Outline of the Deductive Development of the Theory of the Universe of Motion

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Preface

Ever since the dawn of science, the ultimate objective of the theoreticians in the scientific field has been to devise a general physical theory: one in which all physical phenomena are derived from a single set of premises. As expressed by Richard Schlegel of Michigan State University:

> In a significant sense, the ideal of science is a single set of principles, or perhaps a set of mathematical equations, from which all the vast process and structure of nature could be deduced.

Up to the present time, all of the many efforts along this line have been fruitless. It has not even been possible to derive the relations in one major physical field from general premises; that is, without making assumptions specifically applicable to that particular field and to that field only. But, the development of the *Reciprocal System* of theory has now produced just the kind of a thing that Dr. Schlegel describes: a set of basic postulates whose necessary consequences are sufficient in themselves to describe a complete, theoretical universe.

More than 90% of the conclusions derived from these postulates are in agreement with concurrent scientific thought and are not contested. Thus, the Reciprocal System is not only a general physical theory; it is a general physical theory that, on the basis of present knowledge, is at least 90% correct. It therefore constitutes a significant advance in scientific understanding, irrespective of the judgment that may ultimately be passed upon the remaining 10% of the conclusions derived from the theory.

Under the circumstances, many individuals are interested in making a critical examination of the development of thought from the fundamental postulates to the various conclusions in order to satisfy themselves that this development is, in fact, purely deductive. This present work has been designed to facilitate such an examination. In the previous publications which introduced the new theoretical system it was, of course, necessary to devote much of the text to explanation and argument, and even though these works have emphasized the fact that all of the conclusions reached in the theoretical development are derived solely from a determination of the consequences of the postulates, many readers have been unable to follow all of the logical development of the various lines of thought. It is probably that this is due, at least in large part, to a tendency to expect something of a more esoteric nature—some magic formula or all-embracing mathematical expression—rather than the simple "if this, then that" type of deductive development by which the theoretical structure has been constructed. In any event, it has seemed advisable to supplement these previous publications with a presentation which will cover the basic portions of the new system of theory without explanation or argument, and will concentrate entirely on a step-by-step derivation of the pertinent points.

This presentation as it now stands (subject to possible extension later) is essentially no more than a sample; it carries the development of theory forward only a few steps. But even this very modest start toward a determination of the consequences of the postulates already brings us to the point where some of the most important features of the physical universe have been duplicated by the theoretical features that have emerged. Already, in this very early stage of the theoretical development, we find that the universe defined by the theory is expanding (as the observed universe does). It contains radiation, consisting of individual particles (photons) which travel outward at unit speed (the speed of light) in all directions from various points of emission, followed a wave-like path (in full agreement with the properties of radiation as observed.) The speed of light, and of radiation in general, in this universe is constant, irrespective of the reference system (as it is in the observed universe).

The theoretical universe contains matter, consisting of individual atoms (as the observed universe does). This matter is subject to gravitation, which acts instantaneously, without an intervening medium, and in such a manner that it cannot be screened off or modified in any way (just as gravitation does in the observed universe, although most theorists close their eyes to these facts because they cannot account for them). In this theoretical universe, there are a specific number of different kinds of atoms with different properties; the chemical elements (as in the observed universe). These elements constitute a series, each member of which differs from its predecessor by one unit of a particular kind, and the series is divided into groups and sub-groups with certain group characteristics (all of which is in full agreement with observation). There are additional types of units similar to, but less complex than, the atoms, which have some, but not all, of the properties of the atoms (also in agreement with the observed properties that are currently assumed to exist).

In the light of this demonstration of how the major features of a theoretical counterpart of the observed physical universe—radiation, matter, gravitation, the galactic recession, atomic structure, etc.—can be derived by a relatively simple logical development of the conclusions that are implicit in the postulates of the theory, it should not be difficult to understand how the theoretical universe can be extended into great detail by further application of the same process of following out the logical implications of the postulates and the conclusions previously derived. Furthermore, it is clear, even at this very early stage of the investigation, that this development is capable of resolving some of the most serious issues facing current science.

The manner in which the development of the theoretical structure leads to a unique set of numerical values for each chemical element—a series number, and three rotational displacement values—also shows how the mathematical character of the theoretical universe emerges side by side with the qualitative relationships. Obviously, these sets of numbers are the means by which the elements enter into the mathematical aspects of the many physical relations that appear later in the development, and the simple manner in which they are deduced from the basic premises should serve as an explanation as to why nothing of a more complex mathematical nature than simple arithmetic is needed in the early stages of the inquiry.

The fundamental postulates, together with some comments concerning the interpretation of the language in which they are expressed, are stated in Section A. The statements that follow are sequential; that is, each is a necessary consequence of the statements that have preceded it, either in the postulates themselves, or in previous deductions from the postulates. The justification for asserting that each specific conclusion is a necessary consequence of something that preceded this may not always be obvious, but the objective of the present work is to identify the specific items entering into the system of deductions leading from the postulates to the various theoretical conclusions, and to show how each fits into the deductive pattern. Everything which might tend to divert attention from this objective, such as explanation or argument, has therefore been omitted. In any case where the continuity of thought may not be clear reference should be made to previous publications describing the theory.

Section A

Conceptual Fundamentals

This theory introduces two new concepts into physical science: the concept of *physical location*, and the concept of *scalar motion*.

The nature of these new concepts 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 we will call a physical location in space. This physical location is moving outward in the context of the stationary spatial reference system, 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 uniformly outward from all others, each is moving outward 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 a positive scalar motion of all physical locations (represented as outward in the spatial reference system). Our new 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 the motion from which all physical phenomena are derived.

Basic Premises

The basic premises of the theory consist of certain preliminary assumptions, a postulate, and a definition.

A. In order to make science possible, some preliminary assumptions of a philosophical nature must be made. We assume that the universe is rational, that the same physical laws apply throughout the universe, that the results of experiments are reproducible, etc. These assumptions are accepted by scientists as a condition of becoming scientists, and are not usually mentioned in purely scientific discourse.

B. We assume that the generally accepted principles of mathematics, to the extent that they will be used in this development, are valid.

C. We postulate that the universe is composed entirely of one component, motion, existing in three dimensions and in discrete units.

D. We define motion as the relation between two uniformly progressing reciprocal quantities, space and time.

Deductive Development

Each of the following statements is a deduction from the postulate and the preceding statements. The objective of the deductive development is to determine what can exist in the theoretical universe defined by the premises of the theory. In most cases it will be evident that the entity or phenomenon that theoretically *can* exist is identical with one that *does* exist in the actual physical universe, and there are no definite conflicts in any case. To the extent that the outline has been carried, the theoretical universe is thus a correct representation of the observed physical universe.

(1) *Motion*, as defined, is measured in terms of speed, the scalar magnitude of the relation between space and time.[1]

(2) By reason of the postulated reciprocal relation between space and time, each individual *unit of motion*[2] is a relation between one unit of space and one unit of time, a motion at *unit speed*.

(3) We define the *primary motions* as those which can exist independently of the existence of motions of other types.

(4) According to our definition, motion involves a uniform *progression* of both space and time. We define a point, or segment, on the line of the space progression *at a given time* as a physical location in space.

(5) Inasmuch as we postulate that the universe is three-dimensional, we may represent the scalar progression of space by a line in a stationary three-dimensional spatial reference system, measuring the corresponding progression in time by means of a scalar device, a *clock*. In this reference system, a positive motion is represented as *outward* from a reference point, and a negative motion as *inward*. The terms outward and inward will be used in preference to "positive" and "negative" to avoid possible confusion with another use of the latter set of terms.[3]

(6) The initial point of the progression of an individual unit of motion is zero. As the distance between two points cannot be less than zero, it follows that the primary motions are necessarily outward,[4] increasing the distances relative to the initial points.

(7) This progression is scalar. It is simply outward without any inherent direction. Motion outward from the initial point of the progression is therefore outward from all points of reference.[5]

(8) From the foregoing, any two physical locations are progressing outward from each other at unit speed; that is, their separation is increasing at the rate of one unit of space per unit of time.

(9) We define the *natural system of reference* as that system in which the primary motions do not cause any change in the positions of physical locations.

(10) From (8) it follows that the natural system of reference is progressing outward at unit speed

1 Do not consider "motion" as "something moving," but simply a *ratio* of a quantity of space, to a quantity of time.
2 A "unit" is a quantity of 1, not a container. You cannot have a box of 45 mph's, but you could increase your speed by increments of 45 mph, as "unit" increments.
3 Outward can also be considered as *away* from the reference point, and inward, *towards* the reference point.
4 When you are standing *on* a reference point, whichever direction you move will be *away* from that reference point, hence "outward."
5 Consider outward, scalar motion as *expansion*, and inward, scalar motion, as *compression*.

relative to the spatial system of reference.

