The universe is composed of matter, and, as a system, is sustained by motion. Motion is not a property of matter, and without this motion, the solar system could not exist. Were motion a property of matter, that undiscovered and undiscoverable thing called perpetual motion would establish itself.

- Thomas Paine

The principal obstacle that stands in the way of acceptance of the idea of a finite universe is the observed outward motion of the photons of light and other electromagnetic radiation. On first consideration, it would seem that regardless of what the the aggregate of matter may be doing, the radiation is being dispersed outward into space, and is eventually lost from the universe as we know it. But we now find that this apparent outward movement of the photons is an illusion due to the inward movement of the gravitationally bound system from which we are doing our observing. The photons actually have no capability of independent motion. This is why the physicists have never been able to find a mechanism for the "propagation of radiation." There is no propagation, and therefore no need for a mechanism.

- Dewey B. Larson

Table of Contents

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time is the Essence</td>
<td>Dewey B. Larson</td>
<td>1</td>
</tr>
<tr>
<td>Liquid State in the Reciprocal System: Part 2</td>
<td>Ronald W. Satz</td>
<td>7</td>
</tr>
<tr>
<td>Updated Values for Unit Space and Unit Time</td>
<td>Bruce M. Peret</td>
<td>12</td>
</tr>
<tr>
<td>Subatomic Mass Recalculated</td>
<td>Bruce M. Peret</td>
<td>13</td>
</tr>
<tr>
<td>Laws of Mechanics in a 3-Dimensional Universe</td>
<td>Lawrence E. Denslow</td>
<td>17</td>
</tr>
<tr>
<td>Speed of Space-Time Progression</td>
<td></td>
<td>21</td>
</tr>
</tbody>
</table>
Time is the Essence

DEWEY B. LARSON

Dewey B. Larson is an anachronism in the modern scientific world. Whatever else may be said of modern science, it is generally true that it has become and is further becoming, less and less controversial. The great success of science seems to have instilled into 'the man in the street' and scientist alike, an exaggerated respect akin to religious reverence. Most scientists preoccupied as they are with the obscurities of their own narrow field, rarely, if ever, question the underlying assumptions on which science rests. Larson does. He advances in this article the belief that the basis of our scientific thought, namely our conception of space and time, is at fault, and provides some alternative ideas.

"To attempt a definite statement as to the meaning of so fundamental and underlying a notion as that of time is a task from which even philosophy may shrink,"1 says Richard Tolman in his classic treatise on Relativity. But the "notion" of time is basic in every field of science. In legal documents we often see the expression "Time is the essence of the contract." It is no less the essence of physical theory - without the symbol and all that it stands for, there would be little left in physical science. In order to make a definite and meaningful statement about any physical phenomena it is therefore necessary to define the concept to which the name "time" is to be attached. This definition may not actually be expressed—indeed is seldom expressed except in such basic works as Tolman's—but in any work that lays claim to scientific accuracy, the exact meaning of the concept must be specified, implicitly if not explicitly. Those who use the concept without defining it are not evading this requirement; they are simply accepting a definition set up by someone who has preceded them. How then does science meet this serious challenge at the very base of its theoretical structure: the absolute necessity of a precise and unequivocal definition of an entity that is so difficult to grasp that the mere thought of trying to understand it appals the scientist? Tolman tells us frankly how he and his colleagues have met this issue: "we shall assume without examination the unidirectional, one-valued, one-dimensional character of the time continuum."2

Physical science justifiably prides itself on the "rigor" of its treatment of the subject matter which it covers: precise definitions, clear-cut distinctions, careful and critical development of theory by exact logical and mathematical processes. But when we examine the foundations of this work, we find that the entire structure of carefully developed theory rests upon nothing more substantial than three items which are "assumed without examination." Scientific precision has here taken the form of precise formulation of pure assumptions: the most unreliable of all instruments of thought. Unfortunately, precision is no substitute for validity; an assumption is no less uncertain and speculative because it is expressed in definite and exact language. As matters now stand we have not grasped the essence: we see it only through a thick veil of uncertainty. And without a solid foundation which only a clear understanding of the true properties of time can give us, all of our vaunted logical and mathematical precision is spurious; indeed, if the premises are false, the more precise the logical development the more certain we are to arrive at the wrong conclusion. The physicist who fills pages of the Physical Review with complex mathematical calculations may be giving us a development that, in itself, is faultless, but if any of the properties of time that have been "assumed without examination" are not valid, then he is introducing some kind of an error every time he uses the symbol and, in spite of its impeccable outward appearance, the work as a whole may be completely wrong.
If physical science had been uniformly successful in building up a consistent, integrated structure of theory, fully capable of meeting all demands upon it, this serious defect in the underpinnings of the structure could well be viewed with equanimity, on the ground that the assumptions are justified by the results thereof. It is admitted on all sides, however, that in spite of the spectacular successes that have been achieved in many areas, physical science is still far from having a comprehensive and satisfactory basic theory. In fact, many scientists have given up in despair, and no longer consider the construction of such a theory to be within the range of possibility.

C.N. Yang, for instance, was quoted in a recent news item as "expressing some doubts about the ability of the human brain in general and his in particular to accomplish this task".3 and Henry Margenau admits that "To the outsider the conclusions reached by a modern physicist seem almost like a declaration of the bankruptcy of science".4

In the light of this situation it would seem that science has now reached the point where it can no longer avoid facing the issue as to just what the properties of time actually are. Of course, we have no positive knowledge that errors in the assumptions regarding these properties are responsible for, or contributed to, the failure to construct a satisfactory theory, but when the best efforts of the most competent investigators over a long period of years have failed to produce the expected results, it is certainly much more likely that the fault lies in basic premises that have been assumed arbitrarily and "without examination" than in any lack of "ability of the human brain" to apply logical and mathematical processes to these premises. A thorough and painstaking examination of the validity of the assumptions that have been made concerning the properties of time is therefore very much in order.

The question then arises as to how this issue can be approached. The scientific profession has hitherto believed that there is no alternative to the use of pure assumptions of the kind listed by Tolman, but the investigations that I have carried out have disclosed that it is possible to apply a much more reliable process to this problem, and thereby to arrive at some different conclusions as to the properties of space and time which eliminate most, if not all, of the basic difficulties that physical science now faces. This new approach substitutes a process of extrapolation for the arbitrary assumptions heretofore utilized. It is true that extrapolation is also, in a sense, a process of assumption, but the extrapolation assumption, the assumption that the situation or relation existing in the known region also exists in the unknown region, is inherently vastly superior to any other assumption that can be made, with a far greater possibility of being a true representation of the physical facts, and in any case where extrapolation is possible, it is obviously sound policy to give the consequences of such an extrapolation a complete and thorough examination before anything else is even considered.

