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Carbon unites directly with many metals and non-metals but, almost without exception, this combination takes place only at very high temperatures. For instance, when dissolved in molten iron and slowly cooled, carbon forms iron carbide. By treating these metal carbides with superheated steam, chemists in the latter half of the nineteenth century demonstrated that they could synthesize hydrocarbons in the laboratory. A reasonable postulation then may be that, as the earth began to cool, [17] carbon dissolved in the molten interior of the earth (3000-4000° C.) and formed metallic carbides such as iron carbides. As the earth cooled further the tremendous heat, pressures, and convection currents engendered by the compression and radio-active processes in the earth's interior caused almost constant eruptions of this magma to the earth's surface, bringing the metal carbides into contact with the superheated water vapor of the atmosphere. Hydrocarbons would thus be formed in quantity. At lower temperatures around 1000° C., the hydrocarbons exist as free radicals—e.g., methene (CH) and methylene (CH_2)—from which unsaturated hydrocarbons such as acetylene ($C \equiv C$) are formed. In the presence of water vapor these unsaturated compounds take on water and form saturated hydrocarbons.

The earth's molten interior likewise contained compounds of nitrogen with iron and other metals, the nitrides. When these nitrides were

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[17 According to the dust cloud hypothesis, our sun and planets were built by the slow accretion of dust particles due to the forcing pressure of light. (The dust is presumably present due to the cataclysmic explosion of the universe mentioned above. Many such dust clouds have been discovered and are believed to be stars in the making.) According to this theory, there was once a slowly rotating circular dust cloud with the dimensions of our solar system. In time, this dust cloud condensed under the force of its own gravity and began to rotate faster and faster. The central part of the dust cloud eventually collapsed and gained the current angular momentum of our sun—the huge temperatures generated in the contraction process setting off the thermonuclear reactions. The minor dust clouds left behind also began to condense and acquired the current angular momentum characteristic of our planets and the various types of planetary bodies that are found in our solar system. At some time during its contraction period, the earth passed through a gaseous or molten stage at which point we are taking up the sequence of events above. [Oparin maintains that the cooling of a gaseous planet led to the progressive settling of the elements and compounds which reach their solid or liquid states (from the gaseous state) at the highest temperature. This would be carbon, metallic carbides, silicates and water in that order. This settling process was accompanied by violent volcanic activity. This sequence led to the appearance of carbon compounds in their reduced form (e.g., methane) instead of their oxidized forms (e.g., carbon dioxide) as Haldane had postulated many years ago.] Since the planets were relatively small, their heat of contraction was not sufficient to initiate the thermonuclear reaction which would have otherwise made them radiate permanently as suns. In time, the earth cooled further, with the settling out of elements and compounds in progressive order of their specific gravities with the subsequent congealing and formation of the lighter granite continents.]

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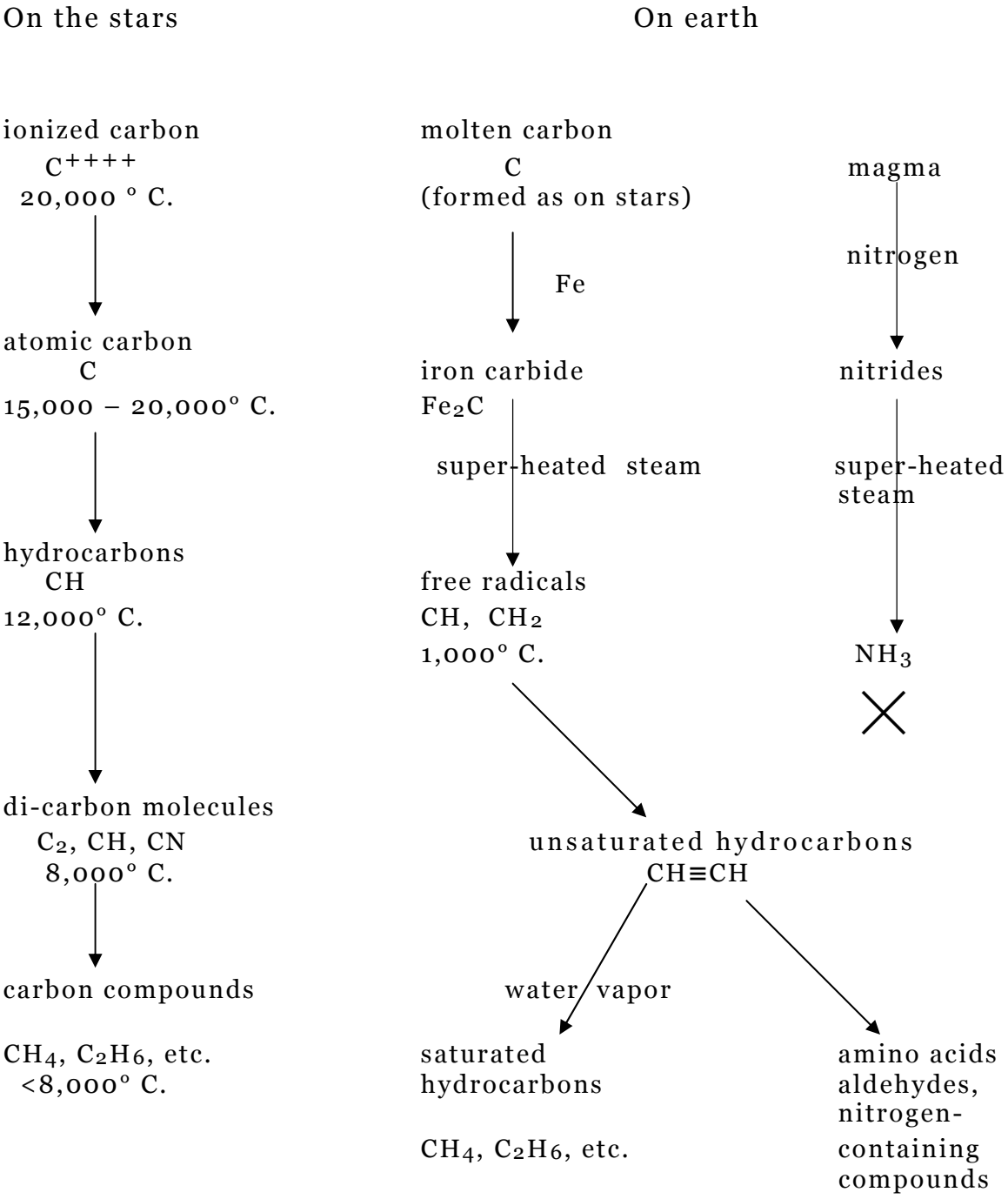
erupted to the surface as part of the magma, they reacted with the gaseous water vapor to form ammonia, NH_3, which even now (along with methane) is an important constituent of the atmospheres of Jupiter, Saturn, Uranus, and Neptune. Then, the unsaturated hydrocarbons, such as acetylene, reacted with this ammonia to form aldehyde-ammonia. There was now present in the atmosphere a mixture of hydrocarbon radicals, unsaturated hydrocarbons, saturated hydrocarbons, nitrogen, carbon dioxide and ammonia.[18] From these were formed—due to slow oxidation and reduction and to other factors such as electric discharge, ultra-violet and cosmic ray radiation—alcohols, acids, aldehydes, ammonia salts, amines, amino-acids, and various other carbon and nitrogen-containing compounds such as the extremely important heterocyclic compounds which play important roles in all living systems. (Heterocyclic compounds are ringed compounds composed of carbon atoms and one other kind of atom such as nitrogen, oxygen, sulfur or phosphate.)

The evolutionary process of the increasing complexity of carbon and nitrogen might be summarized as shown on chart on next page. Thus, the micro-evolution of carbon-nitrogen compounds is conceived as a continuous process of increasing atomic and then molecular complexity from ionized carbon in the hottest stars to the amino acids and heterocyclic compounds in the earth's atmosphere.

After perhaps millions of years, with sufficient cooling of the earth's surface, the critical temperature of water (374° C.) was subsequently reached. Above this temperature, no amount of pressure could form water from the gaseous vapor. At this temperature, however, the tremendous pressures then existent could finally cause it to rain. This rain began far out in space and subsequently deluged the earth for perhaps thousands of years to form the primary oceans. Thus in time, the complex mixture of simple organic compounds formed in the early atmosphere as described above had a fluid medium in which to continue their evolution of increasing molecular complexity. Reactions among these primordial compounds continued both in the hydrosphere and in the water-laden atmosphere. As the heavy rains continued, the atmosphere became less and less dense and finally the sun shone through.


On the stars
On earth
ionized carbon
C++++
20,000 ° C.
atomic carbon
C
15,000 – 20,000° C.
hydrocarbons
CH
12,000° C.
di-carbon molecules
C2, CH, CN
8,000° C.
carbon compounds
CH4, C2H6, etc.
<8,000° C.
molten carbon
C
(formed as on stars)
Fe
iron carbide
Fe2C
super-heated steam
free radicals
CH, CH2
1,000° C.
magma
nitrogen
nitrides
super-heated steam
NH3
unsaturated hydrocarbons
CH≡CH
water vapor
saturated hydrocarbons
CH4, C2H6, etc.
amino acids
aldehydes,
nitrogen-containing compounds

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The simple carbon compounds are capable of being built into an almost infinite variety of complex organic compounds—carbohydrates, fats, proteins, nucleic acids, and their precursors. The same syntheses go on in living cells but at tremendous velocities and in the presence of an intricate network of inter-locking organic protein catalysts, the highly specific enzymes and co-enzymes. However, these same reactions occur in mixtures of simple carbon- and nitrogen-containing compounds in the absence of catalysts if their equilibrium state is disturbed in some way such as by the precipitation of the products of the reaction. The difference is in the slow speed of the reaction and not in its absence.

Moreover, the synthesis of the complex organic compounds is a complex process only in the sense that it consists of a long chain of chemical reactions. These reactions may be classed under three headings: condensation, polymerization, and oxidation, and their respective reciprocals. Condensation consists of a lengthening of carbon chains by the successive additions of carbon atoms or by the union of two shorter chains through a linkage between carbon atoms. Its reciprocal consists of splitting carbon chains at the linkages between the carbon atoms. Polymerization consists of linkages of organic molecules by way of an atom of nitrogen or oxygen and hydrolysis is the reverse. In the former a molecule of water is given up; in the latter it is added. Oxidation is the addition of oxygen, the removal of hydrogen, or some equivalent reaction in which electrons are lost; and its reciprocal is termed reduction.