(11) We identify *unit speed* as the *speed of light*.

The various features of the theoretical universe emerge from the deductive development without labels. It is therefore necessary to identify the physical phenomena to which they correspond. The correlation is usually quite evident, as in this instance. In any event, it is self-verifying, as any error would quickly show up in the subsequent development.

(12) Since the postulate specifies that nothing exists other than discrete units of motion, and the natural reference system is a direct consequence of the existence of the primary units, this reference system is the framework, or background, of the universe of motion, and does not represent any activity *in* that universe. The natural system of reference, as defined, is therefore the physical zero, or datum level, from which all physical activity extend.

(13) We identify the outward progression of the natural reference system relative to the stationary system of reference as the "expansion of the universe" reported by the astronomers.[6]

At this point we have arrived, by deduction from our basic premises, at an explanation of the general background of the physical universe that is essentially in agreement with the astronomers' assumption. (Our derivation leads to a uniform outward speed, rather than a speed that varies with the distance, as produced by the kind of an expansion assumed by the astronomers, but this difference is easily accounted for, because there is a known force, gravitation, that acts against the outward motion, with a magnitude varying as an inverse function of distance.)

The advantage of deriving this explanation of the universal background from a set of general premises, rather than merely assuming its existence, lies in the fact that further deductions can be made from these same premises. Instead of a single process involving the universe as a whole, the explanation that we have just derived from the premises of the theory of the universe of motion identifies the expansion as the result of outward scalar motions of individual physical locations. This opens the way for the existence of other scalar motions of the same physical locations, *independent motions,* as we will call them.

(14) Once the primary units of motion are in existence, units of inward scalar motion can be superimposed on the outward units. The net magnitude of the two motions is zero, and the combination therefore has no physical properties in a spatial reference system, but it constitutes a base upon which other combinations can be formed.

(15) As stated in our definition, motion is a progression. Thus it is not a succession of jumps, even though it exists only in discrete units. There is progression within the unit, as well as unit by unit, simply because the unit is a unit of motion (progression). The significance of the discrete unit postulate is that discontinuity can occur only between units, not within a unit.[7] But the various stages of the progression within a unit can be *identified*.

(16) The continuity of the progression within the units enables the existence of another type of scalar motion of physical locations. This is a motion in which there is a continuous and uniform change from outward to inward and vice versa; that is, a *simple harmonic motion*. At this stage of the development only continuous processes are possible, but a continuous change from outward to inward and the inverse is just as permanent as a continuous outward or

6 The *Hubble Expansion*.

7 Larson describes this progression as a moving chain versus a moving rope. A chain can only be bent where the links join, "between units." If the links are *really* tiny, the chain *looks* like a rope, but still *behaves* like a chain.

inward motion.[8]

(17) In the two-unit complete cycle of the simple harmonic motion the net change of the spatial position of the physical location is zero. As represented in the spatial reference system, the two-unit combination remains *stationary in the dimension of motion*.

(18) From (10) it follows that the physical location occupied by that motion combination (17) moves outward at the speed of light in a second dimension.[9]

(19) The path of the combined progressions then takes the form of a sine curve.[10]

(20) We identify such scalar motion combinations as *photons*. A system of photons is *electromagnetic radiation*.

This derivation shows why radiation has the properties of a wave as well as those of particles. It is composed of particles (discrete units), but the motion (progression) of these particles is wave-like.

(21) The outward movement of physical locations due to the motion of the natural reference system relative to the stationary spatial system carries with it not only the photons, but also any other physical entities that occupy such locations.

In addition to the photons, there are certain other massless particles that have no known motion-producing mechanism and must therefore remain stationary in the natural system of reference, unless acted upon by some outside agency. There are also objects—very distant galaxies—that do have a motion-producing mechanism (gravitation), but are so far away that the gravitational motion toward our location has been reduced to negligible levels. All of these objects behave exactly as required by the theory; that is, they move outward relative to the spatial reference system at the speed of light.

(22) There is no inherent relation between the time magnitudes involved in the different dimensions of the photon motion. One is the time of the progression of the natural reference system. The other is independent of this progression. Thus the *frequency* of the radiation, the number of cycles per unit of the linear progression, can take any value, subject only to the capability of the process whereby the radiation is produced.

(23) The postulate that the universe is three-dimensional means that three independent magnitudes are required for a complete definition of each of its basic quantities. Thus three dimensions of scalar motion are possible. In order to distinguish these purely mathematical dimensions of motion from the dimensions of *space*, which are geometrical as well as mathematical in the context of a spatial reference system, we will refer to them as *scalar dimensions.*

(24) Only one dimension of motion can be represented in a three-dimensional spatial system of reference. Each motion shown in such a system is represented by a vector, a one-dimensional quantity having both magnitude and direction, and any combinations of such motions can be represented by the vector sum, which is likewise one-dimensional.

(25) A scalar motion has magnitude only, and no inherent spatial direction. It therefore has to be

8 It has been argued that an SHM, being an accelerated motion, cannot be primary nor continuous without the application of force. Prof. KVK Nehru addresses this issue, along with the alternate concept of *birotation*, in the paper, "The Law of Conservation of Direction."

9 All three scalar dimensions default to unit speed, the speed of light, so with a direction reversal in just one dimension, there are still two "free" dimensions to carry the SHM outward at the speed of light. All motion that has a "free" dimension will be observed as moving at the speed of light.

10 It has been argued that in point (15), "discontinuity can occur only between units, not within a unit," the path would be a *square wave*, not a sine curve. This is discussed in Prof. KVK Nehru's paper (footnote 8).

given a direction in order to be represented in a spatial reference system.

(26) To give directions to the members of a system of scalar motions, it is necessary to couple one of the moving locations to the stationary reference system in such a way that it is represented as motionless. The directions imputed to the other motions of the system are then determined by their relation to this assumed motionless *reference point.*

For example, if we designate our galaxy as A, the direction of the motion of distant galaxy X, as we see it, is AX. But observers in galaxy B see galaxy X as moving in a very different direction BX because they use a different reference point. This contrasts sharply with the directions of the motions of our ordinary experience—vectorial motions—which are the same regardless of the location from which they are being observed. In this vectorial case the direction is the property of the motion.

(27) From (25) and (26), it follows that the factors which determine the direction of a scalar motion are independent of those which determine the magnitude. The direction is a result of the nature and location of the coupling of the motion to the reference system. It may be a *constant* direction, as in the outward travel of the photons of radiation, or it may be a *rotationally distributed* direction, one that is continually changing.

(28) From (27), the translational motion of a photon, instead of being unidirectional as in (18), may be rotationally distributed in the reference system. The motion thus distributed, which we will call a *scalar rotation,* is a linear progression with a constant magnitude but a continually changing direction.[11]

(29) From (23), scalar rotation can take place coincidentally in three dimensions. From (24), however, it can be represented in a spatial reference system only on a one-dimensional basis. The magnitudes of the motions in the three dimensions are additive, and can be represented as a total, but the directions of the different distributions cannot be combined. The representation in the reference system therefore indicates the correct magnitude (speed) of the three-dimensional motion, but shows only the directions applicable to the single dimension of the motion that is parallel to the dimension of the reference system.

(30) In the absence of any specific restrictive factor, rotationally distributed scalar motions are distributed over all spatial directions. The magnitude of such a motion toward a point in any given direction is therefore inversely proportional to the second power of the intervening distance.

This is the origin of the "inverse square law."

(31) Inasmuch as the natural reference system progresses outward at unit speed relative to the spatial reference system, no further increment of outward speed is possible, because of the discrete unit postulate. The net total magnitude of a rotationally distributed linear motion must therefore be inward.

(32) If the scalar motion is less than three-dimensional, the basic photon will move outward as radiation in a vacant dimension and the motion combination will disintegrate. In order to be stable, the rotationally distributed motion must therefore be three-dimensional.

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11 Larson bases his work on *linear velocity* and does not recognize the concept of *angular velocity* as a primary motion. In the RS2 research, both are considered primary, the yin (angular) and yang (linear) aspects of motion. Consider that in a vacuum where no other forces are present, you can throw a baseball with linear velocity, or spin it in place with an angular velocity. Both will retain their velocity, forever, and are therefore primary motions.