As a general proposition, the superiority of this approach is not open to serious question, but a direct extrapolation does not appear feasible in this case, as we have no positive knowledge as to what the properties of space and time actually are anywhere, and consequently there is no adequate base from which to extrapolate. All previous investigators have therefore relied upon assumptions--some related to our rather vague general impressions of space and time, others wholly conjectural--not because they preferred to do so, but because they had no option. The method which I have employed to overcome the existing difficulties is to approach the question indirectly, beginning with an examination of the relation between space and time. This relationship is one that has never been adequately explored hitherto. In the days of Newton, its existence was not recognized at all, the two entities being regarded as completely independent. Since then there has been a growing realization that they are not independent and that basically we must deal with space-time, not with space and time
individually. Thus far, however, it does not appear to have been suspected that the existing concepts of the fundamental nature of space and time may be in error—that time, for instance, may actually be something other than a "unidirectional, one-valued, one-dimensional continuum"—and the hypotheses that have been advanced as to the character of the space-time relation, such as Minkowski’s concept of a four-dimensional continuum, have retained these basic assumptions and thus have simply piled speculation upon conjecture.

Instead of starting with arbitrary assumptions, the first move in the present investigation has been to extrapolate to the universe as a whole the relation between space and time which we find existing in the known region of the universe. In this known region the relation between space and time is motion, and in motion space and time are reciprocally related. This is not surmise or assumption, nor is its accuracy in any way open to doubt. It is positive knowledge from which we can extrapolate. Irrespective of the nature and properties of space and time individually, the method of extrapolation leads directly to the conclusion that we should postulate a general reciprocal relation between space and time effective throughout the universe.

Of course, any new viewpoint that conflicts with long-standing beliefs concerning space and time, no matter how firmly based it may be, will seem strange and hardly credible on first consideration, but nothing that we actually know about space or time is inconsistent with this reciprocal postulate. The truth is that we know very little about either of these entities. Time has always been mysterious and elusive, but even space, which seems so much more understandable, has been a difficult problem for those who have sought to discover its true nature, and no general agreement on this score has ever been reached. To Aristotle space was merely a relationship between physical objects: to Democritus and his fellow atomists it was a container in which such objects exist: to Einstein it was a medium connecting these objects.* Certainly it cannot be claimed that there now exists any positive knowledge to which a new theory must conform. On the contrary, the conclusion of this current investigation, which in effect asserts that space is merely an aspect of motion, has a much greater a priori probability of being correct than any of its predecessors, since it has been reached by way of a more reliable process. Nevertheless, the proof of the pudding must be in the eating; that is, we must develop the consequences of the new concept and see whether they give us a more logical and consistent picture of physical relations than the currently accepted idea.

*Einstein specifically uses the word “medium” in this connection, contrary to the assertions of writers who claim that his system dispenses with mediums. See his book Sidelights on Relativity, P. Dutton & Co., New York, 1922, page 23.

It will not be possible in a short article of this kind to describe all of the results that have been obtained in the application of the reciprocal hypothesis to a wide variety of physical phenomena during the many years that this investigation has been under way, but the general nature of the results can be demonstrated by a typical example. And in the discussion that follows, the consequences of the reciprocal postulate will be developed far enough to produce an explanation of gravitation, something that no other physical theory has been able to do. The gravitational findings are particularly interesting because they not only demonstrate the ease with which this new development surmounts the difficulties that have stood in the way of progress in such areas as this, but also show why we get a distorted view of space and time from our everyday experience, and why most of the inferences as to the nature of these entities that we draw from such experience are erroneous and misleading.

No doubt many readers will be surprised at the assertion that gravitation still remains
unexplained, as there is a very common misconception that Einstein’s General Theory of Relativity supplies such an explanation. But, as Willem de Sitter has pointed out very clearly no hypothesis thus far advanced to explain gravitation “has ever had the least chance, they have all been failures.” Einstein’s contribution, de Sitter says, is to make gravitation identical with inertia, and thus to put it into the category of “one of the fundamental facts of nature, which have to be accepted without explanation, like the axioms of geometry”. After fifty years, the inadequacy of this treatment is clearly apparent. As R.H. Dicke puts it, gravitation is still an “enigma” and “It may well be the most fundamental and the least understood of the interactions”. A recently published review of the proceedings of the First Soviet Gravitational Conference confirms this opinion with the following comments: “..........the gathering seemed painfully perplexed with endless questions, nearly all of which remained unanswered.”

The crux of the gravitational problem is the dilemma which no previous theory has been able to avoid: the apparent necessity of postulating either action at a distance, which is philosophically unacceptable to most scientists, or propagation through a medium, which is completely lacking in observational support and is faced with seemingly insurmountable practical obstacles. After three hundred years in which it has been agreed that these are the only two possibilities, the new development based on the reciprocal postulate now produces a third alternative that has been completely overlooked by previous investigators; one in which gravitation acts in a perfectly natural and understandable way, instantaneously, without an intervening medium or a medium-like space, and in such a way that it cannot be screened off or modified in any way; all of which are exactly in accord with what our observations have always indicated.

To begin the explanation of how these results were obtained, let us now return to the basic assumption of a reciprocal relation between space and time. It is evident that this assumption necessitates a further postulate that space and time have the same dimensions, since quantities of different dimensions cannot stand in a reciprocal relation to each other. We can recognize three dimensions of space; and the simplest assumption that is consistent with both the reciprocal postulate and the observed properties of space is that both space and time are three-dimensional. Limitation of both space and time to discrete units is also necessary in order to make the reciprocal postulate mathematically workable. Extrapolation of the relation between space and time that is observed in the phenomenon of motion thus leads directly to three conclusions about the properties of time and space which can replace the assumptions that physicists have made “without examination”. Together with the further assumption that space-time as thus defined is the sole constituent of the physical universe, these can be combined into one comprehensive postulate as follows:

FIRST FUNDAMENTAL POSTULATE: The physical universe is composed entirely of one component, space-time, existing in three dimensions, in discrete units and in two reciprocal forms; space and time.

In addition to this First Postulate, which defines the physical universe, some further assumptions as to mathematical behavior will be necessary, and since this present development does not get into any difficulties of the kind that have forced modern physics to resort to the use of complex and abstruse mathematics, it will be possible to formulate the following simple postulate:

SECOND FUNDAMENTAL POSTULATE. The physical universe conforms to the relations of ordinary commutative mathematics, its magnitudes are absolute, and its geometry is Euclidean.