4. THE CONCENTRATION PROBLEM

Oparin has pointed out that, if the hypothesis of a slow continuous evolutionary increase in organic complexity is accepted as the basis for the origin of life, the "concentration of products in the primary hydrosphere was an absolute essential for further evolution." That is, assuming the primary hydrosphere contained a complex but highly dilute mixture of alcohols, acids, aldehydes, amines, amino acids, etc., how would these compounds become concentrated and, secondly, how would the *same types* of amino acids link to one another to form the long polypeptide chains characteristic of living protein or, more specifically, how would the nucleotides connect to one another to form the nucleic acids and nucleoproteins that appear to be the basis of all living systems?[19] Or put more succinctly by Oparin:

[[19] Both proteins and nucleic acids have a common structure consisting of a main backbone with side groups (heterocyclic bases) attached. Desoxynucleic acid (DNA) of which the genes

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> If we accept the hypothesis of evolution of organic substance, it must be admitted that a successive growth of the molecule, by polymerization of link to link, will indeed result in compounds with definite structures, but these will be static and dead. The primary hydrosphere of the Earth was

> not a pure solution of some organic substance nor did it offer any possibility for the isolation of the former products. Beyond any question one is dealing here with a complicated mixture of high molecular organic compounds in which the infinite growth of chains made of the same type of molecule or group would not occur.

Oparin, however, does not suggest any means which might produce this concentration and separation of like molecules before the colloidal stage is reached, at which stage he posits that coazervation [coacervation] might have affected both the concentration and separation of similar organic molecules via the known isolating and selective adsorption properties of colloidal substances. Bernal, in a recent work, points out that clay and other hydrated particles selectively adsorb many organic substances on their surfaces and hence might well have played an important role in this process of concentration and separation at the level of organic molecules.

Blum in a recent article objects to placing the concentration process in the hydrosphere: "...there seems to be considerable advantage in having the first polypeptide formed in the absence of water where this (the formation of the polypeptide) would be predicated thermodynamically, rather than in a primitive aqueous solution where it would be most unlikely" and offers the following hypothesis. Amino acids were formed in the atmosphere and later precipitated to form pools of such solutions. These pools subsequently dried up and spontaneous polymerization of amino acids into long polypeptides occurred, which takes place readily in the absence of water. Subsequently, in geological ages, the waters returned to these dried up pools and the polypeptides adsorbed on the surface of clays might have played the role of the first enzyme catalysts and in turn might have caused the synthesis of the first protein.

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are comprised consists of a long helical chain made up of alternative sugar and phosphate groups with bases protruding off each sugar in irregular order. The sugar is always the same sugar, always joined onto the phosphate-sugar backbone in the same way. There are four different types of bases attached to the phosphate sugar in irregular order. Two are purines: adenine and guanine, and two are pyrimidines: thymine and cytosine. A few years ago, it was thought that genetic specificity lay in the protein of the chromosome but a great deal of research has pointed to DNA as playing the main genetic role. Consequently, it is currently postulated that the order of the bases is that which confers specificity on a given DNA segment. The sequence of bases is, however, unknown. The writer postulates below that DNA is neither a carrier of genetic continuity nor genetic order but that the quantum structures (mediated by these nucleoproteins) are the carriers of both genetic continuity and biological order.]

The writer, in an unpublished work, suggested that the means of 161
concentration and separation might have been due to the formation of stratification layers of chemical compounds such as amino acids in the primary hydrosphere. The stratification layers of importance were postulated to have existed in the great depths of the sea. The writer based this viewpoint on the properties of both enzymes and the stability

of phosphate-bond energy release at low temperatures. For example, it is known that ATP bond energy release is stable in ice water and that enzyme catalyzed reactions are more stable at lower temperatures. (The enzyme catalyzed reactions are very susceptible to thermal inactivation; the higher the temperature becomes, the more rapidly are the catalytic properties of the enzymes destroyed.) Consequently, at low temperatures such as present in the depths of the sea, in reactions involving ATP, amino acids, and organic catalysts, the reactants and catalysts are stable and can hence display continuous but slow reaction rates. The products formed from such reactions would change slightly in specific gravity and in thermodynamic potentials (a rise in free energy level being postulated) and would hence rise or sink to higher or lower stratification levels and, in these new levels, would continue their synthesis to form the polymerized chains of organic molecules. The inorganic phosphate bonds would be the source of free energy during the reaction and the longitudinal ascent or descent of the products of each reaction would provide the means of continuously disturbing the equilibrium of each previous system of reactants, thereby providing for the continuous transformations of reactants into more and more complex products.

Pringle, following a different approach than the above writers, offers the following view: At the beginning of organic synthesis there were already steady states with a long evolutionary history behind them in the inorganic sphere. These steady states, forming a dynamic-equilibrium, were a balance of auto-catalytic synthetic processes and "death" or entropy-increasing processes with the balance in favor of the auto-catalytic synthetic processes. It was these auto-catalytic synthetic processes, Pringle postulates, that yielded branching chain reactions resulting in organic synthesis. Thus, according to Pringle, "...there is no need to provide for a means of concentration and separation for both essentials are provided for by the above steady states and the branching-chain reactions." Pringle also utilized the great depths of the ocean as the site of the aboriginal organic synthesis pointing out that at these depths turbulence would be at a minimum and the great pressures would facilitate the process of synthesis much as they do in the laboratory.

5. POSTULATES AS TO THE ORIGIN OF THE DYNAMIC CHARACTERISTICS OF LIVING ORGANISMS 162

Most theorists now accept an evolutionary process of one sort or another as the fundamental assumption underlying the appearance of the dynamic characteristics of life. Thus, one theorist postulates that growth and other characteristics of living organisms were due to the appearance of these characteristics in colloidal systems which were a resultant of this evolutionary process. Another theorist postulates that the free energy transport and mobilization system involving ATP antedated both the first protein and the first reproducing system and possibly formed both. Another theorist places the onset of organic syntheses in physico-chemical processes, in balanced steady states, which already had a long evolutionary existence in the inorganic sphere. Some theorists in the past have found it necessary to postulate a sudden leap such as a

thermodynamically improbable event (in a complex mixture of organic compounds) leading to the formation of a protein molecule with some essential property of life such as reproduction or replication.[20]

Oparin, for example, does not try to imbue the organic molecules with dynamic properties until the colloidal state is reached. Oparin sees in the coazervation [coacervation] of hydrophillic colloids (after B. de Jong) the beginning of growth processes, the origin of lability, the beginnings of structural order, the material interchange which is found in more highly developed organisms, etc.

> The mutual attraction of oppositely charged particles can, to a certain degree, overcome the effect of hydration. This so called complex coazervate [coacervate], resulting from the mixture of oppositely charged colloids, exists by virtue of the antagonistic action of the hydration and electrostatic forces, and the stability of the system is determined by the cooperation of two opposed but balanced influences. This imparts to the system the property of extreme lability making it possible for them to shift easily in either direction from the equilibrium point under the influence of the smallest change in external conditions...
>
> Oparin—*Origin of Life*

[[20] The reasoning behind these views goes somewhat as follows. Complex organic molecules in solution tend to form chemical equilibria, but calculations show that from each equilibria—say a complex solution of amino acids—the probability that a polypeptide chain of only ten amino acids would form spontaneously from such solutions is of the order of 10^{-20} and hence, the spontaneous formation of polypeptides of the size of the smallest protein (which contains close to a hundred of such peptide links) would seem to be beyond all probability. Therefore, to account for the formation of a protein, a thermodynamically improbable event must be postulated. However, many recent theorists have rejected these purely statistical considerations which—in the opinion of the writer—are actually the spontaneous generation hypothesis in a quantitative dress, and look to empirical referents to explain the synthesis of the first proteins.]

In the coazervate, Oparin, with B. de Jong, discerns "a structural plan of a more or less regular form." In the process of coazervation itself new surface phenomena appear (selective adsorption by the coazervate of various molecules from the solvent) "..this would result in an increase in size and weight...in other words, in its growth." As a result of the sharp division between the aqueous medium (the primary ocean) and the coazervate: "..the chemical interactions between organism and its environment acquire a rather complex, peculiar character, which we designate as the material exchange between organism and environment." Oparin then goes on to trace the evolutionary history of enzymatic systems whose progressive elaboration led to a gradual rise in metabolistic rate in living organisms. He points out that first there were very inefficient means of molecular catabolism (glucose to butyric acid with a yield of 15 calories); superimposed upon this molecular organization were more efficient means of catabolism (glucose to lactic acid with a yield of 18 calories). The former was not used any more but it can be so used when

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the latter is made inoperative. The next complex organization (glucose to alcohol with a yield of 28 calories) is imposed upon the organization of lesser complexity and lesser efficiency—the property or function of the last one is used for optimum efficiency; each level is more organized and efficient than the other.

In the course of evolution appeared the process of photosynthesis which "...created enormous odds for further rapid growth and evolution in favor of the pigmented organisms. This endowment with pigment put these organisms ahead of the rest of the Earth's population." (This process was to form the basic method of plant metabolism for plants use carbon dioxide and water plus the enzyme chlorophyll and the sun's energy to form the high energy compounds which all animal life employ for their energy supplies.) This process of the evolutionary increase of catabolistic efficiency continues over a period of evolution covering more than a billion years until apparently the optimum efficiency has been reached (glucose to carbon dioxide and water with a yield of 674 calories by the process called oxidative phosphorylation.) To the writer this is a curious fact—the evolutionary increase of catabolistic efficiency takes place over a billion years and then apparently abruptly stops. Further evolution is then attended by the progressive elaboration of the internal medium, by the addition of new, secondary features which increase the organism's power to transport oxygen and carbon dioxide and this is accompanied by the development of a highly elaborate system for hormonal regulation of metabolism which adds to an overall constancy of the steady states in the fluid matrix. The easy way out would be to postulate that the structural potentialities of the nucleo-protein system was exhausted by the appearance of the oxidative phosphorylation system but this view is belied by the appearance of the other complex auxiliaries which served the same purpose of increasing the efficiency of free energy expenditure. For this reason, the writer postulates below that some significant limiting factor was reached by these systems and this was the asymmetry level of the normalizing process in our galaxy or galactic group. When this point was reached in living systems. the normalizing process, to facilitate normalization, developed these auxiliaries above; the great increase in the efficiency of man's agriculture and ways of using his energy via what is called industrialization are continuations of this same process, its acme being reached with hydrogen power becoming available for man's constructive purposes. 164

Blum, utilizing a thermodynamic conceptual methodology in his theorizing, points to the salient importance of the ATP free energy transport and mobilization system in all living systems and postulates that its origin possibly antedated the appearance of the first protein and possibly formed part of the basis for the process of protein reproduction or replication.

> Few of those concerned with the problem of the origin of life seem to have given more than passing attention to the question of mobilization of free energy for the reproduction of the original living systems. Since the reproduction of proteins could not have gone on without a means of energy mobilization, it may also be necessary to assume that these two processes had their origin at the same time

> unless indeed that latter actually antedated the former...And this brings me to the introduction of an apparently new hypothesis of the origin of life. In the metabolism of living organisms the adenylic acid-ATP-ADP system seems an almost exclusive means of carrying out the mobilization and transport of free energy, which it accomplishes by the transfer of energy-rich phosphate bonds. If the first life is to be pictured as arising from a complex mixture of organic compounds, some such from non-living to the living state. It seems reasonable to suggest that the transfer of high energy phosphate bonds by the adenylic acid system may have been this key factor.
>
> Blum—*Time's Arrow and Evolution*

Thus, into the pools described above by Blum that now contained fairly long polypeptides adsorbed on the surface of clays, "there arrived purine ring compounds, carbohydrates, and inorganic phosphorus compounds, which too could have been adsorbed on solid particles, ATP might have been formed, and the stage set for the emergence of the first reproducing system." The long polypeptides previously formed could have served as aboriginal catalytic agents catalyzing the formation of much longer polypeptide chains, eventuating finally in nucleo-protein 165
synthesis, using the free energy of the high energy phosphate for the synthesis.