(33) The three-dimensional combination of vibrational and rotationally distributed motions appears in the reference system as an identifiable object moving inward in all directions. We identify such an object as an *atom* or a *sub-atomic particle*. Collectively, the atoms and particles constitute *matter.*

(34) We identify *mass* as a measure of the net magnitude of the rotationally distributed scalar motions of matter. We identify the observable inward-directed effects of this motion as *gravitation*. The magnitude of the gravitational effect is therefore directly proportional to the mass.

(35) The inward gravitational motion of the atoms results in the formation of material aggregates of various sizes. In these aggregates the atomic motions (and masses) are independent and additive.

(36) The outward motion due to the progression of the natural reference system always takes place at unit speed, regardless of the size of the aggregate or the distance that is involved (8). The *net* relative motion of any two gravitating objects with no additional motions is the algebraic sum of the unit outward motion and the inward gravitational motion.

Because of the spherical distribution of the gravitational motion in the reference system, the magnitude of the motion of one unit of matter toward another is inversely proportional to the square of the intervening distance.

(37) At relatively short distances gravitation predominates and the net motion is inward. Since the gravitational motion decreases with distance, while the outward progression remains constant, the opposing motions reach equality at some greater distance, which we will call 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 observationally by measurements of the Doppler shift in the radiation received from the distant galaxies.

(38) The conventional spatial reference system in conjunction with a clock for measuring time represents a physical situation in which the space component of the progression of the natural reference system is neutralized by gravitation, while the time component progresses at the full normal rate. In this reference system, the space progression, as indicated by the motion of a massless object, appears as a one-dimensional motion through three-dimensional space.

(39) Since we postulate a reciprocal relation between space and time, each of the deductions expressed in the foregoing numbered statements is also valid in the inverse form; that is, with space and time interchanged.

(40) We identify the time component of the progression of the natural reference system as the "flow of time" registered on a clock.

(41) It follows from (39) that motion in time takes place in three dimensions, in the same manner as motion in space. The time component of the progression of the natural reference system (clock time) is a one-dimensional outward motion through a stationary three-dimensional temporal system of reference, in which independent motions at different speeds and different directions also take place.

(42) Motion at unit speed causes unit change of position in both the spatial reference system and the temporal reference system. It is a *motion in time* as well as a motion in space.

(43) When motion takes place in time, the constant progression analogous to clock time is in space, and would be measured by some kind of a "space clock." But the rates of progression are the same, one unit of space and one unit of time per unit of motion. Thus the measurements relative to the "space clock" are identical with those relative to a clock that registers time, if expressed in the same units.

(44) As noted in (2), the space-time ratio in the units of motion is fixed at unity by the reciprocal postulate. It follows that a reduction of speed—as, for instance, by an increase in the distance between gravitating objects—does not alter the ratio of space to time in the effective motion; it reduces the proportion of the total motion that is effective in increasing the spatial separation of the objects. This effective portion of the motion increases the separation by x units of space per one unit of clock time, where x is a fraction, and because of the fixed relation between space and time in the individual units, also increases the separation in time by x units.

(45) Where only one motion is involved, the x units of time are coincident with the time progression, and do not enter separately into the determination of the speed. But if two objects are both moving, their relative position in space may change at a rate exceeding unity by some quantity x. From (44), the change in the separation in time then also exceeds unity (clock time) by x. The speed is $(1+x)/(1+x)=1$. Thus, if at least one of the two objects is a photon (or other object moving with unit speed), the relative speed is always unity. This agrees with statement (8).

This is the explanation of the observed fact that the speed of light is independent of the reference system.

(46) Where motion at a speed greater than unity (motion in time) takes place under conditions that preclude actual changes of position in time, this motion acts as a modifier of the spatial motion; that is, a motion in *equivalent space*. The spatial equivalent of a temporal magnitude x is $^1/_x$.

(47) Where scalar motion in space is three-dimensional, the speed in one of the dimensions may be greater than unity. But, as indicated in (29), the effective magnitude of a combination of motions is determined by the net total of the scalar speeds, and because there are *two* low speed dimensions, the net speed is less than unity. In this case, then, the motion in the high speed dimension acts as a motion in equivalent space and modifies the magnitude of the change of position in space, rather than causing a change of position in time.

(48) We identify the material atoms with scalar rotation in equivalent space as the atoms of the *electronegative elements*.

(49) We also encounter motion in equivalent space within the units of space. Here no modification of the normal progression of space can take place (because of the discrete unit postulate), but motion can take place in time. Inasmuch as this motion within the spatial unit does not alter the position in time of the unit as a whole, the changes within the unit that result from the motion are observed in equivalent space rather than in actual time.

(50) The existence of a spatial unit, where motion has properties quite different from those prevailing in the region outside the unit, explains the discontinuity in physical properties at very short distances that has led to the development of the quantum theory.

(51) The progression of the natural reference system relative to the spatial system of reference is

always outward, but, as indicated in (10), the natural datum level, or physical zero, is at unity, rather than at the mathematical zero. Within a unit of space, outward from unity is toward zero. It follows that the progression within the unit, as seen in the spatial reference system, is inward.

(52) From (31), the gravitational motion is inward. This direction, too, is inward relative to the natural datum, unity. Within a unit of space, it is therefore outward in the spatial reference system.

(53) No stable equilibrium between the atoms or aggregates of matter is possible at separations greater than one unit of space. The inward and outward motions are equal at the gravitational limit, but this equilibrium is unstable, as the change in separation due to any unbalance between the opposing motions increases the unbalance. Within a unit of space, where the directions of the basic motions as seen in the spatial reference system, are reversed; the effect of a change in separation between atoms due to an unbalance of the opposing motions reduces the unbalance, and eventually results in the establishment of a stable equilibrium.

(54) The positional equilibrium in equivalent space that is established within a unit of space accounts for the existence of the crystalline state of matter.[12]

Section B

In the first section of this outline, the general characteristics of the motion of which the universe is constructed, together with additional information about the various forms and manifestations of that motion, were deduced from the postulates of the theory. With the benefit of this information we are now in a position to develop the details of the individual phenomena in the various physical fields. We will begin by identifying the possible combinations of scalar rotations (atoms and sub-atomic particles) and their individual characteristics, including the properties that are represented in the periodic table of the elements. As in Section A, each statement is a deduction from the postulates of the theory or from one or more of the numbered statements earlier in the outline.

(55) As noted in (12), the primary motions are the framework, or background, of the universe of motion, and do not constitute any physical activity in that universe. Physical activity—that is, meaningful change—in the physical universe results from motions superimposed on the primary motions. We will now want to examine the general considerations involved in such *combinations* of motions. First we note that there are no restrictions on the combination of motions of the same kind in different dimensions. For instance, rotations in different scalar dimensions can combine by rotating around the same central point.

(56) The normal progression, both of the natural reference system and of the added motions, is a continuous *succession* (rather than a combination) of units of the same kind. As soon as one unit of the progression ends, another one begins. But the units in a succession do not necessarily have to be identical. For example, the two-unit cycle of simple harmonic motion has the same initial and final points as a two-unit segment of unidirectional linear motion, and therefore fits into the linear progression. We may generalize this situation and say that *compatible* units of a different kind of motion can replace units in the normal progression.

(57) It follows from (44) and (56) that compatible units of motion added in a dimension of an

12 The crystal is continuous in the *time* of the reference system, but discontinuous in the *space* of the reference system.

existing motion will merge with this previously existing motion, merely altering its magnitude. Formation of a *compound motion*, a combination that retains the distinction between its components, therefore requires the addition of an incompatible motion.

(58) Except where outside forces intervene, the added motion must oppose the original in order to achieve stability. Otherwise there is nothing to hold the components together. The opposition reduces the net total magnitude of the motion, and since lower numbers are more probable than higher numbers, this makes the combination more probable than independent existence of the components.

(59) A numerical constraint on the combinations is imposed by the discrete unit postulate. Addition of two inward units of motion to the unit outward progression of the natural reference system produces one net inward unit, the limiting value. The maximum linear addition to a motion combination is thus two units.

(60) Where the motion is n-dimensional, the maximum is two units in each dimension, a total of 2^n units.[13]

(61) Scalar motion is measured in terms of *speed* (or inverse speed). As we have seen, however, the natural datum level is at unity, not at zero. The natural speed magnitudes are therefore the deviations from unity. A deviation downward from unity, 1/1 to 1/*n*, has the same natural magnitude, *n-1* units, as a deviation upward from 1/1 to *n*/1. In dealing with the basic scalar motions we will therefore use the deviations rather than the speeds measured from zero. We will call these deviations "*speed displacements*," abbreviated to "displacements" where the meaning is clear.