On examination of these two postulates, it is apparent that they require a progression of space-time similar to the progression of time as ordinarily visualized. Let us consider some
location A in space-time. When one more unit of time has elapsed, this location has progressed to A + 1 in space. Since one unit of time is equivalent to one unit of space, according to the First Postulate, this location has also progressed to A + 1 in space. At the very outset, therefore, the new development confronts us with an important basic phenomenon which has not hitherto been recognized: a progression of space similar to the observed progression of time. We thus have an immediate opportunity to test the validity of the new system by observation of the actual physical universe. If space-time actually progresses, as the new theory contends, then we should be able to recognize some phenomena in which identifiable objects without inherent motion of their own are being carried along in space by the progression of space-time.

In order to simplify the question of a reference system, let us assume that a large number of such objects originate at the same space-time location, which means that they originate at the same space location simultaneously. Due to the progression of space-time these objects immediately begin moving outward, but outward in space-time is a scalar direction, and the spatial motions of the individual objects will be distributed over all possible directions in accordance with the probability principles. Hence if there actually is a progression of space-time, we should observe objects of this kind originating at various spatial locations and moving away from the points of origin in all directions and at a constant velocity. We do not have to look very far to find physical entities which display exactly this behaviour. Throughout the physical universe there are sources of light or other electromagnetic radiation from which photons emanate in all directions and recede from the points of emission at a constant velocity. This radiation phenomenon therefore furnishes the definite independent evidence that is necessary to demonstrate the reality of space-time progression.

Additional confirmation is provided by the motions of the external galaxies. All galaxies except our immediate neighbors are receding from us in exactly the same manner as the photons of light that originate in our galaxy except for the fact that the relative galactic velocity is a function of the distance, and has only reached about one-fourth of the velocity of light at the extreme range of our optical telescopes, and perhaps one-half of the velocity of light at the greatest distances accessible to radio observation. The lower velocities of the galaxies as compared to the velocity of the light photons are quite obviously due to the modifying effect of gravitation which, even at these enormous distances, still exerts a small force of attraction that operates against the progression. Thus the reality of the space progression, a basic feature of the new theory that has no counterpart in any other physical theory, is substantiated by two independent lines of evidence.

Space limitations preclude a detailed discussion of the development of the consequences of the Fundamental Postulates to the point where they require the existence of matter, but for present purposes it should be sufficient to say that this development indicates that the atoms of matter are rotating units in which the direction of the rotation is opposite to that of the space-time progression; that is, irrespective of the spatial direction in which the atoms are moving, their scalar space-time direction is always inward, directly opposite to the outward motion of the space-time progression. Whereas the progression is continually carrying all physical objects outward away from each other, the inherent rotational motion of the atoms is carrying them inward toward each other. This is the phenomenon that we call gravitation.

As an aid to visualizing how gravitation operates, according to this theory, let us assume that a violent explosion has taken place and that we are looking at the results shortly thereafter without any knowledge of what has happened. We will see a cloud of flying
particles apparently exerting a force of repulsion upon each other, and we will observe that this force has some peculiar characteristics: it acts instantaneously, without an intervening medium, and in such a way that it cannot be screened off or modified. According to the new development, gravitation is a force of the same general nature, except that it acts in the inverse direction: inward instead of outward. Like the apparent force which the particles of debris exert on each other, gravitation merely appears to be an action of one mass upon another; in reality each mass is pursuing its own course independently of all others.

Inasmuch as the motion of the progression originates everywhere and is constant regardless of location, whereas the gravitational motion originates at the location which the atom happens to occupy, and the component directed toward any other atom therefore decreases with distance in accordance with the inverse square relation, there is a point at which the two velocities are equal. Inside this equilibrium distance the gravitational distance is greater, and there is a net gravitational effect. Beyond the equilibrium point the motion of the progression is greater, and objects move away from each other, the net outward velocity increasing with the distance as the gravitational effect decreases. The actual behavior of the universe is exactly in accord with these predictions of the new theory.

Throughout the physical realm the new viewpoint as to the nature of space and time derived by the relatively straightforward and dependable process of extrapolation similarly resolved the dilemmas and difficulties which have resulted from basing physical theories on pure assumptions. It is evident from these results that space and time are actually entities of the same nature and that great differences which we seem to see in them are merely the result of the gravitational motion of matter. Gravitation conceals the effect of the space progression in our immediate vicinity, and the progression is observable only at extreme distances; hence the most evident property of space is its three-dimensionality. The progression of time, on the other hand, is unchecked by gravitation, and the velocity of the progression is so high that any motion in three-dimensional time is negligible (relatively) except at extreme velocities. We therefore recognize only the progression. But science now is penetrating the regions of extreme distance and very high velocities, where the progression of space and the three-dimensionality of time play significant roles, and in order to remove serious obstacles to a clear understanding of phenomena in these regions it will be necessary to take heed of the salient point disclosed by the extrapolation process of the present investigation: the fact that both space and time actually have all the properties that have hitherto been attributed to either of them individually.

REFERENCES

2. Tolman, Richard, ibid., page 27
THE LIQUID STATE IN THE RECIPROCAL SYSTEM: THE VOLUME/PRESSURE RELATION, A CONTEMPORARY MATHEMATICAL TREATMENT

by
Ronald W. Satz, Ph.D.

From thermodynamics\(^1\), the general equation of state of a pure substance is

\[
\frac{dV}{V} = \beta dT - \kappa dP
\]

where

\[
\beta = \frac{1}{V} \left( \frac{\partial V}{\partial T} \right)_P = \text{volume expansivity}
\]  \hspace{1cm} (2)

and

\[
\kappa = -\frac{1}{V} \left( \frac{\partial V}{\partial P} \right)_T = \text{isothermal compressibility}
\]  \hspace{1cm} (3)

(Of course, \(V\) = volume, \(P\) = pressure, \(T\) = temperature.)