> The suggestion that the nucleic acid structure may stem originally from that of adenylic acid calls attention to the nucleoprotein. The latter are intimately connected with some of the most important functions of living organisms...In fact the nucleoproteins are so intimately connected with the kind of life processes we know that one can without hesitation select them as one of the most fundamental components of living systems as they exist today and it may justifiably be said life as we know it is based on a nucleoprotein system... Hence one might reason that the nucleoproteins were among the earliest—possibly the first of the proteins... Although the nucleoproteins may have arisen very early in the transition from the non-living to the living state, they do not constitute complete living systems and their advent should not be taken—as some would do—to mark the origin of life... To my way of thinking the origin of life is not to be pictured as occurring at a particular point in time, but as spread over a long period with rather vague limits.
>
> Blum—*Time's Arrow and Evolution*

Thus, according to Blum's theory, the polypeptides marked the origin of the first catalysts, the adenylic acid-ATP system marked the origin of the free energy transport and mobilizations system, and the process or dynamic characteristic of reproduction resulted from their cooperative action.

Pringle, synthesizing facts and theories from various fields and utilizing a combination of statistical thermodynamic concepts and Bertalanffy's hierarchy of open systems concept as his explanatory methodology, states that in order to attain an understanding of evolution and the origin of life, we must focus our attention on the processes involved in life rather than upon their constituents.

> The subject (evolution and the origin of life) can, however, be approached in a different way by focusing attention less on the organic and inorganic aspects

> of the problem and more on the dynamic aspects—on the processes involved in life rather than on the substances in which we see the processes at work in biochemical laboratories. In simple chemical systems the study of processes falls within the domain of physical chemistry, and the object of this paper is to try to relate the phenomena of evolution to the physical and physico-chemical processes which can be safely assumed to have been at work before anything which could be called life appeared on the earth's surface. The basic thesis is this—that the phenomena of evolution is a general type of process, some of whose characteristics can now be defined in a sufficiently precise way for them to be identified in organic chemical and even in inorganic and physical systems, and that just as we suppose the course of evolution of living organisms to have been continuous from simpler to the more complex forms of life, so the extrapolation can be pushed back, beyond the point at which coherent organisms first appeared, into the realm of the chemical evolution of matter and even beyond to the evolution of planets, of elements, and even of ultimate particles.
>
> Pringle— *Symposium on Evolution*

Pringle proceeds to postulate that the evolution of matter is a continuous succession of transitions from one steady state to another. He 166
postulates the existence of an evolutionary type of dynamic process in the inorganic and organic sphere—with successive stages from the purely inorganic, to the borderland between the non-living and living, and then a transition to the living sphere. Each stage in the process manifests a stable dynamic equilibrium and alternative stable states and is capable of existence under slowly changing conditions.

Pringle points to the fact (as we have noted above) that a feature of living organisms and of many living processes is that in them entropy appears to decrease at the expense of a greater entropy increase in the universe. What made this possible in aboriginal living systems in which the entropy increasing tendencies (or "the randomizing tendencies of physical matter as embodied in the second law") were as great as they are now? To this Pringle answers: "...in more detailed analysis, the aspect of the behavior of living systems which makes possible this localized entropy decrease is the autocatalytic synthesis of material in living systems." Pringle thus postulates a general type process which operates in both the inorganic and organic realms that has, as one of its aspects, this autocatalytic feature. Pringle regards this general type process as the balance between autocatalytic-synthetic (growth) processes on the one hand and entropy or "death" processes on the other hand. Such a balance Pringle identifies with Bertalanffy's steady state. The balance is not that of thermodynamic equilibrium but a balance in the favor of the autocatalytic chain-reaction synthetic growth processes. Autocatalysis is of fundamental importance for, according to Pringle:

> ...it is only in systems possessing this characteristic that there can be any escape from the randomizing tendencies of the second law. If a highly organized system like a living organism is to arise from less organized states of matter by any process than a single, highly improbable event, each successive stage in that evolution must have a dynamic permanence which can only occur when

> autocatalytic formation is present, balancing the "death processes" resulting from the tendency to come into statistical equilibrium.

(By autocatalysis in living organisms, Pringle is referring to "the activated enzyme-substrate complex which increases autocatalytically the energy released in the cell via a complex interlocked series of reactions which in turn results in synthesis." In other words, Pringle's autocatalysis actually refers to what is ordinarily called catabolism and anabolism.)

This general type process or steady state has the following characteristics (all of which can be observed in living systems): a flow and ratio of components and self-regulation to sustain the balance of components, irreversibility, growth characteristics, and minimum entropy production. Pringle then proceeds to postulate that such steady states in 167
the inorganic sphere could have served as a transition from the inorganic to the living sphere for, in addition to the above properties, these systems provide for dynamic permanence and alternative stable states. The evolutionary process in the inorganic sphere was such a balanced process containing a divergent element (after Langmuir). Many such processes are known in the inorganic sphere. For example, one crystal (a single event) inserted into a super-saturated solution induces crystallization (induces other similar events) in an autocatalytic fashion. In the organic sphere, low temperature oxidation of hydrocarbons is known to produce chain reactions of considerable length; these chains in turn display autocatalytic branching. The formation of chains of considerable length is the answer to the growth of carbon atoms link to link referred to as the concentration problem above. The side chain branchings are reproductive or growth processes and their differentiation may have led to the appearance of the differentiated subsystems. (The central chain and side chains of such processes grow in interrelationship just as the constituent parts of living systems are observed to grown in certain ratios.) The process of evolution and the origin of life is thus regarded by Pringle as due to a progressive series of steady states which have the above properties and wherein this balance is maintained over time. This leads to the formation of heterogeneous structural organizations in which the dynamic characteristics of life appeared.

In the opinion of the writer, Pringle has enough to conceptualize his general type process in the empirical referent, the "activated enzyme-substrate complex, etc.", (or, in the catabolism-anabolism system) to account for the entropy decreasing nature of living organisms without introducing autocatalysis as a fundamental explanatory hypothesis and without postulating a balance between "birth" and "death" processes. As postulated above, the catabolism-anabolism system (a part of which is the intricate and interlocked system of protein catalysts) is actually a differentiated expression of the two aspects of the unitary field process acting in cooperation and one of these aspects is a free energy maximizing or entropy minimizing feature. When these field tendencies act in cooperation, a creative structuring process is formed part of whose external properties are those of the steady state. It was also postulated above that the "randomizing tendencies of physical nature" are actually

the unitary field in the process of restoring its asymmetry level and have nothing to do with an increase in entropy per se. Any structure that approaches quantum size will display this intrinsic feature of the unitary field, but living systems, being based on a free energy maximizing process, 168
do not display this feature unless they fall out of relation (in any number of ways) with the free energy maximizing process of which they are a part. Pringle's view of the general type process, interpreted in terms of the unitary field, can be easily conceived to underlie all evolutionary processes from the level of ultimate (quantum structure) particles to the psycho-social level of the human.

The writer, utilizing a thermodynamic methodology and synthesizing data and theory from various fields, in an unpublished synthetic work postulated the origin of a "free energy protective process" (within an aboriginal nucleoprotein system) whose intrinsic operation led to the origin of the differentiated sub-systems of living organisms, to biological evolution, and then to the psycho-social development of the human race. The basic idea was that a "free energy protective process" started in a nucleo-protein system which had formed in the depths of the ocean in a very early geological era. Once initiated, the "free energy protective process" tended to continue its intrinsic activity and to promote its own development. Slowly changing conditions of pressure, temperature, and chemical content of the primary ocean were sources of the free energy stress that continuously activated this process operating in the nucleoprotein system. The process, in offsetting this stress, led to the differentiated development of the nucleoprotein system. The primary sensitivities of the process were pressure, temperature, electromagnetic and chemical labilities. Other labilities were acquired as the nucleoprotein system acquired other structural organizations. These primary and secondary labilities, being sources of free energy stress which activated the "free energy protective process," gradually differentiated into the human's physiological sub-systems and the various modalities of the human's nervous system. The human genetic and nervous systems were regarded as highly differentiated expressions of this "free energy protective process." Free energy stress, manifested as subjective experience in the human, led to the development of psycho-social organizations—physiological and cognitive—which are directed so as to offset free energy stress. An environment free of free energy stress in all of its aspects was postulated to be the basic motivational motif in human psycho-social development. What follows are excerpts from this unpublished work adapted for presentation in this book.

The writer began the above unpublished work by pointing out that the free energy change value of chemical reactions is a dependent variable and, as such, is contingent upon the manner in which several variables 169
vary. The measure in which these variables manifested themselves, thereby affecting the free energy change value, was the measure in which some aboriginal (or pre-living) molecular system was affected as a whole. Since a primordial living entity must have been dependent upon the free energy change value for its available energy (actually the free energy change value of some aboriginal free energy substance), it was postulated

that any fluctuations or limitations affecting the free energy change value due to external or internal factors within the system was a stress on the free energy system as a whole.

At the time this development was written there were two views as to the basic nature of the living entity. Some theorists postulated that genes were the aboriginal living entities and were the first manifestation of life, growth and reproduction on this planet and that the complicated organization of cells was first developed under their influence. Another group of theorists postulated that the nucleoproteins were still more fundamental living entities and were the first organizations to manifest the above dynamic characteristics of life—a postulate which the writer accepted.

The writer based his development on Oparin's theory of increasing carbon and nitrogen complexity and attempted to resolve the concentration problem by suggesting the stratification scheme outlined above, which process (it was postulated) led to the formation of the first nucleoprotein. It was pointed out that molecules as large as nucleoproteins fall into the colloidal range; thus, it was postulated that colloidal properties permitted the nucleoproteins to adsorb selectively and retain on their surface many ions and reactive molecules. The acid characteristics of the early seas prevented these reactive particles from interacting with the nucleoprotein upon which they were adsorbed for many long eons. Gradually with widespread land erosion and with the decay of radioactive potassium to calcium, conditions became such that some of the particles adsorbed on the nucleoprotein began to act as catalysts (lowering the free energy of activation) which lead to the initiation of molecular reactions within the nucleoprotein aggregate.

The structural resemblance of nucleic acid to ATP (which, of course, had long been known) was pointed out. The significance of this structural resemblance, this writer postulated, was that nucleic acid was the likely source of the ATP-free energy mobilization and transport system. Thus, the nucleoprotein-aggregate had all the essentials to develop into a living process. It had the structural essentials for a free energy mobilization 170
system which could transport free energy from the external environment (in the form of high energy phosphate bonds) to the nucleoprotein-aggregate. The system had an abundant supply of high energy phosphate bonds in its external environment—the primary ocean—that could be channeled into this system by the ATP transport system. It had the necessary catalysts and other structural potentialities within the nucleoprotein system itself and within the adsorbed aggregate to initiate a reproductive process. How did the sub-systems of living organisms develop from this aboriginal entity which apparently had every potentiality to develop into a living process?