(62) Where quantities are reciprocally related, the choice as to which should be called "positive" is purely arbitrary. It will, however, be convenient to refer to the phenomena of our ordinary experience as positive. Since the speeds in our local environment are below unity, we will call a decrease in speed from 1/*m* to 1/*n* a *positive* displacement of *n-m* units, and an increase in speed from *m*/1 to *n*/1 a *negative* displacement of *n-m* units.

(63) The photon, as defined in (20), is a vibrating unit that moves outward translationally at the speed of light. As noted in (22) the frequency of the vibration is limited only by the capacity of the production process. The atom, defined in (33) is likewise a vibrating unit with an added linear (scalar) motion, but in this case the linear motion is rotationally distributed over all directions, and the rotational character of the added motion imposes some restrictions on the numerical magnitudes.

(64) A one-dimensional scalar rotation (28) of the linear vibrational unit generates a two-dimensional figure, a disk. A scalar rotation of the disk around another axis generates a three-dimensional figure, a sphere. This exhausts the available dimensions. The basic scalar rotation of the atom is therefore two-dimensional.

(65) While no further rotation of the same kind (inward) is possible, the entire combination of motions can be given an *outward* scalar rotation around the third axis. This conforms to the requirements of (57)—it is a one-dimensional addition to a two-dimensional motion—and those of (58)—it is an outward motion added to an inward motion.

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13 In three dimensions, a total of $2^3 = 8$ units is possible, not 2+2+2=6, as the effect of dimensional motion is to double the prior number. In a single dimension, there are two possibilities; double for 2D to four, and in 3D, double four to eight.

(66) The vibrational speed displacement of the basic photon may be either positive (less than unity) or negative (greater than unity). For the present, we will consider only those combinations in which the basic vibrational displacement is negative. We will call this system of combinations the *material* system. The system based on the positive photon speed will be called the *cosmic* system.

(67) From (58) we find that where the vibrational displacement is negative the net total rotational displacement must be positive.

(68) Where a one-unit positive rotational displacement is applied to a one-unit negative vibration, the net total speed displacement (a scalar quantity) is *zero*. This combination of motions has no effective deviation from unit speed (the physical datum) and therefore has no observed physical properties. We will call it the *rotational base* of the material system. A similar combination with positive vibration and negative rotation is the rotational base of the cosmic system.

(69) For convenience, we will represent the different motion combinations of this type of sets of numbers representing the speed displacements in the three scalar dimensions. We will specify only the *effective* magnitudes of the displacements and we will use the letters M and C to indicate whether the combination belongs to the material or the cosmic system. The displacement magnitudes will be expressed in the form M a-b-c, where a and b are the effective displacements of the two-dimensional rotation, which we will call the *magnetic rotation*, and c is the effective displacement of the one-dimensional, or *electric rotation*. Negative (spatial) displacements will be enclosed in parentheses. On this basis, the material rotational base is M 0-0-0, and the cosmic rotational base is C 0-0-0.

(70) To the material rotational base we may add a unit of positive electric rotational displacement (that is, one unit of effective one-dimensional scalar rotation), producing M 0-0-1, which we identify as the *positron*. Or we may add a unit of negative electric displacement, producing M 0-0-(1), which we identify as the *electron*. These are the first members of a series of combinations that we identify as the *sub-atomic particles* of the material system.

(71) Addition of a magnetic (two-dimensional) displacement unit to the material rotational base produces M ½-½-0. There are no half units, but a magnetic unit occupies both dimensions, and we therefore credit half to each. We identify this combination as the *muon neutrino*.[14]

(72) At the unit level, the magnetic and electric displacement units are numerically equal; that is, $1^2 = 1$. Addition of a unit of negative electric displacement to the muon neutrino therefore produces a combination with a net total rotational displacement of zero. We identify this combination, M ½-½-(1), as the *electron neutrino* (hereinafter referred to simply as the *neutrino*).[15]

(73) Geometrical considerations indicate that two photons—in different scalar dimensions—can rotate around the same central point without interference as long as the rotational speeds are the same, thus forming a double structure. Any rotational combination with two or more net units of rotational displacement can take the double structure.

(74) This introduces a new situation: the existence of competing structures. The aim of our development of the consequences of the postulates of the theory of the universe of motion is to

14 The muon neutrino was called a “massless neutron” in Larson’s earlier books.

15 Because of the electron neutrino’s net displacement of zero, it can pass through any structure without interference.

determine what *can* exist in that theoretical universe. Thus far we have been able to identify an existing feature of the observed physical universe corresponding to each of the entities and phenomena that we have found that can exist in the theoretical universe. From now on we will have to consider the possibility that the existence of certain structures may preclude the existence of competing structures. The result of the competition in each case is a matter of relative probability. Where the probabilities are nearly equal, the structures may coexist. Otherwise, the structure that is most probable (in a given set of circumstances), is the only one that exists under those circumstances, other than momentarily.

(75) The double rotational structure is more compact, and therefore more resistant to disruption than the equivalent single structures. This gives it a sufficient margin of probability to preclude the existence of any significant quantity of the competing single structures (unless external forces intervene).

(76) We identify the double rotational combinations as *atoms*.

(77) The combination ½-½-1 has a total net rotational displacement of 2 and is excluded by (75). The two-unit magnetic structure M 1-1-0, and its positive derivative M 1-1-1, which have net displacements of 2 and 3 respectively, are likewise excluded for the same reason. But the negative derivative M 1-1-(1) can exist as a particle, since its net displacement is only one unit. We identify it as the *proton*.

(78) A double rotating system with only one net unit of displacement can be formed by a combination of a rotation of the proton type, M 1-1-(1) and a rotation of the neutrino type, M ½-½-(1). We identify this combination, M 1½-1½-(2), as the mass 1 isotope of *hydrogen*. Since the second rotation has a net displacement of zero, the probability difference between this double structure and the equivalent single structure, the proton, is small. These structures therefore coexist under appropriate conditions.[16]

(79) If the cosmic neutrino type of rotation, C (½)-(½)-1, is substituted for the material neutrino type of rotation in this double structure, the combination has net total displacements of M ½-½-0. We identify it as the *neutron*.[17]

(80) Because of some significant differences between atoms and sub-atomic particles, we will use a different system of notation in representing the atomic combinations. This notation will show the *total* speed displacement in each dimension (including the initial non-effective unit), will use a double unit, and will omit the letter symbols M and C, which are unnecessary when the initial unit is included.

(81) To convert the rotational displacement of the mass 1 hydrogen atom from the sub-atomic notation, M 1½-1½-(2), to the atomic notation, we divide by 2, obtaining 1-½-(1), and then add the initial unit, the result being 1½-1-(1). The net effective displacement, in terms of the double unit is ½.

(82) An additional single unit of displacement[18] brings the total to 2-1-(1). We identify this

16 The neutrino has a free dimension and is thus carried by the progression, whereas the proton is gravitating against the progression. This combination will disintegrate in one natural unit of time, unless the neutrino is *charged*, trapping it inside the time of the proton. (See chapter on "Isotopes" in *Basic Properties of Matter*.)

17 The neutron does not require the cosmic neutrino to be charged, as the cosmic neutrino is being carried by the temporal progression, which is *outward in time* and therefore *inward in space*—the same direction as the gravitating proton.

18 The single unit of displacement is ½, the "net effective displacement" for a "double unit" from (81).

combination as the mass 2 isotope of hydrogen.[19] This is the first of the complete two-rotation combinations (those with effective rotational displacement in both rotations). It is therefore given the *atomic number* 1.

(83) One positive displacement unit (atomic basis) added to mass 2 hydrogen, 2-1-(1), neutralizes the negative electric rotation, and produces 2-1-0. We identify this combination as *helium*, atomic number 2.

(84) Successive additions of units of positive electric displacement, or the equivalent, to the helium atom, produce the other members of a series of atomic combinations, the series of *chemical elements*.

(85) Inasmuch as the two-dimensional (magnetic) rotation is the basic rotation of the atom, as indicated in (64), the magnetic rotation takes precedence over the electric rotation where both are possible. It follows that some of the additions to the atomic series involve magnetic displacement in lieu of electric displacement. If we let n represent the number of double magnetic units of displacement (units of atomic number), the corresponding number of single magnetic units is $2n$. When acting jointly in a motion combination, x magnetic units are equivalent to x^2 one-dimensional (electric) units. The $2n$ single magnetic units are therefore equivalent to $4n^2$ single electric units. Dividing by 2 to convert the double units of the atomic system, we find that n magnetic displacement units in an atom are equivalent to $2n^2$ electric displacement units.