From my previous paper\(^2\) (and Larson's original work\(^8\)),

\[
V_L(T) = V_1 + V_2 + V_3
\]

where

\(V_L\) = overall specific volume of liquid (cm\(^3\)/g) (total volume/total mass)

\(V_1\) = specific volume increment at \(0^\circ\)K and that due to the solid molecules in solution of the liquid (solid volume/total mass)

\(V_2\) = specific volume increment due to the liquid molecules of the substance, temperature above \(0^\circ\)K (liquid volume/total mass)

\(V_3\) = specific volume increment due to the critical (gaseous or vapor) molecules in solution of the liquid (gaseous volume/total mass)

In this paper we will consider the effect of pressure on a liquid at temperatures below the liquid natural temperature unit, \(510.8\) K. At low temperature, \(V_3 \approx 0\). Pressure has a different effect on \(V_3\) than it has on \(V_2\). Also, pressure has a different effect on a liquid at a temperature above, rather than below, \(510.8\) K. These differences will be handled in another paper.
For a solid under pressure, the volume is multiplied by \( \sqrt{\frac{P_o}{P + P_o}} \), where \( P_o \) is the internal pressure and \( P \) is the external pressure. For a liquid under pressure, the volume is multiplied by the square of the solid factor, or simply \( \frac{P_o}{P + P_o} \). So,

\[
V_l(T, P) = V_1 + V_2 \left( \frac{P_o}{P + P_o} \right)
\]

It follows that isothermal compressibility is

\[
\kappa = -\frac{1}{V_l} \left( \frac{\partial V_l}{\partial P} \right)_T = -\frac{1}{V_l + V_2 \left( \frac{P_o}{P + P_o} \right)} \left( -V_2 \right) \left( \frac{1}{(P + P_o)^2} \right)
\]

It's often easier to work with the bulk modulus, \( B \), which is the inverse of \( \kappa \).

\[
B = \frac{1}{\kappa} = \frac{\left( V_1 + V_2 \left( \frac{P_o}{P + P_o} \right) \right)(P + P_o)^2}{V_2 P_o}
\]

From my previous paper,

\[
V_1 = V_\infty k_{x1} + \Delta V \approx V_\infty k_{x1} \text{ cm}^3/\text{g}
\]

since \( \Delta V \) is negligible for most liquids above the melting point.

\[
V_2 = V_\infty k_{x2} \frac{T}{n_1 T_{\text{usu}}} \text{ cm}^3/\text{g}
\]

\[
V_\infty = \frac{10.5389 n_v}{m} \text{ cm}^3/\text{g}
\]

where \( n_v \) is the number of volumetric units.
The internal pressure of a liquid is obviously different from that of a solid. The natural unit of pressure in the Reciprocal System is $15,538,642$ atm. To calculate the internal pressure of a solid we divide this number by the interregional ratio, $156.45$. For a liquid, we divide by the square of the interregional ratio. Because liquid cohesion is two-dimensional rather than three-dimensional we must also multiply the expression by $2/3$. Therefore,

$$P_{\text{int}} = \frac{2}{3} \times \frac{15538642}{(156.45)^2} = 423.22437 \text{ atm}$$

(11)

This expression is then multiplied by the number of pressure units, $n_p$, and divided by the ratio of the base volume to 1, raised to the $2/3$ power. (The solid expression just uses volume, or $s_0^3$.) Therefore,

$$P_o = \frac{423.22437n_p}{\left(\frac{V_{oo}}{1}\right)^{2/3}} \text{ atm}$$

(12)

Substituting eq. 10 in eq. 12, we get

$$P_o = 88.045482m^{(2/3)} \frac{n_p}{n_v^{(2/3)}} \text{ atm}$$

(13)

$n_p$ is the number of atoms effectively acting against the external pressure. It is sometimes, but not usually, equal to the number of volumetric units, $n_v$. Using eqs. 8, 9, and 10, $B$ can be expressed as

$$B = \frac{k_{\text{int}}n_iT_{\text{int}}}{k_{\text{int}}} \left(\frac{P^2}{P_o} + 2P + P_o\right) + P + P_o \text{ atm}$$

(14)

Now let's turn to calculating the volume expansivity.

$$\beta = \frac{1}{V_L} \left(\frac{\partial V_L}{\partial T}\right)_p = \frac{k_{\text{int}}}{n_iT_{\text{int}} + k_{\text{int}}T\left(\frac{P_o}{P + P_o}\right) + \beta_o \text{ K}^{-1}}$$

(15)

where $\beta_o$ is the value of the expansivity at the end point of the solid.
One could plug $x$ (or $1/B$) and $\beta$ into eq. 1 and integrate, but the resulting equation is more complex than eq. 5 and thus not useful.

In summary, to calculate bulk modulus and volume expansivity of a liquid, it is necessary to determine

- $m$, the molecular weight
- $n_v$, the number of volumetric units
- $\kappa_{S1}$, geometric factor
- $\kappa_{S2}$, geometric factor
- $n_t$, the number of temperature units
- $n_p$, the number of pressure units

Example Calculations and Comparisons with Experiment$^5,6$

I selected four important liquids: acetic acid, carbon tetrachloride, ethyl acetate, and water. Here are the results, in table format.

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Formula</th>
<th>$m$</th>
<th>$k_{S1}$</th>
<th>$k_{S2}$</th>
<th>$n_v$</th>
<th>$n_t$</th>
<th>$n_p$</th>
<th>$P_{aim}$</th>
<th>$T_0 K$</th>
<th>$B_{calc, atm}$</th>
<th>$B_{obs, atm}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic Acid</td>
<td>CH$_3$CO$_2$H</td>
<td>60.05</td>
<td>.9046</td>
<td>.7820</td>
<td>4</td>
<td>1.0</td>
<td>7</td>
<td>1</td>
<td>288.16</td>
<td>11441.503</td>
<td>11279.014</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>COCl$_4$</td>
<td>153.81</td>
<td>1.0</td>
<td>.9183</td>
<td>6</td>
<td>1.0</td>
<td>5</td>
<td>1</td>
<td>250.26</td>
<td>12334.317</td>
<td>11878.218</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
<td>CH$_3$CO$_2$C$_2$H$_5$</td>
<td>88.10</td>
<td>.9818</td>
<td>.9818</td>
<td>6</td>
<td>1.0</td>
<td>6</td>
<td>1</td>
<td>293.16</td>
<td>8687.0274</td>
<td>8733.6283</td>
</tr>
<tr>
<td>Water</td>
<td>H$_2$O</td>
<td>18.0153</td>
<td>.8707</td>
<td>.8707</td>
<td>1.5</td>
<td>2.0</td>
<td>9</td>
<td>1</td>
<td>273.16</td>
<td>19697.592</td>
<td>19698.877</td>
</tr>
</tbody>
</table>

(The values of $\beta_{v}$ have not yet been determined, which explains the discrepancy between $\beta_{calc}$ and $\beta_{obs}$)

The $n_p$ values are easy to understand. In acetic acid, the CH$_3$ contributes 3 units and the CO$_2$H contributes 4. In carbon tetrachloride, each atom contributes 1 unit. In ethyl acetate, each volumetric group contributes a unit. In water, 3 molecules of 3 atoms each act against the external pressure, for a total of 9. All values of $n_v$, $n_t$, and $n_p$ are integral or half-integral, as required by the nature of the Reciprocal System. This is very different from the empirical correlations used by other investigators.$^7$

In the coming years I hope some member of ISUS will calculate the results for thousands of liquids following the equations given here.
References:


2. R. Satz, "The Liquid State in the Reciprocal System: The Volume/Temperature Relation, a Contemporary Mathematical Treatment," *Reciprocity*, Vol. XXIII, No. 2, Autumn 1994. Incidentally, the normal function should have been denoted by $\Phi$, not $\text{erf}$.

\[
\Phi(z) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{z} e^{-t^2} dt
\]

\[
\text{erf}(z) = \frac{2}{\sqrt{\pi}} \int_{0}^{z} e^{-t^2} dt
\]

(The numerical results of the paper do not change, because $\Phi$ was actually used.)