This writer felt that the living process must have possessed certain minimum characteristics at or before the time any living system appeared on this planet. One of these characteristics (which was indicated by a vast amount of biological research) was a free energy maximizing feature.

But this was clearly contrary to the second law of thermodynamics which states that all natural processes tend toward a minimum of free energy. Therefore, to account for this free energy maximizing feature and to accord with the second law, it was postulated that the great concentration of free energy substance in the environment (over and above that intrinsically present within the aboriginal nucleoprotein-aggregate) constituted an unbalanced force which constantly drove the nucleoprotein-aggregate's processes upward thus imbuing the system with a constant high level of free energy despite the operation of the second law.

It was known that when the high-energy phosphate bonds of the ATP molecule are cleaved, phosphate intermediaries accompany the release of energy. According to Lippmann, these phosphate intermediaries function in the process of reproduction (in conjunction with other catalysts) by catalyzing peptide bond formation resulting in the formation of long chains of peptide linkages. Thus, since the nucleic acid provided both the ATP system which functioned as a channel for free energy coming from the environment *and* the breakdown [of] by-products which apparently played a role in nucleoprotein reproduction as catalysts, it was postulated that the energy yielding and the reproductive process must have been closely correlated in this aboriginal entity. The energy mobilization system (ATP) furnishes both the energy and the chemical by-products which function as catalysts in the reproductive process. The reproductive process however, forms more structural organizations which use more energy and hence, yield more phosphate catalysts.

Once chemical reproduction in the nucleoprotein had been initiated in some such manner, it tended to continue as long as there were 171
constantly present high free energy units to replenish those used. The constant supply of energy to the nucleoprotein system was made possible, it was postulated, by an equilibrium established between the energy-rich units in the nucleic acid-ATP portion of the nucleoprotein-aggregate and the high energy phosphate bonds in the surrounding sea. Then, according to Le Chatelier's principle, these units were automatically re-supplied because of the greater concentration gradient existing in the surrounding sea. Through the continuous reestablishment of this equilibrium, the nucleoprotein was always kept at a high level of free energy. The reserve of high energy units in the sea, this writer postulated, was the source of an unbalanced force which the nucleoprotein system continuously used for its reproductive and other intrinsic reactions. Thus, since the nucleic acid-ATP system channeled this energy to the nucleoprotein-aggregate for the continued activity of the nucleoprotein as a whole and simultaneously furnished the catalysts for further reproduction, an essentially continuous process was present. That is, the reproductive and other processes of the nucleoprotein system, once initiated, tended to continue their functioning and their development as long as an unbalanced force in the form of a continuous supply of external energy was present.

The nucleoprotein system apparently had a continuous supply of energy via the high energy phosphate bonds in the environment for many

millions of years. The continuous presence of this unbalanced force led the processes of the nucleoprotein system to manifest a property which, for the want of a better term or really for the want of a better concept, this writer called "chemical inertia." That is, the process of the nucleoprotein system tended to continue their intrinsic functioning and acted so as to oppose any factor (free energy stress) which tended to diminish this unbalanced force. Free energy stress was defined as any factor that could diminish this unbalanced force such as dissipative activity on the part of the nucleoprotein system's processes themselves or any environmental change which would diminish the free energy change value (or the source of) the replenishing high energy phosphate upon which the above unbalance force was contingent. Such free energy stress initiated counter-chemical reactions in the nucleoprotein system that developed structural organizations to offset this stress and thereby sustained the above unbalanced force. Since these counter-chemical reactions of the nucleoprotein system offset free energy stress, the net result of the reactions initiated and the structuro-functional organizations developed was the sustaining or the "protection" of this unbalanced force 172
which in turn furnished the free energy for the continuous development of the nucleoprotein system. It was upon this reasoning that the writer designated these counter-reactions of the processes of the nucleoprotein system as the "free energy protective process."

Thus, according to this development, the origin of a nucleoprotein system within which operated a "free energy protective process" acting to offset free energy stress and thus sustain the above unbalanced force, marked the origin of an organizing general physico-chemical process with diverse labilities in potential form which laid the basis for the subsequent evolutionary appearance of both the plant and animal kingdoms. These "diverse labilities in potential form" were the properties of free energy which are indicated by equations in physical chemistry that relate the free energy change value of chemical reactions to a number of variables such as temperature, pressure, volume changes of a system, electromotive force, pH, ionic and molecular concentrations, etc. (Since the writer had no empirical conception of free energy, it was simply assumed that free energy was channeled into the nucleoprotein system which somehow used the properties of the energy in its differentiations.) To borrow a clarifying concept from Whyte, the free energy channeled into, and impressed on, the yet unorganized nucleoprotein patterns was a field—a free energy field with certain properties which invested the nucleoprotein system with the above diverse potential labilities to react to external and internal environmental variations. These patterns of the nucleoprotein could be differentiated by these environmental variations. The coordinating mechanism that organized all of these primary labilities to form structuro-functional organizations in the nucleoprotein patterns (which permitted more organized responses to similar environmental variations in the future) was the "free energy protective process" itself, for all of these primary labilities were sources of free energy stress which initiated the counter reactions of the process to offset these forms of stress.

Over geological ages, the high energy phosphate bonds (upon which the unbalanced force was contingent) gradually disappeared and a changing environment led to changes in the pressure, temperature, pH, ionic concentration and other characteristics of the oceanic environment all of which were forms of free energy stress. (Perhaps the first major evolutionary trek of an aboriginal living entity was an ascent from the depths to the surface layers of the sea.) The protective process reacting to these sources of stress via the above free energy labilities, developed varied structuro-functional organizations to offset this stress and thereby sustained the unbalanced force. 173

A long series of these structuro-functional innovations by the "protective process" led to the gradual development of the intricate system of enzyme-catalyzed processes (catabolism) which this writer interpreted as the gradual incorporation of this unbalanced force feature into living organisms. Thus, the living organism, by acquiring a process which maximized its free energy, had a continuous unbalanced force within its very structure which constantly worked against the intrinsic free energy minimizing tendencies of the system. (The empirical referents of this unbalanced force, to be sure, were still in the external environment but all the organism had to do was to have a reserve of these on hand to sustain this maximizing process.) Accompanying this biochemical evolution was the gradual development, by the "free energy protective process", of larger structuro-functional organizations and the differentiation of the morphological-physiological-neurological sub-systems whose operations were also organized the protective process. (Perhaps one of the most interesting and best known of these evolutionary developments is the history of the kidney. The change from salt to fresh water involved a challenge—the osmotic pressure barrier—to the free energy labilities to which the nucleoprotein system was sensitive. How the "protective process" developed organizations to offset this stress and hence, adapted the organism to its new fresh water environment is written in the structure of the kidney.) When the point was reached at which the free energy level of the above unbalanced force was matched by catabolistic development on the biochemical level, further evolution (the writer postulated) went into the elaboration of physiological structuro-functional sub-systems: the homeostasis system, the related elaboration of the fluid matrix, the development of the autonomic nervous system, hormonal regulation, etc.,--all of which serve to utilize maximally the free energy available to the organism. Accompanying these innovations was the differentiation of the primary and acquired labilities into the central nervous system. The primary lability to pressure change differentiated to become the auditory, tactile, pain, labyrinthine, and kinesthetic sensitivities or modalities. The primary lability to temperature change differentiated to become our thermal senses. The primary electromagnetic lability differentiated to become the visual modality and perhaps the olfactory modality. (It may be that the olfactory modality is actually an electro-chemical sense being sensitive to both infra-red—or electromagnetic—and chemical variations.) The primary chemical lability differentiated to become our olfactory, gustatory, and reproductive or sexual modality and the many secondary chemical (food) labilities that seem to be localized in 174

the anterior frontal and hypothalamic areas functionally related to the frontal areas. The spontaneous denaturation-renaturation property of the nucleoprotein molecule differentiated out to form the peripheral neuro-muscular mechanisms. Gradually, due to the integration of these primary and secondary labilities and their increasing differentiation, the more elaborate and organized instinctual and perceptual processes were developed. From these latter sub-systems were gradually developed the human's cognitive processes. All of these sub-systems were developed by the "free energy protective process" in it reactions to free energy stress brought about by environmental variations. The coding of biological order was effected by the myriad patterns available in the DNA molecule which nucleoprotein type may have also been the molecular system within which the "free energy protective process" operated.

The phenomenon of evolution itself was postulated to be the resultant of the continued reaction of the "free energy protective process" (within the nucleoprotein system) to the free energy stress over eons of time. The causal factors in evolutionary change were thus the various forms of free energy stress (arising in the external environment or within the processes of the organism itself) which initiated counter-reactions in the nucleoprotein system which in turn developed structuro-functional organizations to offset these forms of stress and by so doing restored or protected the unbalanced force. Spontaneous or random mutations, it was postulated, at best played only a subsidiary role in evolution and, more likely, such factors were sources of "free energy stress" to the "protective process" rather than the primary causes of evolution. When stress was encountered, the "protective process" simply utilized the potentialities available in the nucleoprotein patterns, or those available in the chemical constituents of the nucleoprotein's processes or in the chemical particles which the nucleoprotein could adsorb, to develop structuro-functional organizations to offset this stress. (This is perhaps the underlying reason for the participation of ATP in so many sub-systems such as muscle, nerve, and coenzymes. ATP and its intermediaries were simply constantly available to be used by the "protective process" to form structuro-functional organizations.) When the "protective process" encountered and offset the stress, the total action was recorded as a memory via a discrete pattern change within the DNA molecular system. These pattern changes (mutations) were used by the "protective process" operating in future generations of nucleoprotein systems to develop the more adaptable structuro-functional organizations. 175

A large share of the writer's unpublished work was devoted to the extrapolation of this general type process to the sphere of human psycho-social development. The driving force in human psycho-social development was the same force driving biological evolution; the "protective process" offset internal and external sources of free energy stress by developing structuro-functional organizations which in turn sustained the unbalanced force. The above primary and secondary labilities to free energy stress, it was postulated, took the form of the primary drives and the affects related to the perceptual and cognitive processes. An environment in all of its aspects free of the free energy

stress initiated or encountered via these complex processes, was and is the basic motivation of primitive and modern man. Such an environment was defined by the writer as a physiological and psychological conductive environment.

Man's external physiological conductive environment progressively differentiated from early food gathering and hunting together with cave (and other type) dwellings and the fashioning of crude tools and weapons, to the early development of agriculture, which in turn permitted the growth of the first towns and cities (in what is now called the Middle East) which differentiated into our modern far-flung systems of agriculture, industry, business, finance and commerce. In the human the unconductive environment has as many aspects as there are sources of free energy stress and, conversely, there are as many internal and external aspects to the conductive environment as there are ways and means of offsetting these forms of free energy stress. With the development of symbolization, man acquired a most powerful means of impressing stress on his internal processes (which he could carry with him in the form of concepts and ideas) but at the same time, these symbolizing processes afforded man with a powerful means to offset these stresses. Thus came the differentiation of the superstitious man and his socio-cultural organizations covering more than a period of 200,000 years; he progressively differentiated to become (at a logarithmically increasing tempo[21]) the religious man whose differentiation covered a period of 25,000 years; this led to the philosophical man whose differentiation took 5,000 years; this was followed by the (pure) scientific

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[21 Evolution is a cumulative process and in it, as usual in such processes, there is an effect of acceleration. Early stages were aeon-long and slow beyond imagination. They built a basis on which, finally, more rapid evolution occurred.