(86) Successive additions of magnetic displacement go alternately to the two magnetic dimensions, since small numbers are more probable than larger numbers. One magnetic unit added to helium, 2-1-0, produces 2-2-0, which we identify as *neon*.

(87) Helium already has one effective magnetic displacement unit in each magnetic dimension. Thus the increase from 2-2-0 involves a second unit in one of the dimensions. From (85), this second magnetic unit is equivalent to $2 \times 2^2 = 8$ electric units. It should be noted that this is the electric equivalent of the *second* unit, not the sum of the two units. The reason is that the progression in the region inside unit space takes place in time only, and the succession of values is 1/1, 1/2, 1/3,… 1/n. The number of time units involved is 1, 2, 3,… n. Thus the value 2 applies to the second unit only, not to the total of the first two units.

(88) The first four additions of electric displacement units to helium produce the following series of elements:

Number	Displacements	Element
3	2-1-1	Lithium
4	2-1-2	Beryllium
5	2-1-3	Boron
6	2-1-4	Carbon

(89) As long as the magnetic displacement—the major component of the atomic rotation—is positive, the electric displacement—the minor component—can be negative without violating

19 *Deuterium*. In the Reciprocal System, deuterium is the *first atomic element*, Z=1, and *not* an isotope of hydrogen. The neutrino is not a full double-rotating system making hydrogen *subatomic*, and subatomic particles do not have isotopes because they are an *atomic* property. *Tritium* would be the first isotope of deuterium.

the requirement (67) that the net total rotational displacement of a material atom must be positive. Carbon can therefore exist with the alternate displacements of 2-2-(4). Here the neon type magnetic rotation with net displacement 10 is combined with 4 negative electric displacement units, for a net positive total of 6, the same as the net displacement of the 2-1-4 combination. The probability difference between these two combinations is small, and both are found observationally. Beyond carbon the probabilities favor the smaller negative electric displacement. The normal forms of the next three elements are therefore:

Number	Displacements	Element
7	2-2-(3)	Nitrogen
8	2-2-(2)	Oxygen
9	2-2-(1)	Fluorine

(90) Another group of eight elements follows, bringing the second magnetic dimension up to two effective displacement units at argon, 3-2-0. A further one-unit increase raises the effective displacement level to 3 units in one of the magnetic dimensions. The third magnetic unit is equivalent to 2×3^2=18 electric units. Two 18-unit groups of elements therefore follow, increasing the displacements first to 3-3-0 (krypton, element 36) and then to 4-3-0 (xenon, element 54). Finally, there are two groups of 2×4^2=32 elements each. The first of these carries the series of 4-4-0 (radon, element 86). The second would reach 5-4-0 (element 118), but here another factor intervenes.

(91) From (60), the maximum three-dimensional scalar rotation has a magnitude of eight units. The significance of this is that at a speed displacement of eight net units, the rotationally distributed progression reaches the same scalar location, the end of the spatial unit, that a linear progression reaches in the same time interval. The next unit of the progression then begins without any limitation on the nature of the coupling to the reference system. In the absence of such a limitation, the motion takes the most probable form, a unidirectional linear progression. This means that at element 118, where the rotational displacements are 5-4-0, and there are a total of eight effective magnetic displacement units (four in each dimension), the rotational combination of motions disintegrates and reverts to the linear basis. The series of chemical elements therefore terminates at element 117.

(92) Because the succession of speed displacements follows the definite pattern outlined in (84) to (91), each element can be characterized by a unique set of numbers (subject to some modification under special circumstances). These are the values that enter into the various equations which determine the magnitudes of the different properties of the elements and their combinations.

(93) Each successive element in the atomic series adds one double unit of positive three-dimensional rotational speed displacement to the combination of motions (the atom). In (34), three-dimensional speed displacement, positive in the material system, was identified as *mass*. The atomic mass is expressed in terms of *atomic weight*, the unit of which is half the rotational mass corresponding to the atomic number. The *rotational mass* of an atom of atomic number n is thus *2n* atomic weight units.

(94) When physical quantities are resolved into component quantities of a fundamental nature, these component quantities are called “dimensions.” Since we postulate that the physical universe is composed entirely of units of motion, a relation between space and time, the

dimensions of all physical quantities (in this sense of the the term) can be expressed in terms of space and time only. From (34), the three-dimensional gravitational motion of the atoms of matter has the dimensions s^3/t^3, where s and t are space and time, respectively.

(95) In order to change the spatial position of an atom, or an aggregate of atoms, an outward motion must be applied against the inward scalar motion of the atom. That inherent inward motion then acts as a resistance to the applied outward motion. In this capacity as a resistance, or *inertia*, the mass acts as the inverse of a three-dimensional speed, with the dimensions t^3/s^3. In practice, gravitation is measured in terms of force, a derivative of inertia, rather than in terms of speed. Both the gravitational and the inertial relations are therefore expressed in terms of the t^3/s^3 magnitudes.

This explains why measurements of the "gravitational mass" and the "inertial mass" arrive at the same result.

(96) Having established the space-time dimensions of mass, we can now define the dimensions of the other physical quantities of the mechanical system. The product of mass and speed, *momentum*, is $t^3/s^3 \times s/t = t^2/s^2$. The product of mass and the second power of speed is *energy*, is $t^3/s^3 \times s^2/t^2 = t/s$.[20] *Acceleration*, the time rate of change of speed, is $s/t \times 1/t = s/t^2$. *Force*, the product of mass and acceleration, is $t^3/s^3 \times s/t^2 = t/s^2$.

(97) Physical phenomena with the same dimensions have the same general status in physical interactions and are interchangeable. For example, all phenomena with the dimensions t/s are equivalent to energy, and can be converted to kinetic energy by appropriate processes.

Section C

In this section, we examine the application of the general physical principles developed in Section A to the basic phenomena of another physical field. The field selected for examination in Section B was chosen to show how the quantitative relations emerge easily and naturally from the mainly qualitative general principles and relations. Now in this third section, we demonstrate the ability of the theory of the universe of motion to clarify the theoretical relations in a field that has heretofore been subject to much confusion. As in the preceding sections, each statement is a deduction from the postulates of the theory or one or more of the numbered statements earlier in the outline.

(98) The only difference between the effective component of the electron, M 0-0-(1), and the rotational base, M 0-0-0 (69), is one unit of rotational space displacement. It is therefore a rotational combination with the dimensions of space.

The term "electron," as used in this outline refers to the particle defined in (70). Similar particles carrying charges will be identified as "charged electrons."

(99) As noted in (97), different physical phenomena with the same space-time dimensions have the same status in physical interactions. From the general physical standpoint, the electron is therefore equivalent to a unit of what we may call extension space, the "space" of our ordinary experience.

The idea of the equivalent of ordinary space is new to science and may be conceptually difficult for some scientists, but it is the same kind of a concept as the idea of the equivalent of

20 $E = mc^2$, because "c" is a speed, s/t.

ordinary kinetic energy that we have all become accustomed to. For example, if we wish to put a rocket into orbit, what we have to do is to accelerate it to a certain speed; that is, give it a certain amount of kinetic energy. But, in addition, we must provide enough fuel energy to compensate for the difference in the energy of position—potential energy—and lift the rocket against the earth's gravity. This potential energy is not "kinetic energy," but it is "energy," and in relations involving energy in general it is the *equivalent* of kinetic energy. Similarly, electron space is not "extension space," but it is "space," and in relations involving space in general it is the equivalent of extension space.

(100) From (67), the net speed displacement of the atoms of ordinary matter is positive; that is, in terms of effective units there is an excess of time over space. The electron can therefore move through matter, as the relation of space (electrons) to time (matter) constitutes motion, according to the postulates of the theory of the universe of motion. It cannot move thru space, relative to the natural reference system, as the relation of space (electrons) to extension space does not constitute motion.

(101) We identify the movement of electrons through matter as *current electricity*. It should be noted that the current moves through the matter, *not* through the spaces between the atoms, as has been assumed.

(102) The movement of space (electrons) through matter is identical, except in scalar direction, with the movement of matter through extension space. Thus quantities involved in these motions, and the relations between them, are thus the same in both cases. We may characterize the relations involved in the movement of space through matter as the mechanical aspects of electricity.

(103) Since the scalar direction of gravitation (a movement of matter through space) is inward (34), it follows from (102) that the scalar direction of current electricity is outward.