6. *American Institute of Physics Handbook* (New York: McGraw-Hill Book Company, 1972). $\beta$ values are difficult to find. If you know the volume at temperature $i$ and temperature $f$ (and the pressure is constant), then from equation 1, $\beta \approx \frac{\ln \left( \frac{V_f}{V_i} \right)}{T_f - T_i}$.


8. D. Larson, *The Liquid State*, privately circulated series of papers on the liquid state, circa. 1960-1964. Note: for this work, I made use of his paper IV. Larson used the semi-empirical value 415.84 atm for the liquid natural pressure unit. My derivation of $P_{\text{lnu}}$ is unique.
Updated Values for Unit Space and Unit Time

Bruce M. Peret

The basis of measurement in the Reciprocal System of Theory requires an accurate measurement of unit space and unit time. These values were computed by Dewey B. Larson back in 1959 from the speed of light and the Rydberg frequency of hydrogen.1

Today, the speed of light is now considered an exact value, defining the meter as “the length of path traveled by light in vacuum in 1/299,792,458 second.”2 Therefore, the speed of light has unlimited precision, as it now defines the system of measurement.

Instead of using the Rydberg frequency of hydrogen to determine unit time, the Rydberg Constant (R_o) can be utilized to determine unit space. This value is available to 11 significant digits.

The Rydberg Constant has units of “per meter”, thus the inverse of the Rydberg Constant, the meter, can be considered the wavelength of space. Unit space, as defined in Reciprocity, consists of the half-cycle. Thus, a very accurate measurement of unit space can be found by taking the reciprocal of the Rydberg Constant (the length of a full cycle) and dividing by 2 to obtain the half cycle.

Unit time can be determined by the division of unit space by the speed of light.

Constants (1986 CODATA set, mks)

<table>
<thead>
<tr>
<th>c</th>
<th>Speed of Light</th>
<th>299,792,458 m s⁻¹ (exact)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R_o</td>
<td>Rydberg Constant</td>
<td>10,973,731.534 ±0.013 m⁻¹</td>
</tr>
</tbody>
</table>

Unit Values Derived from Constants (cgs)

| Unit Space | 4.563352671 ×10⁻⁶ cm |
| old unit space | 4.558816 ×10⁻⁶ cm |
| Unit Time   | 1.5198298508 ×10⁻¹⁶ s |
| old unit time | 1.520655 ×10⁻¹⁶ s |

Though the difference between old and new values is approximately 0.05%, it should be noted that, “Since the 1986 adjustment, new experiments have yielded improved values for a number of constants, including the Rydberg Constant R_o, the Planck constant ħ, …” and because of this, these constants are only valid until the next CODATA publication.

References

Subatomic Mass Recalculated

Bruce M. Peret

Having recently received a copy of PHYSICAL REVIEW, which contains everything known about subatomic particles, I decided to put Reciprocity to the test—to see if Larson’s original calculations would still hold up under the scrutiny of today’s accurate measurement systems. The results, some of which are related here, have been quite interesting.

All observed particle measurements were taken from PHYSICAL REVIEW D, Particles and Fields. Values were calculated with “C” programs, compiled with SAS/C, version 6.51, using standard, double precision floating point with an accuracy of 15 significant digits. The code was executed on an Amiga 3000 computer under AmigaDOS version 2.1.

Mass Components

The calculated values for subatomic particle mass, in terms of natural units, are listed in Table 1. In keeping with Larson’s original tabular format, not all the significant digits are shown (though they are used in all computations).

<table>
<thead>
<tr>
<th>p</th>
<th>primary mass</th>
<th>1.00000000000000</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>magnetic mass</td>
<td>0.006392045455</td>
</tr>
<tr>
<td></td>
<td>gravitational mass</td>
<td>1.006392045455</td>
</tr>
<tr>
<td>E</td>
<td>electric mass (3 dim.)</td>
<td>0.000868055556</td>
</tr>
<tr>
<td>e</td>
<td>electric mass (2 dim.)</td>
<td>0.000578703704</td>
</tr>
<tr>
<td>C</td>
<td>mass of normal charge</td>
<td>0.000044944070</td>
</tr>
<tr>
<td>c</td>
<td>mass of electron charge</td>
<td>-0.000029962713</td>
</tr>
</tbody>
</table>

Table 1 - Mass Components (natural units)

Observed Mass

The observed mass values for the various subatomic particles have changed since the publication of Nothing But Motion, and tentative neutrino and “massless neutron” mass now exist.

The observed neutrino mass is taken from the electron neutrino, which is listed with a “formal upper limit” of 5.1 eV, and a “95% certainty level.” To maintain consistent units in the table, this value was converted to unified atomic mass units (u) with the conversion factor of 931.49432 MeV/u.

The mass of the “massless neutron” is taken from the muon neutrino, as suggested by Larson: “...and the logical conclusion is that the particle now called the muon neutrino is the particle required by the theory: the massless neutron.”

The mass of the muon neutrino is inferred from measurements of muon momentum in the decay of a π粒子 particle, and results in a mass of 105.658389 MeV (0.11342891388 u).

The observed proton is included in both the charged and uncharged proton entries, for comparison. (The uncharged proton is listed as “unobserved” in Nothing But Motion.)