Simpson—*Meaning of Evolution*]

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man in 400 years and the predicted differentiation of a nuclear age (or modern) man in perhaps one or two generations. Each type of man and his social and cultural organizations offset free energy stress more efficiently and effectively and was, hence, more adapted to his environment. All these types of men (with the exception of the last whose differentiation lies in the future), their societies and cultures, exist today telescoped into the present. 176

This writer applied the above general type process in an attempt to provide a unitary explanatory concept for the various fields of psychology. The same general-type process was applied to other fields of psychology such as perception, learning, emotions and feelings, the cognitive processes, memory, personality and the universally important role of reified concepts in the individual, society and culture—all of which superseded by this work.

There are many specific objections to the view discussed above but its main significance was that it applied a general-type concept of process to the sphere of psycho-social development; it crudely anticipated

Whyte's concept of the formative process and it led to the conviction that such a formative process (whose intrinsic operation led to the origin of life) could be discovered operating in our astronomical environment. The salient objection to this view of process and to the way life arose was the concept of "chemical inertia." If an unbalanced force upon which any inertial properties were dependent ceased operating, these properties would also cease. However, this writer could conceive of no other way to account for the gradual rise of the metabolistic rate over perhaps billions of years (and yet accord with the second law) unless some very basic property of physio-chemical systems was involved.

6. LIMITATION OF THE ABOVE VIEWS—REINTERPRETATION OF THE LAWS AND PRINCIPLES OF THERMODYNAMICS

All of the above theoretical schemes, in attempting to account for the origin of the dynamic characteristics of life (in the course of an evolutionary process of increasing molecular complexity), implicitly or explicitly share one or both of two basic assumptions: 1. that classical or statistical thermodynamics are adequate explanatory conceputologies which can be used to account for the origin of these dynamic features, 2. that is was molecular particle (usually assumed to be a protein or a nucleoprotein) which somehow achieved a high degree of organization (with chance as the only arbiter) and led to both the appearance and the subsequent differentiation of these sub-systems. It is this writer's view 177
that both of these assumptions contain certain limitations that have proved to be stumbling blocks in attempting to resolve the issues involved in the "origin of life."

It is here suggested that thermodynamic theory is based on two implicit assumptions which, if removed, would merge the first and second law of thermodynamics with unitary theory. One of these assumptions is:

> The energy of a system can be divided into two main categories. One of these is that energy which is dependent upon the position of the system in electric, gravitational, magnetic or any force field, as well as upon the energy of motion of the system as a whole through space. The other category is that energy which is a characteristic property of the system itself and will be called the energy content of a system...It is this last category which we shall call the energy content of the system, that is the domain of Thermodynamics.

The second assumption is that the energy of molecular and atomic motion is the proper empirical referent upon which to base the laws and principles of thermodynamics.

Unitary theory posits that all energy of all systems is ultimately based on the structural asymmetry of the unitary structured field and the field's intrinsic tendencies. The proper empirical referents of the laws and principles of thermodynamics, if these laws are to be generalized into universal laws of nature as they have been in the past, is the structural symmetry of the unitary structured field and the intrinsic tendencies of the field—not the energy of random atomic or molecular motion. Thus,

the potential energy of any system is ultimately traceable to the field asymmetry inducted into the system and kinetic energy is the system in process, i.e., the system going from a more asymmetrical to a less asymmetrical configuration. (The motion of a system is part of the structural configuration of the system.) When "heat" is introduced into an isolated system, structural asymmetry is actually introduced into the system. When the system approaches thermodynamic equilibrium, the system approaches the level of structural asymmetry of the system's surroundings. The incessant motion of the atoms and molecules at thermodynamic equilibrium is due to the fact that these particles are closed to the free energy field structures in size and, hence, become involved in the normalizing activity of the unitary field which is a tendency toward uniformity of asymmetry observed as the tendency toward complete randomization of the molecular and atomic velocities.

Unitary theory, in positing that all energy of all systems is based on the structural asymmetry of the unitary field, consequently holds that the division of energy into the energy of the field and that of an internal system is a convenient but not a valid differentiation. The thermodynamic property of "internal energy" does not exist as a separate property from the structured field. If this bifurcation of energy is allowed, then thermodynamics as a separate discipline exists; if this division is not allowed, then laws and principles of thermodynamics are seen to be part of unitary theory. If this division is allowed, then the conservation of mass, energy and momentum are not seen as aspects of a unitary field process. If this division is allowed many complex problems such as the "inside-out" problem arise. (After Allport); 178

> The situation is not unlike ballistics in the physical world. A ball that is thrown has a characteristic trajectory as a whole; but there is going on within it at the same time a complicated dynamic process involving molecular and atomic cohesive actions and vibrations. That is, there is also an "inside" structure. We feel that these two structures must be related but the ordinary principles of mechanics do not show us how.

At first glance one many not think that this "inside-out" problem is of much importance; however, when one realizes that the most widely accepted theory in cosmology (the theory of the expanding universe) hinges on this problem, it takes on its true significance. (The transactions between a living organism and his environment are, of course, of crucial importance for biology, psychology and sociology but mechanical theory gives no hint of how they occur beyond an impingement of stimulus energy hypothesis.) Unitary theory relates the photon to both tendencies—that of the larger context (the field as a whole) which invests the photon with both its energy level and its frequency, and those of the structures within the photon itself which tend to undergo asymmetry to symmetry change over time. The expanding universe theorists do not relate the inside and outside structures and hence, look to the Doppler effect to explain the red-shift.

The various statements of the second law may be grouped into two categories—one referring to free energy and the other to entropy. The two concepts from the unitary viewpoint each refer to but different

aspects of the same tendency; that is, both refer to different aspects of the decrease of structural asymmetry in isolable processes. That aspect of the second law referring to free energy may be summarized by the statement: "All naturally occurring processes tend to change spontaneously in a direction which leads to equilibrium." From the unitary viewpoint, this actually is atomic or molecular sub-systems or their macro-aggregates spontaneously going from a less to a more symmetrical configuration. The changing structural configuration of the system exerts the force of "free 179
energy" properties and the change in the asymmetry level of the sub-system is the change in free energy of the system. That aspect of the second law referring to entropy is summarized by the following statement: "The essence of the second law is that heat is never converted completely into work without some permanent change in the system." From the unitary viewpoint, the entropy principle signifies that symmetry never decreases in an isolated system without an increase in structural asymmetry in the system. Entropy, S, in this sense represents the structural field asymmetry per degree of absolute temperature which is converted into structural field symmetry.

For example, this situation in the extreme seems to be the case of the structural organizations containing population II stars in the universe. (This one-way tendency toward maximum symmetrization must be going on at the present time in our earth and may be the primary process which underlies geological change.[22]) These stars, found mainly in globular clusters, in elliptical galaxies, and in the nuclei of spiral galaxies have apparently converted their structural asymmetry to structural symmetry and have lost the potentiality for further change. These are dense, slow moving systems which appear to be in advanced stages in stellar evolution. (Where did their increased density come from and where did their energy and momentum go? The suggestion is that their energy-—other than that given off in radiation—and momentum which are part of the same structural configuration, have both been converted into structural symmetry which appears in part as an increase in the system's density.) Thus, it is postulated that the population II stars represent systems in their maximum symmetrization which have converted their structural asymmetry to structural symmetry over a long period of one-way stellar evolution. This, however, is not their end for they are still governed by the normalizing process of the field as a whole, which action, in restoring the level of asymmetry in the filed, this writer postulates, is manifested by the stars becoming novae or exploding stars. [Perhaps one of the last steps in the final symmetrization of a star is the asymmetry to symmetry change of the

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[[22] Radioactive decay seems to be the primary process in this tendency toward symmetrization which underlies geo-chemical evolution. But this writer would hold that there are other far more subtle and, perhaps, far more important (for geo-chemical evolution) symmetry changes that occur in each and every atomic nucleus in our planet, but those changes are so subtle that they can not be detected by present physio-chemical methods. Both of these symmetrization tendencies, however, are responsible for the three great geological processes: gradation, diastrophism, and volcanism, which in turn are responsible for geological change (rock cycles) and geo-chemical evolution (e.g., the increasing compactness of the earth).]

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very quantum structures (mesons—after Yukawa) which couple the 180
particles together in the atomic nuclei. This event is perhaps the spark that initiates the transformation of a star in[to] a nova. Due to the loss of the nuclear binding structures (the star's energy and rotational velocity have already been lost by conversion into structural symmetry), the star begin to collapse into nuclear matter. The protons and neutrons and other nuclear particles acquire tremendous velocities due in part to proton-proton repulsion which serves to disintegrate the unexploded portion of the star.[23] Most nuclear particles simply disappear into the field, the normalizing process converting the particles back into structural field asymmetry once again. A few protons and other nuclei may escape the conversion process and acquire high enough velocities to escape to outer space as cosmic rays.] At the moment the star begins to explode and its rigid symmetry is progressively destroyed, the entropy (or structural symmetry) of the system begins to disappear. This signifies that the stars are being converted into structural asymmetry (or energy) once again by the normalizing process restoring the particles of the exploded stellar aggregate to the level of asymmetry of the field as a whole. Thus, the universe does not approach an entropy nor a rigid symmetry death, for all structural organizations within it are part of a continuous process of creation and final symmetrization. The universe as a whole, moreover, is independent of time; the time represented by the symmetrized star disappears with its explosion and its quantum structures are used to form other structural aggregates—one after the other—elsewhere in the universe.

The second law states that all real systems display a tendency toward maximum entropy which is conceived as a tendency toward maximum disorder or maximum disorganization. But unitary theory asserts that the tendency toward maximum entropy in a system is the tendency toward maximum structural symmetry and that what is observed as a tendency toward maximum disorder or disorganization is not part of the entropy tendency but is the unitary field displaying its tendency toward uniformity of asymmetry. The randomization of atomic and molecular motions reduced to their property empirical referent is not a manifestation of a "death process" in nature nor is it (when the whole context is taken into consideration) a tendency toward disorder and disorganization. On the contrary, it is a free energy maximizing process and that aspect of the unitary

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[[23] Or the velocity may be acquired as recoil and after leaving the site of the reaction, the velocity may be considered to be simply the effect of extreme temperatures.]

