacement of 3–3–(8) can assume the equivalent displacement 3–2–10. This all-positive displacement is not normally realized due to its lower probability. This possibility, therefore, occurs only when the element belongs to the highest position in Division III (see pp. 223–4, Ref. 3)—near the border between Divisions II and III. In fact, it is encountered in only one more case, that of Lu (4–4–(15)).

3.4.2 If the rotation in the electric dimension is involved only in the transverse effect, another possibility opens up. In view of the space–time symmetry around unity, a speed \( n \) can achieve the effect of inverting the space–time orientation of the rotation by its ability to act in the capacity of its reciprocal, namely, the speed \( 1/n \). But this ability to act as its reciprocal is limited only to the transverse effect and cannot extend to the collinear effect, since the transverse effect is an inverse effect itself. Thus, in the case of Au (4–4–(7)), for example, the speed 8 in the electric dimension is able to act as speed 1/8 as far as the production of the transverse effect is concerned. This type is indicated in Table I by §. Other examples are Cu, Pd, Ag, Cd, and Hf. The probability of this type of alternative configuration becomes very low as we move away from the middle of a Group.

3.4.3 Under these circumstances, none of the elements of Division IV nor any of those in the lowest positions in Division III are able to take up this expedient. The negative rotation in the electric dimension of these elements is, however, able to achieve the same result by taking recourse to the expedient of zero-shifting mentioned in section 3.3.

As an example, let us consider the element Se with the displacement 3–3–(2). An 8-unit zero-shift in orientation turns the space displacement (2) into the time displacement 6, which then is able to produce the collinear effect. It must also be noted that the inversion of the orientation effected by the zero-shifting enables the rotation to exert either the collinear effect or the transverse effect with equal facility. In the example of Se cited above, the two effects seem to have equal probabilities. The macroscopic result, once again, is that the ionization energy required is the arithmetic mean of the two values.

It will be seen that this alternative of zero-shifting is invariably the expedient adopted by all the elements of Division IV (and those of Division III nearer the border between Divisions III and IV), of Groups 2B, 3A, 3B and 4A. In the case of Group 4A elements Ta (4–4–(14)) through Pt (4–4–(8)) the 8-unit zero-shift is not feasible, since the existing space displacement in the electric dimension is greater than 8 units. These elements, therefore, take the 16-unit zero-shift. It is worth noting that in the case of the elements S (3–2–(2)), Se (3–3–(2)), Os (4–4–(10)), Ir (4–4–(9)) and Pt (4–4–(8))—in all of which the electric displacement is at the bottom of the first or second 8-unit stretch—the positive rotation effectuated by zero-shifting seems to act either in the collinear or in the transverse capacity.
with equal probability.

This leaves the Division IV elements of Group 2A, which have some peculiarity arising out of their low net total displacement. These elements, N, O and F do resort to the zero-shifting, like the rest of their electro-negative family, but, by virtue of their low net total displacements they are able to take on the 16-unit double shift, like the two inert gas elements, He and Ne, that bracket their group. In fact, the probabilities of the 16-unit and 8-unit shifts are about the same for each of these elements.

4. The Special Cases. There remain two special cases in which the large discrepancy between the calculated and the observational values of the ionization energy seems to warrant further study.

(i) The first of these pertains to those elements with displacement 3 in their electric dimension, irrespective of whether this displacement is the direct positive value of 3, or the equivalent positive displacement 3 obtained by an 8-unit zero-shifting of the negative displacement of 5. They are Al (2-2-3), Sc (3-2-3), Ga (3-3-(5)), Y (3-3-3), In (4-3-(5)) and La (4-3-3). The exceptions are B (2-1-3) at the low atomic number end, and Tl (4-4-(5)) and Ac (4-4-3) at the high atomic number end. The calculated value, in these cases, exceeds the observational value by about 15 to 35%, as shown in Table II below.

<table>
<thead>
<tr>
<th>Ele.</th>
<th>Calc.</th>
<th>Obs.</th>
<th>discr. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al</td>
<td>8.08</td>
<td>5.986</td>
<td>35.0</td>
</tr>
<tr>
<td>Sc</td>
<td>7.52</td>
<td>6.54</td>
<td>14.9</td>
</tr>
<tr>
<td>Ga</td>
<td>7.52</td>
<td>5.999</td>
<td>30.7</td>
</tr>
<tr>
<td>Y</td>
<td>7.52</td>
<td>6.38</td>
<td>17.8</td>
</tr>
<tr>
<td>In</td>
<td>7.11</td>
<td>5.786</td>
<td>22.9</td>
</tr>
<tr>
<td>La</td>
<td>7.11</td>
<td>5.577</td>
<td>27.5</td>
</tr>
</tbody>
</table>

(ii) The second special case pertains to the electropositive elements of Group 4A, namely, the Lanthanides from Ce (4-3-4) through Tb (4-3-11). The average calculated value of the ionization energy for these elements is 7.87 eV, while the average observational value is 5.62 eV.
References

# Table I. Ionization Energy of the Elements

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**Reciprocity**

25  B 15.2-25
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**Note:**

- + Alternative all-positive displacement
- § Inverse electric speed (in transverse effect only)
- ¶ 8-unit zero-shift (in the electric dimension)
- \parallel 16-unit zero-shift
Correspondence