Table 2 lists the subatomic mass in natural units, as compared to the unified atomic mass units based on the $^{12}$C isotope.
Table 2 - Calculated Mass (natural) vs Observed Mass (u)

<table>
<thead>
<tr>
<th>Composition</th>
<th>Particle</th>
<th>Calculated</th>
<th>Observed</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>e+c</td>
<td>charged electron</td>
<td>0.00054874099</td>
<td>0.0005487990</td>
<td>0.00000016109</td>
</tr>
<tr>
<td>e+c</td>
<td>charged positron</td>
<td>0.00054874099</td>
<td>0.0005487990</td>
<td>0.00000016109</td>
</tr>
<tr>
<td>e</td>
<td>electron</td>
<td>0.00057870370</td>
<td>massless</td>
<td>massless</td>
</tr>
<tr>
<td>e</td>
<td>positron</td>
<td>0.00057870370</td>
<td>massless</td>
<td>massless</td>
</tr>
<tr>
<td>e</td>
<td>neutrino</td>
<td>0.00057870370</td>
<td>0.00000000548</td>
<td>0.00057869823</td>
</tr>
<tr>
<td>p+m+e</td>
<td>massless neutron</td>
<td>1.00697074916</td>
<td>0.11342891388</td>
<td>0.89354183528</td>
</tr>
<tr>
<td>p+m+2e</td>
<td>proton</td>
<td>1.00754945286</td>
<td>1.00727647000</td>
<td>0.000279286</td>
</tr>
<tr>
<td>p+m+2e+C</td>
<td>charged proton</td>
<td>1.00759439693</td>
<td>1.00727647000</td>
<td>0.00031792693</td>
</tr>
<tr>
<td>p+m+3e</td>
<td>hydrogen (H)</td>
<td>1.00812815657</td>
<td>1.00794000000</td>
<td>0.00018815657</td>
</tr>
<tr>
<td>p+m+3e+E</td>
<td>compound neutron</td>
<td>1.00899621212</td>
<td>1.00866490400</td>
<td>0.00033130812</td>
</tr>
</tbody>
</table>

The values calculated for the neutrino and “massless neutron” are considerably out of line with the observed values. Given that the observed values were deduced indirectly from the decay of other particles, there are undoubtedly numerous factors involved that were not taken into account. I have no explanation for the differences.

The calculated values for the charged electron/positron, proton, $^1$H isotope, and the compound neutron are reasonably close, but not as close as they should be, given the number of significant digits in both the calculations and the observed values. This is due to the measuring system involved, that of the unified atomic mass unit (u). The observed values are based on the $^{12}$C isotope. Larson uses observed values in the $^{16}$O scale, which are closer to the natural mass units of the Reciprocity system, but still not exact.²

Applying Conversion Factors

Instead of converting values from the $^{12}$C to $^{16}$O scales, it may be prudent to avoid both scales, and determine a conversion factor from natural mass units to unified atomic mass units based on an isotope-free, easily measured particle—the charged electron. Of all the particles there are mass values for, the charged electron is, in all probability, the most accurate. Also, the charged electron mass is known more precisely in unified atomic mass units than in any other unit.⁴

Thus, the conversion factor between natural (n) and $^{12}$C (u) mass units can be determined by the ratio between the measured and calculated charged electron:

$$\frac{0.00054857990 \text{ u}}{0.00054874099 \text{ u/n}} = 0.99970644 \text{ u/n} \quad (1)$$

Applying this factor to Table 1, the mass components in “unified atomic mass units” are obtained:

Table 3 - Mass Components (u)

<table>
<thead>
<tr>
<th>Mass Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>p primary mass</td>
<td>0.999706441403</td>
</tr>
<tr>
<td>m magnetic mass</td>
<td>0.006390169015</td>
</tr>
<tr>
<td>gravitational mass</td>
<td>1.006096610417</td>
</tr>
<tr>
<td>E electric mass (3 dim.)</td>
<td>0.000867800730</td>
</tr>
<tr>
<td>e electric mass (2 dim.)</td>
<td>0.000578533820</td>
</tr>
<tr>
<td>C mass of normal charge</td>
<td>0.000044930876</td>
</tr>
<tr>
<td>c mass of electron charge</td>
<td>-0.000029953917</td>
</tr>
</tbody>
</table>

Recalculating Table 2 with the values in Table 3 results in:
Table 4 - Calculated Mass (u) vs Observed Mass (u)

<table>
<thead>
<tr>
<th>Composition</th>
<th>Particle</th>
<th>Calculated</th>
<th>Observed</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>e+c</td>
<td>charged electron</td>
<td>0.00054857990</td>
<td>0.00054857990</td>
<td>0.00000000000</td>
</tr>
<tr>
<td>e+c</td>
<td>charged positron</td>
<td>0.00054857990</td>
<td>0.00054857990</td>
<td>0.00000000000</td>
</tr>
<tr>
<td>e</td>
<td>electron</td>
<td>0.00057853382</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>positron</td>
<td>0.00057853382</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>neutrino</td>
<td>0.00057853382</td>
<td>0.000000000548</td>
<td>0.00057852835</td>
</tr>
<tr>
<td>p+m+e</td>
<td>massless neutron</td>
<td>1.00667514424</td>
<td>0.11342891388</td>
<td>0.89324623036</td>
</tr>
<tr>
<td>p+m+2e</td>
<td>proton</td>
<td>1.00725367806</td>
<td>1.00727647000</td>
<td>-0.00002279194</td>
</tr>
<tr>
<td>p+m+2e+C</td>
<td>charged proton</td>
<td>1.00729860893</td>
<td>1.00727647000</td>
<td>0.00002213893</td>
</tr>
<tr>
<td>p+m+3e</td>
<td>hydrogen ('H)</td>
<td>1.00783221188</td>
<td>1.00794000000</td>
<td>-0.00010778812</td>
</tr>
<tr>
<td>p+m+3e+E</td>
<td>compound neutron</td>
<td>1.00870001261</td>
<td>1.00866490400</td>
<td>0.00003510861</td>
</tr>
</tbody>
</table>

With the exception of the neutrinos, the calculated values are now extremely close to the observed values. The error for hydrogen is only 0.011%. The error in the compound neutron is 0.0035%.

Notice, however, the proton. The difference between the calculated and observed mass in the uncharged proton is almost the same as the charged proton, but in the opposite direction. This is rather suspicious, and one could theorize that the observed proton in the laboratory may actually be a 50/50 mix of charged and uncharged protons. Calculating the atomic weight based on a 50/50 mix yields:

Table 5 - Mixed Sample Protons

<table>
<thead>
<tr>
<th>Composition</th>
<th>Particle</th>
<th>Calculated</th>
<th>Observed</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>p+m+2e</td>
<td>proton</td>
<td>1.00725367806</td>
<td>1.00727647000</td>
<td>-0.00002279194</td>
</tr>
<tr>
<td>p+m+2e+C</td>
<td>charged proton</td>
<td>1.00729860893</td>
<td>1.00727647000</td>
<td>0.00002213893</td>
</tr>
<tr>
<td>50/50</td>
<td>mixed protons</td>
<td>1.00727614350</td>
<td>1.00727647000</td>
<td>-0.00000032650</td>
</tr>
</tbody>
</table>

Which is 0.000032% from the observed value (though still outside the stated error of ±0.000000012 u.)