(104) The electrons (effective dimensions *s*) are units of electric quantity, *q*. The rate at which the electrons move through matter (quantity per unit time) is the electric current, *I*, with dimensions s/t, equivalent to those of *speed*. Electrical force, or voltage, *V*, has the general force dimensions t/s^2. The product of voltage and current is power, *P*, with dimensions $t/s^2 \times s/t = 1/s$. The product of power and time is electrical energy, or work, *W*, dimensions $1/s \times t = t/s$. The mass taking part in the current flow is not a constant quantity, but depends on the duration of the current. The mass per unit time, dimensions $t^3/s^3 \times 1/t = t^2/s^3$, is therefore a significant quantity in current electricity. We identify it as resistance, *R*.

(105) To demonstrate the identity of the electric current relations (motion of space through matter) with those of the mechanical system (motion of matter through space), we may compare the energy equations. Kinetic energy is $\frac{1}{2}mv^2$, space-time dimensions $t^3/s^3 \times s^2/t^2 = t/s$. Electrical energy is $Rt\,I^2$, dimensions $t^2/s^3 \times t \times s^2/t^2 = t/s$. Another mechanical expression for energy is force times distance, $F\,d = t/s^2 \times s = t/s$. The analogous electrical expression is voltage times electrical quantity, $V\,q = t/s^2 \times s = t/s$. In both cases the equations are identical, except for the terminology.

(106) Since they are phenomena of the same kind, the flow of electrons through a conductor is analogous to the flow of gas molecules through a pipeline. A constant force (voltage) differential causes a steady flow of current.

This agrees with observation. Existing theory ascribes the flow to a difference in electrostatic potential, which it does not distinguish from voltage. But such a potential difference applied to the charged electron which is assumed to be the moving entity would result in an accelerated motion. Present-day science has no explanation for this contradiction.

(107) From (33), the scalar motion that constitutes the atom of matter is three-dimensional and inward. The one-dimensional outward movement of electrons (units of space) through matter, or through a gravitational field, therefore neutralizes a portion of the gravitational motion and leaves a scalar motion remnant in two dimensions. The physical effects of this residual motion are known as *electromagnetism*. As would be expected, they are similar to those of gravitation, except for the differences introduced by the two-dimensionality.

(108) The residual motion in two dimensions is perpendicular to the dimension of the motion that is neutralized; that is, perpendicular to the electric current.

This provides the explanation of the unique direction of electromagnetism that has heretofore been an unexplained anomaly.

(109) As the residue of the inward gravitational motion, the electromagnetic motion is necessarily inward. However, the orientation of the scalar direction “inward” with respect to the spatial reference system is reversed when the direction of the current is reversed.

Conductors carrying current in the same direction move toward each other, while conductors carrying currents in opposite directions move away from each other.

(110) There is no two-dimensional analog of the electric current because the material system contains no negative magnetic particle. But the equivalent of a magnetic current, a two-dimensional motion through matter, can be produced by various means, such as mechanical movement of a conductor in a magnetic field. This two-dimensional motion neutralizes a portion of the three-dimensional motion of the matter, and leaves a one-dimensional residue. If a conductor is appropriately located, this residue manifests itself as an electric current. The process of producing a current by this means is known as *electromagnetic induction*.

(111) As noted in (1), motion in general is measured in terms of speed. When represented in a spatial reference system, the motion acquires a direction, and speed becomes *velocity*. The introduction of directions does not affect the dimensional relations. All of the previous dimensional conclusions stated in terms of speed are equally valid in terms of velocity.

(112) From (111) and (96), the product of mass and velocity, *momentum*, has the dimensions t^2/s^2. This quantity was formerly called “quantity of motion,” an expression which more clearly indicates its nature. It is actually a measure of the total motion of the mass, which consists of *n* mass units, each having the quantity of motion measured by the velocity. The time rate of change of velocity is acceleration. The time rate of change of the product of mass and velocity, the “quantity of motion,” is *force*. Thus force is, by definition, the same kind of a property of motion as acceleration. We could appropriately call it “quantity of acceleration.”

(113) Since force is *by definition* (112), a *property* of motion, it follows that a *force cannot be autonomous*. The so-called “fundamental forces of nature” are necessarily properties of fundamental motions.

(114) The same considerations apply to the electrostatic force, which, from (112), must also be the force aspect of an electric motion. For an understanding of this motion we return to the

question as to the types of scalar motion that can exist in the theoretical universe. Thus far we have encountered three general types: 1) Unidirectional linear motion; 2) Vibrational (simple harmonic) motion, which is linear motion with a continuous change from inward to outward, and vice versa; 3) Scalar rotation, which is a uniform rotationally distributed scalar motion.

Obviously, there is a fourth possibility, a *scalar rotational vibration*; that is, a rotationally distributed scalar motion with a continuous change from inward to outward and vice versa, a rotational simple harmonic motion.[21]

(115) An independent rotational vibration cannot exist, as there would be nothing to confine the progression to the rotational path, and it would revert to the more probable linear status. But a unit of rotational vibration can be *combined* with a unit of rotation. The inward phase of the rotational vibration is coincident with the corresponding rotation, and has no physical effect. The outward phase is an effective rotationally distributed scalar motion opposing the atomic rotation in the dimension, or dimensions, of the rotational vibration. It thus conforms to the requirement for stability, as expressed in (58).

(116) From (57), the rotational vibration must not be of the same general nature as the rotation to which it is applied. The effect of this restriction is to bar three-dimensional rotational vibration. The added rotational vibrations may be either one-dimensional or two-dimensional.

(117) We identify a rotational vibration as a *charge*, and a one-dimensional charge as an *electric charge*.

Inability to identify any motion connected with the electric charge is one of the reasons why the theorists have accepted the force exerted by the charge as fundamental, even though this conflicts with the definition of force, as noted in (112). The explanation, as indicated above, is that *the charge itself is the motion*.

(118) From (115), the charge must have a carrier, an atom or particle. Independent charges do not exist.

(119) From (117), the space-time dimensions of the electric charge are t/s; that is, the charge is dimensionally equivalent (97) to energy.

The equivalence is demonstrated by the fact that charge and kinetic energy are interconvertible.

(120) Electric charges may be either positive or negative, but the total displacement is smaller, and therefore more probable, if the displacement of the charge is opposite to that of the rotation. Consequently, a positive rotation takes a negative charge, and vice versa. But in current practice the rotational combinations are designated as positive (or electropositive) if they normally take positive electric charges, and negative (or electronegative) if they normally take negative electric charges. It is not feasible to try to change this firmly established practice, so the usual terminology will be applied in the statements that follow, with the understanding that the significance appertaining to the terms "positive" and "negative" elsewhere in this outline is reversed in application to electric charge.

(121) From (26), we find that in order to represent a scalar motion in a fixed spatial reference system it is necessary to identify a *reference point*.

(122) The motion of a positive charge (a high speed rotational vibration) is outward from a negative

21 A common, mechanical analogy would be the back-and-forth rotational motion of an agitator in a washing machine.

reference point toward more positive values, including the positive reference points. That of a negative charge (a low speed rotational vibration) is outward from a positive reference point toward more negative values, including the negative reference points.

The reference system cannot distinguish between positive and negative reference points. This is another of the deficiencies of the conventional spatial reference system.

(123) From (122), two positive charges move outward from the same reference point, and therefore outward from each other (7). Two negative charges do likewise, but a positive charge moves outward from a negative reference point toward all positive reference points, including the reference point of the negative charge, and therefore *toward* the negative charge. Thus, like charges repel each other, while unlike charges attract.

(124) These scalar directions of the electrostatic forces are opposite to those of the corresponding electromagnetic forces (109); that is, like electric charges repel, whereas like currents (those moving in the same vectorial direction) attract.

This agrees with the theoretical scalar directions of these two types of motion, which are opposite. The electromagnetic motion (109) is inward, while the electrostatic motion (115) is outward.

(125) An electric charge can be applied either against the electric rotation or against one dimension of the magnetic rotation. All atoms and sub-atomic particles of the material system, except the electron, have at least one effective positive displacement unit. With the one exception, all of them can therefore take positive charges. Negative charges are confined to the sub-atomic particles with negative electric displacement, and to the electronegative elements with electric displacement of 4 or less. Those with higher displacements are usually excluded by the greater probability of positive charges based on the lower magnetic displacements.

(126) Application of an electric charge to the electron neutralizes the net negative displacement of the particle.[22] As a neutral particle, containing both positive and negative components, the charged electron is able to move either through matter (predominantly time) or through space. The charged electrons move through matter in the same manner as their uncharged counterparts; that is, they move freely through good conductors, less easily through poor conductors, and are blocked or impeded by insulators. We identify the various phenomena involved in the production and movement of these charged electrons as *static electricity*.