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process which confers temporal order, one-way development features, and 181
the appearance of increasing order and organization in all structural organizations in the universe. It is this aspect of the unitary process which inducts structural asymmetry into sub-systems so that they display the free energy force properties and entropy increasing tendencies as described by the second law. But in terms of empirical referents, both of these tendencies result in the formation of more complex structural aggregates. The continuous operation of the normalizing process results in the coupling

of these more complex structural aggregates one after the other so that what we call temporal order appears in these systems. (The normalizing process prevents the structural aggregates from approaching their maximum symmetry configurations.) The normalizing process uses these symmetrical aggregates, coupled one after the other, to synthesize patterns of structures which facilitate normalization so that the features of one-way development appear in these systems. The normalizing process in a particular structural system must be sustained by the environment of the system (its asymmetrical structures continually approach symmetry) and the environment must furnish the system with other structural components; the system thus undergoes a one-way development in accordance with its environment. Thus, due to these continued operations, we have a system which increases in order and organization in accordance with a particular environment. Herein lies the salient difference between thermodynamics and unitary theory—thermodynamics predicts the discovery of a death process as the salient process in nature whereas unitary theory predicts the discovery of a creative-formative process in nature that works toward the increase of order and organization. When one aspect of this process predominates, a rigid structural symmetrization sets in which may be called death since the system has lost the potentiality for change. This rigid symmetrization, however, is ultimately disrupted and the structural components are used to form new structural organizations elsewhere in the universe. When the normalizing tendency greatly exceeds the tendency for asymmetry to disappear in isolable processes, the structural aggregates formed are either dispersed or structural aggregates with a high level of asymmetry appear. But the two tendencies are acting in some degree of cooperation; neither tendency is ever present alone. The unstable by-products of this process, at its most basic level, it is postulated, are the major source of cosmic rays in the universe. In this process, the normalizing process is involved creatively forming quantum structural aggregates or "matter" from structural asymmetry or "energy."

The implication of the unitary view is that there is a balanced process 182
in nature (the unitary field) wherein structural asymmetry is continuously being converted into structural symmetry and wherein structural symmetry is continuously being converted into structural asymmetry so that all configurational properties of the field—matter, energy, momentum, etc.—remain essentially constant in the unitary field. This balanced process is the unitary process and the first law of thermodynamics can be stated in terms of it in such a way that it also includes the second law. The first law of thermodynamics should read: free energy (structural asymmetry) is continuously being converted into structural symmetry (matter which includes entropy) and structural symmetry (matter) is continuously being converted into structural asymmetry in a balanced process so that all configurational properties of the field—matter, energy, momentum, etc.—remain essentially constant. The significance of this interpretation of thermodynamics is that the tendency toward "disorder" or "disorganization" as a universal tendency of nature disappears from fundamental theory. A further implication is that we live in a steady state universe which had no beginning and which will have no end. (The universe, when taken as a whole, is timeless because the unitary field is

timeless. The empirical referent of what we call time is due to one structural aggregate coming after another; when that order is destroyed, time disappears.) This steady state universe is a homogeneous universe in which galactic groups are fairly evenly distributed throughout and which groups have random recession and approach velocities in respect to one another. New galaxies and galactic groups are being constantly formed by the formative process described by Whyte and their rate of formation is balanced by galaxies and galactic groups undergoing their final symmetrization.

This, then, would be the answer of unitary theory to the first assumption (that classical or statistical thermodynamics are adequate conceptuologies.) The second assumption in the above view is the particle hypothesis. The particle hypothesis is the view that seeks the understanding of the appearance of the dynamic characteristics of life in molecular particles, in their discovery and in the elucidation of their properties. From the point of view of the particle hypothesis, "life" is a manifestation of the existence of proteins or the point of view that the dynamic characteristics of life originated due to the organization acquired by the protein or nucleoprotein molecule with "chance" as the only arbiter. The main objection to this point of view is that it neglects the possibility of 183
the existence of a formative process in nature which might account for both the origin of these dynamic features and for their organization into the structural entities we call living. Therefore, without a knowledge of the formative process, these organizational features must be qualitatively or mathematically contrived; the number of particulate hypotheses involved or the mathematics employed become vastly complex and only a small fraction of the observed order is accounted for with much left unexplained. Unitary theory points to the intrinsic properties and formative tendencies of the unitary structured field as the organizing process which led to both the origin of the dynamic characteristics of life and their organization. Energy, matter, and life are all manifestations of the unitary structured field and its intrinsic formative tendencies. Unitary theory asserts that this creative formative process can be discovered in nature and its properties determined. This writer posits that this creative process can be discovered operating in the region of high cosmic ray activity.

C. The Origin of Life as a Manifestation of a Universal Formative Process

1. GENERAL CHARACTERISTICS OF OUR GALAXY AND OUR UNIVERSE

Of the many achievements of modern science, few discoveries captivate and assault the human imagination more than the discoveries of modern astronomy. The astronomer tells us of gigantic stellar aggregates—gigantic star cities [star groups] no less—numbering into the thousand billion or more and each star city [star group] with its billions of individual stars and these star cities [star groups] spread over distances so great that even the most powerful telescope fails to plumb their furthermost depths with the time of their existence to be reckoned in terms of billions upon billions of

years. It is little wonder that even the most hardened observer gazes upon this celestial panorama in perpetual amazement and that the dualist, terrified, shrinks from it and, attempting to find solace in the broad interpretation of some ancient doctrine, is terrified even more and pulls the dualistic cloak ever so tightly about his cognitive processes that he may shut out that reality of which he is a part. Yet, despite its awesome nature and titanic dimensions, despite offering almost insurmountable obstacles, the complex starry cosmos has slowly yielded to human understanding. The astronomer, in conjunction with the physicist, chemist, mathematician and geologist, is in the process of discovering its general structure and now knows enough of its details as to its size, age, shape and composition to make astronomy a field sparkling with controversy. The universe of today 184
is far from the "unfailingly repetitive clockwork" imagined by Copernicus, Kepler and Newton; it is a universe of motion, of change, of youth and age, of one-way development. Yet despite its colliding galaxies, its exploding stars, its fantastic speeds and other features characteristic of pervasive change, one cannot help but be impressed, as were the ancients, with its equally pervasive characteristics of order and organization.

Realizing that the issues are still matters of controversy and that they will ultimately be resolved by refined technique leading to refined observations rather that by refined theory without benefit of this labor, and assuming that the globular clusters are "abortive galaxies"—that is, galaxies which have failed to mature—it seems that the galactic group is the structural unit of the universe. That is, each galactic group seems to be a sub-system of the larger system which, collectively, we call the universe. The universe seems to be composed of a vast number of these galactic group sub-systems each of which is united by gravitation within a radius of several million light years and all of which are more or less uniformly distributed throughout space and which are somehow interrelated to give the whole which is the universe. The number of galaxies in these galactic sub-systems vary from one for the hermits, to a few such as the seventeen for our galactic sub-system, to densely clustered sub-systems containing as many as five hundred separate galaxies. (The latter are so close that they produce the interesting spectacle of colliding or, perhaps more accurately, inter-penetrating galaxies whose clashing gases generate radio waves we pick up on our planet.) Our galaxy has been discovered to be a gigantic, rotating, spiral-shaped stellar aggregate comprised of 100 billion stars—an important one of which (to us) is our sun. (It would behoove the astronomers to give names to other galaxies in addition to the confusing non-esthetic M and NGC numbers.) Our sun is located near to the rim, in one of the spiral arms, of our galaxy. If we stand with our arms outstretched so that they parallel the Milky Way, to our front, 28,000 light years distant, lies the galactic center; as we face about the vast reaches of intergalactic space lie before us, and to our left and right lie the star-bedecked lanes of the spiral arms of the Milky Way.

The various galaxies of the galactic groups may be classified into several types according to their particular shapes. (The different speeds of their rotation are said to account for their different shapes.) Hubble recognizes three main types: the turbulent, irregular galaxies which

comprise three per cent of the total galaxies in the universe; the fast spinning, spiral galaxies which comprise eighty per cent of the total; and the slow moving, densely packed, elliptical galaxies which comprise the remaining seventeen per cent of the total. Up to a few years ago, many 185
astronomers held that all of these galaxies were approximately of the same age but it is becoming more and more apparent that these three types of galaxies actually form a galactic evolutionary sequence from youth to old age. First come the new born systems—the irregular galaxies with their turbulent (little organized) movements. Then these develop into the fast moving spiral galaxies with their more orderly movements. And as the spirals gradually mature, they develop into the densely packed, slow moving elliptical galaxies.

Within the last decade, Baade made the epoch making discovery that the stars in stellar organizations fall into two distinct groups. The stars between the arm of spiral galaxies, the stars of globular clusters (satellite systems containing thousands of very faint stars which have a globular shape and extreme central density and which seem to accompany all the larger galaxies), the stars within the nuclei of spiral galaxies (especially those with a large central core), and practically all the stars within the elliptical galaxies are red giants or white dwarfs. These stars are called population II stars; the elliptical galaxies and globular clusters are almost pure systems of population II stars. In stellar aggregates that contain these type stars, the pulsating stars and exploding novae are found. In other words, the variable and exploding stars are population II stars. On the other hand, in the irregular galaxies and in the arms of spiral galaxies an altogether different stellar population is found although some population II stars are also present in these systems. These stars are called population I stars and stellar aggregates which contain these stars sparkle with the beautiful O and A blue stars such as we seen in our own heavens.

The relation between color and size is straight forward for the population I stars; the largest stars are blue and hot, the smaller are red and cool; whereas in the population II stars, the giants are red and cool and the smallest are either extremely hot or extremely cold with no intermediate temperatures. The population I stars can be arranged into an evolutionary sequence (such as the Harvard classification O – B – A – G – etc., utilized by Oparin above to trace the progressive increase in carbon complexity) whereas the population II stars fall into a class—either the red giants or the white dwarfs. What seems of particular significance is that the regions containing the population II stars are devoid of cosmic dust and gas whereas the stellar aggregates that contain population I stars are heavily laden with gigantic clouds of gas and dust. (As will be recalled, astronomers believe that this cosmic dust and gas are the raw material 186
used in the creation of new stars. Such new stars—the O-associations—have been recently discovered in the spiral arms of our galaxy. These stars squander their substance in a short time and have only temporary existences and, hence, they can not be more than a few million years old.[24])

The interpretation given to these diverse stellar populations is that they represent different stages of stellar evolution. Based on the assumption that all the galaxies were created at the same time in the cataclysmic explosion hypothesized above, it is conjectured that when the population II stars were created five to ten billion years ago all of the cosmic dust and gas were used up in their creation. The stellar aggregates containing the population II stars thus are thought to have evolved unreplenished with new stars since birth; hence, the stellar aggregates containing the population II stars are thought to be systems of very old stars. Population I stars, on the other hand, undergo similar evolutionary processes but in the creation of the stellar aggregates containing these stars, again some five to ten billion years ago, a great deal of cosmic dust and gas were left over. Hence when the population I stars burn out, they are simply replaced with new blue giants formed from the dust and gas floating in these systems. Thus, the stellar aggregates containing the population I stars still are thought to sparkle with their primordial brilliance and look much the same as they did when they were first created.