This calculation indicates that there is a high probability that the values obtained for the observed proton are a mix of both the charged and uncharged states, if Reciprocity is correct. Back calculating for this set of data, the proton sample would be 50.72668125% charged, and 49.27331875% uncharged (which reproduces the observed value exactly.)

Summary

1. After compensating for differences in measuring systems, Reciprocity’s “1959” calculations of mass agree quite closely with the 1993 observed values.

2. The massless neutron (muon neutrino) and neutrino are several orders of magnitude outside of the calculated values. It is stated that these measurements are inferred from the decay of other particles, and are not measured directly. This seems to be yet another principle of impotence, and thus makes the observed data questionable.

3. The observed proton appears to be a near-even mix of charged and uncharged protons. If this is actually the case, other measurements may also be adversely affected, such as electric dipole moments or polarizability.

4. Because physics does not recognize the charged and uncharged states of subatomic particles, observed values may become increasingly unreliable, tending to be more of a statistical distribution than a direct measurement. This will undoubtedly play havoc with any proposed unified system of theory.
Conclusion

To paraphrase Dr. Leonard McCoy of classic Star Trek, "I'm a farmer, not a physicist!" And, unfortunately, I do not have access to the intimate details of particle accelerators and measurement techniques.

It would be interesting, however, if someone familiar with particle measurement techniques could examine the process of determining proton mass, and propose a method to eliminate either the charged or uncharged protons in the sample. The results should precisely match the values obtained from Reciprocity, when corrected for unified atomic mass. This could lead to the acceptance of the charged and uncharged states of subatomic particles (of the proton at least), and maybe even an objective look at Larson's work.

References

1. Physical Review D, Particles and Fields (The American Physical Society through the American Institute of Physics, 1 August 1994).


3. Physical Review D, Particles and Fields (The American Physical Society through the American Institute of Physics, 1 August 1994), page 1389.

4. Ibid., page 1396, note on electron mass precision.


6. Physical Review D, Particles and Fields (The American Physical Society through the American Institute of Physics, 1 August 1994), page 1392.
CHARACTERISTICS
of
ORDINARY MATHEMATICS
as revealed in the
RECIPROCAL SYSTEM of THEORY

by
Lawrence E. Denslow

Development of any theoretical system requires starting with a fundamental premise or concept, whether expressed or unexpressed. Of all the observations that have been made of this physical universe, the most pervasive feature has been motion. The "Laws of Mechanics", as we presently understand them, were developed to explain the observed relationships among the movements of material objects in this physical universe.

The Reciprocal System of theory uses the concept of motion as a starting point from which to develop all of the relations causing the appearances of things in this physical universe. D.B. Larson developed the first statement of principles and consequences from a set of postulates for a universe of motion and has published an analysis of the deductive development of the concepts involved in that theory.¹ The first few items in that development show that the presently recognized characteristics of the ordinary system of mathematics were assumed and that no further analysis of the characteristics of the ordinary system of mathematics were deemed necessary. But there are hints in the development of the Reciprocal System about certain characteristics of ordinary mathematics that are not a part of normal everyday thought. These must now be addressed.

Before just flatly stating what those characteristics are, it seems proper to review the characteristics of scalar motion and certain points in the development of the consequences of the postulates for the Reciprocal System. The three principal characteristics of scalar motion are: (1) continuity between contiguous units of motion, as well as within individual units of motion; (2) All motion progresses with respect to a reference point in whatever reference system the motion is to be represented; All units of primary motion progress outward from points of reference in any dimensional reference system; All units of displaced motion progress inward with respect to reference points in dimensional reference systems; (3) Primary motion causes no change of location in the natural reference system. This, of course, means that so far as analysis and explanation of physical phenomena are concerned, primary motion is only a scalar value reference from which all displacement is evaluated.

The principal limitation that a generalized dimensional reference system experiences is that it cannot represent separately the outward and inward directions. All motion relative to any reference, either a point or a line, in the generalized three dimensional system is confined to being linearly or rotationally one directional movement. ALL generalized dimensional reference systems fail to differentiate between coexisting primary motion of the natural reference system and any opposition or displacement from the primary progression.

In Larson's development each reference point was recognized as having an individual, specifically oriented, three dimensional coordinate system, randomly oriented with respect to every other reference point coordinate system. The necessity of having multiple reference points automatically requires specific recognition of the concept that each and every atom, sub-atomic particle, and photon, is its own reference point and has its own randomly oriented three dimensional system of coordinates.

The basic definition for motion does not specify either directionality or dimensionality. only quantity; therefore, the fundamental concept of motion could only

be scalar. By being scalar, one is stating that in space the relationship of the motions at or within any two locations has no dependence on directionality or dimensionality.

What the Postulate and definition for motion also mean is that scalar motions in different scalar dimensions can be represented in a three dimensional system only by representationally placing them in geometrically perpendicular dimensions.

It is with respect to the concept of "inward" being unitarily in opposition to "outward", rather than merely being a direction relative to a reference point, that the postulated definition of motion becomes demonstrably quantitative.

The quantities of motion being compounded must come in a specific order. The only possibilities for quantitative variation that could have immediate bearing on which is to be incremented are the number of directions and the number of dimensions. To control this, two factors come to mind: first, the remaining possibilities for representation of primary motion within the individual system; and second, the distribution of motions within the individual system.

Every reference point must have at least one direction that is being specified as the direction for the progression of the natural reference system. This meant that a dimension had to be left open. For as long as possible, for primary motion in the individual coordinate system, in order to minimize distribution of the actual motions over as few dimensions, not directions, as possible while maximizing the outward progression. Then move the point of thought to the more generalized system obtaining randomness of directional orientation of the individual coordinate system for maximum distribution of the effects of the displacement motion. This is what makes the motions in each reference point have an overall scalar effect with respect to each other.

The order in which motions may be represented in an individual reference point system is not necessarily a function of either of the two factors that affect maximizing the distribution of effects having dominance or priority. Effects within an individual system that are not reflected by representation, directly or as an effect, in a generalized system are of little or no value. Thus, the order for compounding the directionality and dimensionality of motions within an individual coordinate system follows the rules of mathematical logic; the mathematical order of one, two, three, is not open for debate. Larson has already shown the results of compounding scalar motions to be in a particular order; all that is being proposed here, is some possible reasons why that order is required.

The difference of meaning for the word "inward" as being in opposition to outward not only hinted at conceptual isolation of individual reference points, but directly required isolation of the scalar dimensions for each individual coordinate system from each other. This concept of "inward" not merely being a direction allowed thinking within an individual coordinate system without being at all concerned about the idea of representation with respect to anything other than that specific system.