To the Editor:

In "The Nature of Scalar Rotation" (Reciprocity XIV. 2-3), K.V.K. Nehru presents an explanation of the periodic table that differs substantially from the standard explanation of the Reciprocal System. He introduces the term "folds," which obfuscates, rather than clarifies, the situation. For readers who want the standard (and clear) explanation of the periodic table, I recommend Chapter 10 ("Atoms"), of Larson's Nothing But Motion. According to the publication policy statement of Reciprocity, the objective of ISUS is the advancement of the Reciprocal System of physical theory; I think that "The Nature of Scalar Rotation" hinders the advancement of the theory. Now, let me be very quick to add that Nehru's other paper in the issue, "The Inter-Regional Ratio," is a model of clarity and precision—it is the first straightforward explanation and calculation of this important parameter.

Ronald W. Satz
Parkerford, Pennsylvania

The author replies:

It is heartening to see R.W. Satz' comments on "The Nature of Scalar Rotation." Readers seem seldom to interact over articles in Reciprocity.

It must be noted that "The Nature of Scalar Rotation" is intended to supplement, and not contravene, the chapter on "Atoms" in Nothing But Motion. The critical reader would have noticed that none of the mathematical conclusions developed there by Larson is contested. On the other hand, the article tries to draw attention to the lacunae present in the logic that was adopted to arrive at some of the mathematical conclusions. Since it has already been stated in the article, at appropriate places, how the alternate conceptual interpretations presented therein not only overcome these lacunae but clarify some collateral points too, there is no need to give again a full account of these here.

The term "folds," if found misleading, could be dropped. The comments would have been even more helpful if they had discussed whether the issues raised at the outset, in the article, are valid: and if not, how the "standard" explanation has been misunderstood by the author.

K.V.K. Nehru
Hyderabad, India
ANNOUNCEMENT

Basic Properties of Matter, which constitutes Volume II of the new edition of Dewey B. Larson’s The Structure of the Physical Universe, is nearing completion, and the Officers and Trustees have been giving consideration to the matter of getting enough copies of the book published to serve the purposes of the members and friends of the organization. No doubt the book will be published in the normal manner sooner or later. In the meantime, it would be very helpful to those who are interested in becoming better acquainted with the theory to have access to the wealth of material contained in this volume.

The contents of Volume II include the detailed calculations of such properties of matter as inter-atomic distance, compressibility and thermal expansion. The first third of the volume is taken up with this material, after which the nature of the electric current is explained, and its various properties are examined in detail. The text then shows that the electric charge is a scalar motion of a type not encountered in the previous discussion, either in Volume I or in the previous chapters of Volume II. The properties of this type of motion and their relation to the properties of current electricity are discussed in detail. The succeeding chapters deal with the subject of ionization, that is, the application of charges to atoms. The clarification of the nature of ionization leads to the conclusion that if large aggregates of matter—the stars—are subject to increasing temperature they ultimately reach a destructive limit at which the star blows apart in a gigantic explosion, which we identify as a Type I supernova. The nature of radioactivity, the various types of radioactive transformations, and the atom-building process are discussed in detail. Further information about the contents of the volume is contained in the chapter titles given in the table of contents on the next page.

From the foregoing description it can easily be seen that an acquaintance with the contents of this volume will be extremely helpful, not only for a full understanding of the explosive phenomena discussed in Volume III, but also for a full appreciation of the theoretical development as a whole.

We therefore believe that you will want to join with us in making this work available as soon as possible. Because of the limited market the publication of a highly specialized work of this kind is not financially possible without a subsidy of some kind. The various sources from which subsidies can be obtained will be explored, but in order to make the work available in the meantime we are proposing to produce a limited edition of a hundred (100) copies, using a microcomputer and a laser printer. To make the project possible, we are asking our members and friends to give us advance orders at this time, with shipment to be made on publication, estimated for July, 1987.

Since some of our members have expressed interest in having numbered copies of this edition, these copies will be numbered from 1 to 100, and made available on a “first come, first served” basis.
Basic Properties of Matter

This volume is the second in a series of separately titled volumes of a revised and greatly enlarged edition of The Structure of the Physical Universe, originally published in 1959. It is the third volume actually published. The other volumes now available are Nothing But Motion (1979) and The Universe of Motion (1984). The nature of the subject matter covered in the present volume is indicated in the following Table of Contents:

Preface
1 Solid Cohesion
2 Inter-atomic Distances
3 Distances in Compounds
4 Compressibility
5 Heat
6 Specific Heat Patterns
7 Temperature Relations
8 Thermal Expansion
9 Electric Currents
10 Electrical Resistance
11 Thermoelectric Properties
12 Scalar Motion
13 Electric Charges
14 The Force Equations
15 Electrical Storage
16 Electrostatics
17 Induction of Charges
18 Ionization
19 Magnetostatics
20 Magnetic Quantities and Units
21 Electromagnetism
22 Charges in Motion
23 Magnetic Materials
24 Isotopes
25 Radioactivity
26 Atom Building
27 Mass and Energy

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