The existence of population I and II stars in different stellar aggregates is perhaps the best evidence for the evolution of galaxies. The irregular galaxies contain population I stars in such overwhelming numbers that they obliterate the population II stars present in these systems; these seem to be newly born systems. As was mentioned above, the elliptical galaxies are almost pure population II systems; these seem to be very old systems that constantly lose stars in the form of exploding novae. The different types of spiral galaxies, containing varying ratios of population I and population II stars seem to be stellar systems of varying degrees of maturity and seem to be interspersed between the very youthful and the very aged galaxies which fill the evolutionary sequence. And yet, many hold that all of these galaxies are approximately the same age. This view, however, can be traced to the cataclysmic creation assumption which in turn is based on the interpretation of the red-shift.

[[24] The life span of a star, depending upon how fast it utilizes its energy, is from 10 million to 50 billion years. Our sun is thought to have the longer life span of 50 billion years.]

If the universe is arranged into sub-systems of galactic groups, then 187
the galactic group must be arranged into sub-systems of individual galaxies; what then is the structural unit sub-system of the individual galaxy? In other words, what stellar units are fitted together to form the structural organizations which we call galaxies? The astronomer tells us that single stars such as our sun are rare in the galaxy and that double and even triple stars are far more frequent. But these stars, in turn, are often if not always, a part of a star cloud system. Thus, it appears that the structural unit-sub-system of a galaxy are these star clouds which are in turn made up of units such as the O-association or cluster mentioned above. In other words, stars in associations or clusters seem to be created all at one time (rather than individual single, double, or triple stars) and it is these units that are interrelated to form the star clouds which are in turn interrelated to form the galaxy.

About 5,000 light years from our sun in the central plane of the spiral arms, lie gigantic clouds of interstellar dust and gas. These dust and gas clouds must, in some way, be related to the creation of new star clusters—the creation of new galactic units. The dust cloud theorists hypothesize that these gas and dust clouds are initially aggregated by the forcing pressure of star light and then condensed by gravitational contraction and, in the final stages, the dust cloud is collapsed and thermonuclear reactions are initiated which produce the star-suns. (It is not clear whether these theorists assume nuclear evolution to have taken place prior to the formation of the dust or whether nuclear evolution is postulated to take place in the hot interior of the stars after the thermonuclear reactions have been initiated.) But what organizes these stars into clusters and then relates them to other multiple systems within the galactic structure, these theorists give us no hint.

There are currently two cosmological theories each with more or less its own theories to explain the cosmogonic features of the universe such as the origin of the elements of the periodic table. As we have already noted, the expanding universe theorists postulate that the universe started in a cataclysmic explosion from a superdense state some five to ten billion years ago. At the onset of the expansion there was a great preponderance of radiant energy over the density of matter but as the universe continued its expansion, the energy density fell sharply in comparison to the density of matter. Consequently, gravitational attraction has played an increasingly important role which means that the rate of expansion has been slowing down for billions of years. That is, "the rate of expansion of the universe was greatest at the beginning and has been slowing down ever since because of 188
the opposing gravitational attractions of it matter, which acts as a brake on its expansion." Theorists holding to the expanding universe view which involves the postulate of a cataclysmic explosion, postulate that, during this primordial explosion and subsequent expansion, the elements of the periodic table were built up in one half hour by simple process of proton-neutron-electron capture. These theorists have held that, except for the lightest elements such as are involved in the sun's nuclear cycle, the tremendous temperatures required for nuclear transmutation do not exist in the hot interior of the stars at the present time. Yet this scheme of nuclear evolution faces certain difficulties (pointed out by these theorists themselves); nuclei of atomic weight five and eight are extremely unstable so it is unlikely that the higher weight elements would have had time enough to form in so short a period.

The second cosmological theory is the steady state theory. This theory holds that the universe as a whole does not change and only the galaxies and clusters of galaxies change; the universe, in other words, is in a steady state equilibrium. (The steady state refers to the density of matter; the density of matter in the universe is believed to remain relatively constant.) According to the steady state cosmologist Hoyle: the universe is stationary in time and infinite in space; it has neither a beginning nor an end; new matter is steadily being created in space at a rate which exactly compensates for the thinning of matter due to the expansion of the universe—hence, the density of the matter of the universe remains constant;

as a consequence of the expansion of the universe and the creation of new matter, new galaxies are continuously being born, etc. Hoyle, pointing to recent evidence which indicates that heavier elements beyond those involved in the sun's nuclear cycle are being synthesized in the hot interior of the stars, uses Bethe's proton-proton fusion and carbon-nitrogen cycle and Gamow's proton-neutron-electron hypothesis (the latter to account for the synthesis of the heavier elements after iron) to account for the creation of the atomic elements. The postulated presence of the nuclear building process in the hot star affords ample time for the nuclear building process to cross the atomic weight 5 and 8 barrier for the synthesis and breakdown of these elements would be a continuous affair which would insure a small but continuous supply of these elements for a long period of time.

(It should be carefully noted that the expansion of the universe is a basic feature of the steady state theory as Hoyle conceives it. Hoyle, accepting the apparent fact that the universe is expanding, however, also observes that we have a homogeneous universe—i.e., the galactic groups are fairly evenly distributed—instead of a heterogeneous one—i.e., galactic 189
groups concentrated more in some parts of the universe than in others—as would follow if the universe were expanding and the galaxies moving apart from each other. Hoyle poses the question: "Why does space not become more and more empty?" Apparently to answer this question and to take into account the apparent expansion of the universe, Hoyle suggests that the matter being diluted due to the expansion of the universe is compensated for by the creation of more matter. This created matter goes into the formation of new galaxies that fill up the holes left between the galactic groups by the expansion of the universe. This theory thus includes the apparent expansion of the universe and at the same time provides for the homogeneous universe of the astronomer's observation. But where does the energy for this continuous process come from? If the writer understands Hoyle's view correctly, matter is being diluted and new matter is being continuously created; both processes continuously use energy. This point of view seems to lead to the conclusion that the universe must be running down energy-wise and at a very rapid rate as the formula, $m = \frac{E}{c^2}$, indicates. From this point of view, it seems we would have a steady state universe matter-wise but a dead universe energy-wise. This writer has rejected the idea that the universe is expanding on the grounds that the red shift has been misinterpreted. It is postulated that each structural organization in the universe follows an intrinsic unitary tendency—from asymmetry to its final symmetrization. At the point the structural aggregate—namely an individual star—reaches this latter stage, it appears as a nova. This is actually the normalizing process restoring the symmetrized aggregate's structures to the asymmetry level of the structured field once again. This structural asymmetry is used to form new galaxies; the rate of formation of new galaxies just compensates for the asymmetry to symmetry change in other galaxies. Thus, we have a homogeneous universe and steady in reference to the structural and configurational properties of energy, mass, and momentum and not mass alone.)

2. THE ORIGIN OF THE GALACTIC GROUP AND THE GALAXY—

THE FORMATIVE PROCESS [25]

The majestic star cities [star groups] of our universe and their star inhabitants manifest the characteristic of a universe in process—one of change, growth

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[25 This writer is indebted to the theorists writing in the September (1956) issue of *The Scientific American* entitled "The Universe" for enabling him to bring many of the ideas expressed in this section up to date. Upon reading this issue one grasps perhaps the true significance of the

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and one-way development—and yet they display a striking harmony of order 190
and organization; both features would be expected from the implications of unitary theory. The universe seems to be composed of a vast number of galactic groups that are scattered fairly uniformly throughout space, to yield an apparent steady-state homogeneous universe. Within many of these galactic groups (including our own) there are galaxies of different types which appear to be of different ages, from the apparently very youthful or the irregular galaxies to the apparently oldest or the elliptical galaxies. How are we to account for the arrangement of the universe into galactic groups, for the one-way development features of the galaxies within the galactic group and for the apparent fact that new galaxies are being created within the group at the present time? The individual galaxies, moreover, seem to be arranged into multiple systems called star clouds which, interrelated, yield the galaxy. It is fairly well-established that new stars are being created in the irregular and spiral galaxies at the present time. How can we account for the arrangement and one-way development features in the individual galaxies and for the fact that new stars are continuously being created and how is this ongoing activity related to the origin of life on our planet?

> First, the remoter reaches of the sun's atmosphere ought to be such a source of rays...but this suggestion is completely negativated by the practical equality of the rays by day and night, i.e. as the earth turns its face toward or away from its supposed source.
> The first definite proof that they (cosmic rays) came from beyond the Milky Way was brought forward in 1926 when experiments were made in South America where the Milky Way is completely out of sight for hours at a time, and the proof there found that the intensity of the rays is just the same when the Milky Way is out of sight as when it is in full view. The same is true to a first order of accuracy about the position of the sun, so that it would seem that neither the sun nor any of the stars in our galaxy can possibly be a significant primary source of origin of the cosmic rays. But what, then, lies beyond the Milky Way that can possibly act as a source of these extraordinary influences?
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> Fifteen years ago (1926) no one could answer that question. No one knew that there was any such place as "beyond the Milky Way," but within that time we have learned to measure quite accurately the distances of very remote stars and within the last ten years have learned much about what lies beyond the Milky Way.

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red-shift and the theory of the expanding universe. Both the red-shift and theory of the expanding universe, right or wrong, were man's first stepping stone into intergalactic space—man's first courageous venture into what was a great unknown. Both have blazed a trail into the cosmos and have succeeded in ordering the universe to the degree which permits modern man to explore further its mysteries and now to include the universe as part of his environment.]

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Nevertheless, we do not know...what kind of...events, out there beyond the Milky Way are responsible for this continuous shooting up of our dwelling place, the earth...we do not yet know the answer, and the mechanism of origin of the cosmic rays is one of them.

The place of origin of the cosmic rays. The conclusion...above means that the cosmic rays cannot have originated within the stars or in any portions of the universe in which matter is present in appreciable abundance.

Millikan—*Cosmic Rays* (1939)

Geology has its diastrophism, psychology its sex experience, biology its evolution, and physics its cosmic rays. For the past fifty years since these super-powered cosmic particles were discovered (by Hess) to be coming into our atmosphere from interstellar space, cosmic ray research has been one of the most exciting branches of physics for many suspect that the cosmic rays are intimately involved with the most fundamental secrets of the universe itself. [The term "cosmic ray" was coined by Millikan to denote that these particles come into our atmosphere from intergalactic space which particles Millikan (erroneously) thought to be high energy gamma rays.] The cosmic rays that smash into our atmosphere with their enormous energies are natural atom-smashers producing showers of high speed particles. The debris from cosmic ray collisions with the molecules of our upper atmosphere has been studied with the use of the Wilson cloud chamber and other instruments which has led to the discovery of the positron and other nuclear particles. In fact, it was physicists desiring to control the conditions of their nuclear experiments, a feature not permitted by the spontaneously arriving cosmic rays, who designed the modern cyclotron, betatron, synchrotron, cosmotron, etc. which are direct-voltage and resonance particle (proton) accelerators which are yielding the current insights into the microcosm of the atom.[26] Yet the most powerful

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[[26] It is these high energy nuclear experimentalists working with, or rather working toward, the ultimate structure who will yield us information concerning the empirical referent of unitary theory—the unitary structured field. It is particle accelerators such as the above that the future geneticist, neuro-physiologist, and psychologist will use to study their particular empirical referents. If the genetic and psychological empirical referent is the quantum structure, as this writer suspects, chains of quantum structures at high frequency that have been generated by such high energy electronic-nuclear equipment will be channeled into the genetic or neuro-physiological area of study (and will be of such a nature as not to harm the living organism) to resonate and beat with the quantum structural processes going on in these areas. In this way, the experimenter will be able to effect selectively and perhaps even control and change the nature of the quantum structural organizations (memories) in the specialized areas. (Penfield, by selectively activating specific past experiences in the brain, by the use of the macro-electronic

stimulating means of the present, has perhaps paved the way for this sort of therapy. The most powerful means, of course, of changing the structures on the psychological level will still be simple human self-learning or by learning from other members of his environment.)]