Then came the realization that motions within a specific coordinate system need not be restricted by any of the necessities of representation with respect to other coordinate systems. Motions within a specific coordinate system may be one directional or two directional in one dimension or in two dimensions, all concurrently. There is no a priori requirement for a unit of motion in an individual reference point system to be limited to one direction under any conditions other than sequence of representation. The first result of this is that there is no a priori requirement for motion to alternate directions within a specific coordinate.
system. It is my contention that the idea of requiring alternation of direction is a carry over from our biased position in a generalized coordinate system. That biased position is no more logical than the matter based universe concept.

The requirement for representation in a generalized system is subordinate to representation in the individual system. Sequential directionality for general representation of the effect of a scalar motion at a reference point as one direction followed by the opposite is subsequent to the representation at the reference point as 1D2d1 motion. Whatever is going on in a scalar dimension has absolutely nothing to do with how it is represented in a dimensional system nor how many directions or dimensions may be required; nor do all the limitations of generalizing the reference system for being able to have multiple reference points and effects among them.

Equal probability of both directions of one dimension in the generalized system of coordinates has two results. One result is choice of direction of progression, the other causes the effect of a one dimensional two directional reference point motion to be represented by first one direction and then the opposite. This must be a sequential occurrence in the generalized system, otherwise there would not be equal probability of representation of the effect of a 2d1 motion. Equal probability requires sequentiality of the effect of the 2d1 motion between the two directions of one dimension, if any representation of the motion or an effect of the motion is to occur, at all.

Specific attention is drawn again to the representation requirements of photons. Because motion within the photon reference point is self-sustaining and precedes the representation of its effect in the generalized system, representation for the effect of the two directional motion alternates apparent directionality in the generalized reference system as a result of an equal probability and sequentiality requirement.

To adequately represent each photon requires two methods: a reference point for representation of the photon effect at the point of progression in the generalized system which I have called the "energy reference point" AND a reference point specified for the point of origin or point of interaction in the generalized reference system which Larson calls a "negative" reference point. This may be considered by some to be a conceptual departure from Larson's explanation, but I don't think it is.

To represent the photon effect in a generalized system of coordinates, it makes no difference which direction one starts with for the progression of the emitted photon, it takes both directions of one of the perpendicular dimensions to adequately represent the effect. One must have an even number of units of primary progression in order to have equal probability for representation, and thereby, to represent the photon effect in the generalized system, at all, regardless of its frequency. This is the primary reason for taking two (2) units of primary motion to define the fundamental or natural units of representable space and time, and thereby, the reason for the sizes of all things. The actual rates of progression are totally immaterial; the ratios generated by representation are what controls how each aspect is perceived.

Experimental simple harmonic motion is not self sustaining, and thereby, can only be an experimental approximation to the concept of true simple harmonic motion. Simple harmonic motion needs only to satisfy the relation a = sin ϕ. Dewey Larson was absolutely correct in stating that photons are a simple harmonic motion. The only thing he didn't say was that a true simple harmonic motion is the effect of a motion that is not directly observable because the motion causing the effect is a scalar motion.
represented as one-dimensional two
directional motion in a dimension
other than that of the progression.

Numerous comments about photons
are possible at this point, but
that is not the purpose of this
discussion. The main idea here is
that representation of motion at
individual reference points is NOT
limited in the same manner as in a
generalized reference system.

The results of the sequential
requirement for compounding motions
at a reference point are:
1D,1d, the normal progression and
translational motion in the gen-
eralized reference system;
1D,2d, photons, sinusoidal effects
progressing outward from gener-
alized reference system points;
2D,1dr, rotational bases and the
main structural feature of sub-
atomic and atomic structures;
1D,1dr, the differentiating feature
for sub-atomic and atomic struc-
tures;
(1D,1di, translational movement
(vectorial velocity))
1D,2d, heat effects;
2D,2dr, magnetic charge effects;
1D,2dr, electric charge effects.

The ONLY motion directly repre-
sented is PRIMARY motion, every-
thing else is an effect of dis-
placed motion, requiring the use of
definable reference points. It is
the three dimensionality of the
reference points that ultimately
resolves to the three dimension-
ality of the generalized system of
everyday existence.

The BIG reason why unidirec-
tional motion is the only mode by which
motion can be directly represented
is tied up with the basic idea of
this system of theory: primary mo-
tion must exist and the simplest
way by which that can be represent-
ed is unidirectional.

References:

1. D.B. Larson, The Structure of
the Physical Universe, North
Pacific Publishers, 1959; and
all subsequent publications.

D 24.2-20
OUTWARD EQUABLE SPEED OF S-T PROGRESSION

The Larson reciprocal theory of the universe of motion introduces two new concepts into physical science: the concept of physical location, and the concept of scalar motion.

This theory finds that each light photon is a compound unit of motion, which remains throughout its lifetime in the same physical location in which it originated. Thus, every photon's outward, equable translatory speed in vacuo is the speed of its physical location, its light speed in vacuo.

Two main opposed forces of scalar motion govern the behavior of all physical entities and phenomena of the macrocosmic universe of motion: the primary steady outward force of space progression with time progression and the independent inverse square inward force of gravitation.

The nature of these new concepts of scalar motion and physical location can be illustrated by a consideration of the "expansion of the universe" that is postulated in the astronomers' latest theory of the recession of the distant galaxies. As explained by Paul Davies, "The expanding universe is not the motion of the galaxies through space .....but is the steady expansion of space.

Since the galaxies, on this basis, are not moving through space, each galaxy remains in what Larson calls a physical location in space. This physical location is moving outward in the context of a stationary reference frame, carrying the galaxy with it. While only the galactic motion can be observed, all physical locations necessarily participate in the outward motion, irrespective of whether or not they are occupied by galaxies.

Inasmuch as all galaxies and the physical locations that they occupy are moving steadily outward from all others, each is moving in all directions. A motion distributed uniformly over all directions has no specific, or inherent, direction; that is, it is scalar. Thus the expansion can be described as the positive scalar motion of physical locations (represented as outward in the spatial reference system). Larson's reciprocal space-time theory defines a universe of motion in which scalar motion of physical locations is not a unique phenomenon confined to the expansion recognized by the astronomers, but is the basic form of motion from which all physical phenomena are derived.

At relatively short distances gravitation predominates, and the net motion is inward. Since the gravitational motion decreases with distance, while the outward motion remains constant, the opposing motions reach equality at some greater distance, which Larson calls the gravitational limit. Beyond this distance the net motion is outward, increasing with distance, and approaching unity (the speed of light) at extreme distances.

(This theoretical pattern of net speeds is verified experimentally by measurement of the Doppler shift in the radiation received from the distant galaxies).