(127) Electric charges may also be applied to atoms (existing individually or in combinations), which are then known as *ions*. As noted in (115), each unit of rotational vibration combines with a unit of rotation. The maximum degree of ionization (number of applied charges) is therefore equal to the net rotational displacement. negative ionization is confined to the most electronegative members of each rotational group, and is limited to the magnitude of the negative electric displacement of each atom. Positive ionization can take place up to the number of net positive rotational displacement units in the atom (the atomic number). An atom in this limiting condition is said to be *completely ionized*.

(128) A charge (rotational vibration) may be two-dimensional, rather than one-dimensional. In that case, it constitutes a *magnetic charge*. Material objects carrying magnetic charges are known as *magnets*. Where the charge persists for a substantial period of time, the term *permanent*

22 Since the charge is a rotational vibration and only effective when the outward motion of the vibration is acting against the inward rotation, the particle is only neutral for half the time, which is why charged electrons exhibit the "skin effect."

magnet is applied.

(129) Because of the orientation effect noted in (109) which applies to all two-dimensional scalar motion—the scalar direction (inward or outward) of the motion that constitutes the magnetic charge reverses with the direction relative to the reference system. Thus, a magnetic charge exerts an attractive force on a similar charge in one vectorial direction, and a repulsive force on one that is located in the diametrically opposite direction.

(130) The force exerted by a magnet is the net total of the magnetic forces of the individual magnetic charges on the atoms. Each magnet therefore has two centers or *poles* at which the net magnetic forces in the opposite directions are at a maximum.

(131) From (130) it can be seen that while a magnetically charged object has only two poles, if that object is separated into parts, each part also has two poles.

(132) The existence of magnetic monopoles is excluded by (131).

Present-day physical theory requires the existence of positive and negative monopoles analogous to positive and negative charges, and continuing attempts are being made to find such phenomena, without success.

(133) As in the case of positive and negative electric charges, and for the same reasons (123), like poles repel each other, while unlike poles attract.

(134) Inasmuch as the magnetic charge is the two-dimensional analog of the one-dimensional electric charge, it has the space-time dimensions t^2/s^2. The dimensions of the quantities involved in *magnetostatics*, the phenomena of magnetic charges, are therefore related to those of the corresponding electrostatic quantities (where analogous quantities exist) by the factor t/s.

(135) This relation (134) enables us to make a *positive* identification of the dimensions of the magnetostatic quantities. Magnetic charge, t^2/s^2, is not recognized under that name in current scientific thought, but an equivalent quantity, *magnetic flux*, which has these dimensions, is utilized in many of the same applications. The unit of magnetic flux in the SI system is the Weber, which is equal to a volt-second, dimensions $t/s^2 \times t = t^2/s^2$. The analog of electric potential, t/s^2, is *magnetic potential*, also called *vector potential*, to distinguish it from some other quantities which have, or are thought to have, the characteristics of potential. The dimensions of magnetic potential are $t/s^2 \times t/s = t^2/s^3$. The SI unit is the Weber per meter, $t^2/s^2 \times 1/s = t^2/s^3$. Corresponding to electric field intensity, t/s^3, is *magnetic field intensity*, $t/s^3 \times t/s = t^2/s^4$. This quantity is defined as magnetic flux per unit area, on which basis the space-time dimensions are $t^2/s^2 \times 1/s = t^2/s^4$. Thus, all of these magnetic quantities have dimensions equal to the dimensions of the corresponding electric quantities multiplied by the factor t/s, as required by the theory.

(136) In a number of other cases, the dimensions currently assigned to the magnetic quantities do not agree with those derived from theory in the foregoing manner. Here, the currently accepted dimensional assignments have been based on empirical observations, and the accurate dimensional analysis that is now possible shows that the observations have been improperly interpreted.

(137) For example, observations show that *magnetomotive force* (MMF) is related to the current, *I*,

by the expression MMF = nI, where n is the number of turns in a coil. Since n is dimensionless, this relation indicates that the dimensions of MMF are the same as those of the electric current. The unit of MMF is therefore taken as the ampere, dimensions s/t. But MMF has the characteristics of a force (as the name implies), and the dimensions should be those of magnetic potential, t^2/s^3. The dimensional study shows that the discrepancy is due to the fact that the analog of electric resistance, the *permeability*, dimensions $t/s \times t^2/s^3 = t^3/s^4$, enters into the physical relation and this relation is actually MMF = mnI, where m is the permeability. The presence of this quantity is not detected by the usual mathematical analysis, as it takes the unit value in most magnetic applications, and has no numerical effect.

(138) When the magnetic relations are corrected by introducing the permeability, and making the necessary adjustments to remove some other errors, the entire system of magnetic quantities is brought into agreement with the mechanical and electrical dimensions. This completes the identification of a comprehensive and entirely consistent system of dimensional relations covering the full range of physical phenomena.

The demonstrated ability to express the dimensions of all physical quantities in terms of space and time is not only a powerful tool for analyzing physical relations, but also provides an impressive confirmation of the validity of the postulate that the physical universe is composed entirely of these two components.

(139) The most serious error about conventional electric and magnetic theory revealed by the dimensional analysis, is the lack of distinction between *electric quantity* and *electric charge* that has resulted from the assumption that the electric current is a movement of charges. In present-day practice, both charge and quantity are measured in the same units—coulombs in the SI system. But the interconvertibility of electric charge and kinetic energy (97) definitely shows that charge has the energy dimensions, t/s, while the relations cited in (104) demonstrate just as definitely that electric quantity has the dimensions of space, s, as required by the theory of the universe of motion.

(140) From (139) it follows that there are two distinct kinds of electric and magnetic phenomena: (1) the *electric current* and *electromagnetism*, in which the basic entities are units of electric quantity (dimension s), acted upon by forces due to voltage differences, and (2) the phenomena classed as *electrostatic* and *electromagnetic*, the basic units of which are units of electric charge (dimension t/s) and magnetic charge (dimension t^2/s^2), acted upon by forces due to potential differences.

(141) Electric charges moving through matter or through a gravitational field are carried by particles or atomic constituents with rotational characteristics similar to those of the particles. The movement of these carriers produces electromagnetic effects, while the charges that are being carried produce electrostatic effects.

(142) From (141), an aggregate of charged electrons has both a voltage and a potential.

This explains the operation of such devices as the Van de Graaf generator, in which charged electrons at a low potential flow into a storage sphere in which the potential may be very high. A flow in this direction would be impossible if, as asserted by present-day theory, only one force, electric potential, is operative. But the foregoing development of theory shows, that there are actually two forces involved and the direction of flow depends on the voltage differential, not on the potential difference. The voltage in the storage sphere is determined by the electron concentration, and may be low, even when the potential is in the million volt range.

Section D

In the preceding Sections, we have presented a step-by-step deduction from the fundamental Postulates of the *Reciprocal System* of theory of the phenomena of the physical universe pertaining to the atomic domain. In this section, we carry forward these deductions to the astronomical field and show how phenomena, some of which have not had proper explanations in conventional theory, emerge logically from these deductions. This section, therefore, serves to demonstrate the *general* nature of the Reciprocal System of theory.

(143) At this point, we will need to take into account the concentration of energy in the vicinity of matter subject to electrical ionization, and some consideration of the nature of this concentration will be required. As long as atoms or aggregates are free to move unidirectionally, there can be no significant spatial (volumetric) concentration of their kinetic energy. Such a concentration is accomplished by *containment*. Initially, the spatially restricted motion, *thermal motion*, as we will call it, is contained within the individual units of space. When the energy level is high enough to permit the atoms to escape from the spatial units, a force, exerted either by the walls of a container, or otherwise, is required for containment.

(144) The level of containment outside unit space is measured by the pressure, the force per unit area, dimensions $t/s^2 \times 1/s^2 = t/s^4$. The product PV of the pressure and the volume is the energy of the contained thermal motion, dimensions $PV = t/s^4 \times s^3 = t/s$. We identify the thermal energy level as the temperature.

(145) From (144), it follows that atoms of matter that are not confined, and therefore not subject to any pressure, cannot have temperatures above the very low levels at which they are able to escape from the individual spatial units. Free translational motion of an aggregate of matter likewise has no temperature effect. The motion of this aggregate as a whole is *independent* of the thermal motion of its constituents.

Temperatures of millions of degrees are currently reported as applying to individual atoms and molecules in the vicinity of certain astronomical objects. From the foregoing, it follows that these temperature estimates are erroneous. Temperatures of unconfined matter are in the range of a few degrees, not in millions of degrees.

(146) Ionization is produced by a transfer of speed displacement to rotational vibration from some other form of motion, under appropriate circumstances. Thermal motion is one such source. The degree of ionization of the atoms of an aggregate increases with the temperature of the environment in which the aggregate is located, and at extremely high temperatures all elements are completely ionized.

(147) From (95), the translational motion of masses, including the confined thermal motion, is outward. From (115), the electric ionization is also outward. Thus a further increase in temperature beyond the level of complete ionization ultimately brings the atoms up to a limiting level at which the sum of the outward ionization and the outward thermal motion is equal to unity. This unit outward motion then neutralizes one unit of the inward rotational motion. As indicated in (91), both units revert to the linear status, converting the rotational

vibration and a unit of the rotation to kinetic energy. *Mass* t^3/s^3 becomes *energy* t/s.

(148) The conversion factor relating a unit of mass to a unit of energy has the dimensions s^2/t^2 (the dimensions of the second power of speed) and unit magnitude. The energy equivalent of a mass is therefore the product of the mass and the second power of unit speed (the speed of light).

(149) As to the question of the result of further additions of thermal motion beyond the limiting point defined in (147) (the *destructive temperature limit*[23] of the particular element under consideration), we must first return to (59), where we deduced that the maximum addition to the speed of a motion combination in any one dimension—that is, the amount that can be added to a zero base—is two units. In these terms of reference, the range is from zero to +2. In terms of displacement from the natural datum at unity, the range is from +1 to -1 (or from -1 to +1, as the identification of the conventional zero with +1 rather than -1 is purely arbitrary). The first added unit of speed eliminates the unit of speed displacement (+1), and the second adds a unit of time displacement (-1).

(150) Since there are no fractional units of speed, the reduction of linear speeds to levels below unity in the manner described in (44) can be accomplished only by introduction of units of inverse speed. This is motion in time, but the atom is moving gravitationally in space in the other two scalar dimensions, and the net total scalar motion is therefore in space. It follows, in accordance with (47), that the increments of motion in time in the range between zero and unit speed act as motion in equivalent space.

(151) Elimination of displacement in space (increase of speed) can continue only up to the unit speed level, at which point all displacement has been canceled. A speed greater than unity therefore cannot be attained by means of this process.

This is the explanation of the observed inability to accelerate material objects to speeds in excess of the speed of light by application of electrical forces.

(152) As noted in (151), the limit at the unit level is on the capability of the process, not on the speed itself, and it does not preclude an increase in the speed above the unit level by means of a different process. Where speed is available in full units, it may be added directly, up to the absolute limit, which, as stated in (59), is two, one-dimensional units. Because an increment of speed above unity is a scalar motion in time (equivalent space), the extension of the linear motion in space into the second unit is distributed over all three time dimensions. As in the rotational situation of (91), the existence of three-dimensional units of speed then makes intermediate speeds between unity and two full linear units possible.

(153) The aggregation of matter under the influence of gravitation noted in (34) applies to objects of all sizes. Because of the diversity of conditions there is no uniform aggregation pattern, but since gravitation is omnipresent, the average mass of all major classes of physical objects necessarily increases with advancing evolutionary development—with the evolutionary age, we may say.

(154) The process of aggregation results in the conversion of gravitational motion into thermal motion (heat). Coincidentally, there is a loss of heat from the surface of each aggregate, due to radiation. But the mass, which determines the rate of heat production, other things being

23 See: K.V.K. Nehru's paper, "Intrinsic Variables, Supernova and the Thermal Limit" on how to calculate the destructive, temperature limit for the elements.

equal, increases more rapidly than the surface area. The temperature of a large aggregate is therefore a function of the mass, as long as the aggregation process continues.

(155) Extremely high temperatures are reached only in very large aggregates of matter. If the aggregate is large enough to reach the destructive temperature limit of the heaviest element present, this activates the process of conversion of mass to thermal energy described in (147). We identify such an aggregate as a *star*.

(156) Since the maximum degree of electric ionization of an element is equal to its atomic number (127), the heavier elements have a greater content of ionization energy, and therefore require less thermal energy to reach the destructive temperature limit, the temperature at which the total of these two energy components attains the unit level (149). If the stellar temperature continues rising, the elements reach their destructive limits in the inverse order of their atomic numbers.

(157) The principle that small numbers are more probable than larger numbers applies to the formation of the elements (with some modifications due to other factors). The heaviest elements are therefore present in the stars only in relatively small concentrations, and the energy released in their destruction is dissipated by radiation from the stellar surfaces. As successively lighter elements reach their destructive limits, the concentration of the individual element arriving at the limit increases, and eventually this process reaches an element that is present in quantities that produce more energy than the radiation mechanism can handle. The excess energy then blows the star apart in a gigantic explosion. We identify the overabundant element as *iron*, and the explosion as a *Type I supernova*.

Here the development of the theory leads directly to an explanation of a phenomenon for which no generally accepted explanation has been derived from astronomical theory.

(158) From (154), the temperature limit of a star is also a mass limit. From (153), the attainment of this mass limit is a result of advanced evolutionary age. The stars that explode as Type I supernovae are therefore mature stars of approximately the same mass. Thus all Type I supernovae have the same general characteristics.

The astronomers agree that all Type I supernovae are very much alike, but they have no explanation for the similarity.

(159) When the energy released in the supernovae explosion is added to the already high thermal energy level of the surviving portions of the interior structure of the star, a substantial portion of the explosion products are accelerated to speeds in excess of unity, in the manner explained in (152). From (46) and (47), the motion of these products takes place in the spatial equivalent of outward motion in time, which is inward in equivalent space. The aggregate of these very high speed products thus undergoes a drastic spatial contraction, and appears to observation as a small star with a density vastly greater than that of any aggregate of matter existing in the terrestrial environment. We identify this high density aggregate as a *white dwarf star*.

(160) In ordinary stars (those with component speeds below unity) of a given class, the more massive stars are the larger; that is, they occupy a greater amount of three-dimensional space. From (46), the more massive white dwarf stars occupy the spatial equivalent of a greater amount of three-dimensional time, which is less equivalent space. According to the theory of the universe of motion, the more massive white dwarf stars are therefore smaller than the less massive ones.

This deduction is confirmed by observation.

(161) In ordinary stars the spatial density gradient from the surface to the center of the star is positive; that is, the center is the region of greatest density. From (46), the temporal density gradient of a white dwarf star is also positive, which means that the center of the star is the region of greatest density in time, or least density in the corresponding equivalent space. Thus the spatial density gradient is greatest at the surface, and the lowest at the center.

(162) Little or no translational motion in space is imparted to the white dwarf by the supernovae explosion. It therefore remains in the spatial region heavily populated with low speed explosion products, and accretes a substantial amount of these products by reason of its gravitational effect. The surface layers of the younger white dwarfs thus have a composition similar to that of their environment: predominantly hydrogen, with a minor amount of helium, and minute amounts of other elements. Because of the inverse density gradient (161), the hydrogen moves downward preferentially toward the center of the star, leaving the surface layers of the older white dwarfs enriched in helium.

This, too, is confirmed by observation. A substantial proportion of the white dwarfs are reported to have helium-rich surface layers, extending up to "nearly pure helium atmospheres." Current astronomical theory has no explanation of this reversal of the normal density relations.

(163) In the supernovae explosion (157), the speeds imparted to the outer portions of the exploding star are less than unity. These explosion products therefore expand outward in space. Their motion is, however, subject to resistance from dispersed matter in the environment, and to the gravitational effect of the exploding aggregate as a whole, including the white dwarf that does not participate in the outward movement. These opposing forces ultimately terminate the expansion and initiate a contraction. Thus most of the ejected matter is eventually re-condensed into a star. The typical product of a Type I supernovae is therefore a double star system consisting of a diffuse A component on or above the main sequence and a dense B component (white dwarf or system of planets) below the main sequence.

This deduction from the premises of our theory *requires* the existence of double star systems as a direct consequence of the nature of the supernovae process, and explains why so many of these systems consist of dissimilar objects. The present state of astronomical knowledge in this area is described by the following quotation from a current astronomy textbook: "Our hopes of understanding all stars would brighten if we could explain just how binary and multiple stars form… Unfortunately we cannot."

(164) Any explosive event comparable in intensity to a Type I supernovae ejects some products at speeds greater than unity. The explanation given in (159) for the extremely high density of the white dwarfs is equally applicable to these other high speed products.

This accomplishes a significant simplification of astronomical theory, as the currently accepted explanation of the white dwarf density cannot be extended to such extremely dense objects as quasars, pulsars, x-ray emitters, and dense galactic cores, and separate explanations have had to be developed for the density of each of these types of objects.