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accelerator imparts an energy of only two to ten Bev (billion electron volts) to these particles whereas natural cosmic rays often reach energy levels of 100,000 Bevs and occasionally reach the fantastic level of 100 million Bevs![27] Where do these cosmic rays come from and how do they attain their enormous energies; this is one of the most fundamental problems in science. 192

There are currently two theories (after Rossi) as to the basic origin of these cosmic rays. One view holds that the cosmic rays were created in the cataclysmic explosion per the expanding universe theory some five to ten billion years ago and since that time they have traveled along trajectories curved by the universe's gravitational field and occasionally enter the atmosphere of a planet. The other view, favored by the majority of the cosmic ray theorists (after Rossi) holds that cosmic rays are being continuously produced somewhere in our galactic system. Following this second view and the indications of the quotes above that the place of origin of the cosmic rays lay "beyond the Milky Way" or at least the place of their origin

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The current view of the nucleus of the atom holds that atomic nuclei are composed of protons and neutrons and nothing else and that all gamma rays, beta and alpha particles, positrons, mesons, the neutrino, the graviton, etc. are created by internal rearrangements within the atomic nucleus by the conversion of energy into mass. But this is the statistical-atomistic point of view which holds a dualism between particle and field (matter and energy) and hence has no structural empirical referent for energy and can conceive of no other mode of process than that of interaction to go on within the atomic nucleus. Unitary theory, on the other hand, holds that both particle and field are the same thing; both are manifestations of the unitary structured field. Protons and neutrons are only small centers of field concentration within a diverse and complex environment of quantum structures in organization. Protons and neutrons and their coupling quantum meson structures are only the main building blocks in the atomic nucleus microcosm and also undoubtedly undergo one-way change from asymmetry to symmetry. Unitary theory conceives the microcosm of the nucleus to be a tiny complex world wherein many quantum structural events transpire. The mode of process of these quantum nuclear structures is that of transaction; what is already present in the organization of the quantum structures as a historical differentiated order combines with what is taking place and yields a more complex structural organization taking into account both the present and the past. This writer below will reject the view that the nucleus consists of protons and neutrons and nothing else. The atomic nucleus, the writer will postulate, is the site of the significant genetic and psychological parameters and is the site wherein biological order or "memory" is recorded. Quantum structures are postulated to move easily in and out of the atomic nucleus; all that is needed is an agent small enough to enter the atomic nucleus and to carry in and out quantum structures. This, it will be postulated, is the normalizing-respiratory process which empirically is a chain of highly asymmetrical free energy field structures.

[[27] The realization of the truly fantastic nature of this energy level comes when one becomes aware of the fact that *one electron volt* is equivalent to 10,000 degrees centigrade in temperature. The mighty process that produces these energy levels in cosmic particles

approaches in magnitude the other vast dimensions of the universe of which we are only now becoming aware.]
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must be in regions other than those where stars are present in abundance, 193
led theorists to the hypothesis some years ago "that the energies of the cosmic rays are imparted by the fall of electrons through some sort of celestial electrostatic fields which thus impart the observed enormous energies of many billions of e-volts." Millikan himself objected to this point of view: "This conception, difficult enough any way to reconcile with the uniformity of distribution of the incoming rays over the celestial dome, is also not easily reconciled with the fact that the energies of the incoming rays are limited to so narrow a range of energies as from 2 to some 20 billion e-volts." The dualism between particle and field was still in vogue; it was not conceived, consequently, that the fields could have generated the cosmic rays and thereby imparted their energies to them but rather it was conceived that the field simply imparted the energies to the cosmic rays via a process of interaction. Consequently, due to both the inadequacy of the field conceptualization and its failure to fit the facts as they were then known, the tendency has been to identify the source of cosmic rays with stellar bodies. The sun, rotating double stars and super novae have all been postulated to be sources of cosmic rays. But they all face certain difficulties—especially in accounting for the higher energies of these particles and their uniformity of distribution as they enter the upper atmosphere—which make it doubtful that these bodies are more than secondary sources of cosmic ray production. It is well agreed, for example, that the sun cannot produce any appreciable fraction of the more energetic particles. We are, consequently, still left with the idea that the primary source of cosmic rays is "beyond the Milky Way" and/or regions in the galaxy wherein matter is not present in abundance; or, in other words, we are left with the field theory postulate as to the origin of these cosmic rays.

Millikan noted in his book that there are two types of cosmic rays which are called "primary" and "secondary" cosmic rays and, since he wrote his book, the nature of both types of cosmic rays have been more firmly established. It is now known that the secondary cosmic rays are not "cosmic" in their origin at all. The secondary "cosmic" rays, composed of various types of mesons, high speed gamma rays or photons, high speed electrons, etc., are actually particles knocked from atmospheric molecules by the primary cosmic rays which smash into the upper atmosphere of our planet. In other words, the secondary "cosmic" rays have their origin in atmospheric molecules and attain their energies only by the collision of primary rays with these molecules. The primary cosmic rays, on the other hand, ironically are now known not to be "rays" at all; that is, they are not high speed gamma rays as Millikan had thought when he coined the term "cosmic rays." 194 It has been established that the primary cosmic "rays" coming into our atmosphere (apparently from all directions) are positively charged particles—actually atomic nuclei of all atomic weights.[28] What is particularly significant is that these incoming cosmic particles are now known to vary widely in energy. The particles fall into an energy range of from 1 to 100,000 Bev, with an occasional particle attaining the fantastic level of 100 million Bev.

(This is to be contrasted to the narrow range of energies of from 2 to 20 Bev which Millikan thought to represent the cosmic ray energy spectrum.) At any given energy level, according to Rossi, we find constituting the make-up of the cosmic particles: 1000 protons (nuclei of hydrogen), 85 helium nuclei and 6 heavier nuclei. The relative abundance of various nuclei in cosmic radiation, Rossi points out, corresponds closely to the relative abundance of the elements in the universe (by number: hydrogen, 93%; helium, 6.5%; the rest, 0.5%). Thus, it turns out that the primary cosmic particles do have the wide distribution of energies that would follow if the above field-theory hypothesis of the origin of the cosmic particles were correct. We thus have the hypothesis, without coaching from unitary theory, that the primary source of cosmic particles is due to some sort of fields which endow these nuclear particles with their super-energies and which are located "beyond the Milky Way" and/or in the galaxy itself where stars are not present in abundance and which fields are involved in continually producing atomic nuclei in the same proportion as the ratio of elements in the universe.

This writer postulates that the source of the primary cosmic particles is the empirical referent postulated by unitary theory to exist—a creative-formative structuring process within which atomic nuclei are continuously being created from quantum field structures. This writer postulates the existence, and predicts the empirical discovery, of a huge inter-galactic creative-formative quantum structuring process at or near the gravitational center of our galactic group and postulates the existence of two (?) intra-galactic sub-structuring processes which are located within the spiral arms of spiral galaxies.[29]

[[28] It is particles similar to these but of a much lower energy level that are currently being produced in quantity by the recent atomic and hydrogen explosions. This radioactive fallout has already proved its efficacy as a lethal killer of life and is perhaps the main faction which makes this a foreboding age.

[29] This writer predicts that it is only a question of improving techniques of observation and further research until this creative process in the universe is empirically discovered and its significance fully realized. The main attribute which man has ascribed to his deities was that 195
they were creators; the creative process that led to the creation of the star cities [star groups] of our universe, the creation of our sun and out beautiful earth and life upon it is in the process of being discovered by science. Religion, philosophy and science all have the same subject matter. This means that the subject matter of theology and philosophy is the subject matter of science—synthetic and unitary theory. If Whyte has succeeded in delineating the unitary theory of science, then the exciting task of empirically unifying the sciences remains ahead. Without synthetic theory of a systematic and orderly nature the task of empirically unifying the sciences would be impossible. Synthetic theory of a high caliber is available in many of the various branches of science by synthetic theory that relates the various branches, e.g., biology to psychology, is virtually non-existent. The theological seminary, if it can accord with the spirit of the times which demands the pioneering spirit from us all, can become a center of synthetic and perhaps even unitary theory and by so doing can reaffiliate itself with the modern university (or if already in the university, can reaffiliate itself with the modern community) and place itself at the forefront of human learning once again; we should not forget that many of our modern universities have their roots in the religious tradition. The theologian and the philosopher

should shrug off any hostility from science; the scientist, theologian, and philosopher actually have a great deal in common. The major part of the hostility stems from the delaying and defense tactics employed by religion and philosophy (which were perhaps a necessity) and the dire necessity for science to innovate under the grave conditions of our time. It should not be thought, however, that religion and philosophy will go unchallenged. This writer anticipates that, if he has gone an inch in this book as regards a challenge to religion and philosophy, the modern spirit of science will go a mile. The theologian and the philosopher, however, should not allow themselves to be isolated from the modern community but should swing with the changing times. With their accumulated wisdom and experience, the theologian and philosopher can contribute much in the way of maturity and stability to a rough and ready but yet immature science. To minimize psychological disruptions both in themselves and in their followers, it may behoove the religious scholar and the dualistic philosopher and their followers to identify initially this above creative process with their particular concept of deity and particular dualistic unitary principle and slowly extricate themselves from their long archaic doctrines by adopting the concepts of science. The concept of the creative process as a super-human being was archaic three to four thousand years ago and should have been abandoned then. The dualistic postulates of philosophy have invariably been shown to be faulty and have no place in the modern world. At first, as is always the case when one is required to give up his adaptive illusions, the new cognitive environment no doubt will seem strange and disruptive and the theologian and the philosopher and their followers will experience a great reluctance to change. But in time, they will find their new cognitive environment so rewarding and of such encompassing interest and beauty that they will wonder how they could have ever believed as they do now.

The task of determining the nature of this creative process is, of course, the task of science to discover by further research, but the task of relating the human personality to it remains. This writer suggests that the discipline within the social sciences (social psychology) which takes up this task be called the religion of science to honor religion for its valiant battle against superstition—a battle which has not yet been won and which is far from over. By far and large the philosopher has remained affiliated with the university. His encompassing view, employing the concepts and knowledge of science, the humanistic bent of his discipline should assume more importance—within the frame of science—than it has in the past. Unitary theory, it is suggested, might be called the philosophy of science to honor the philosopher founders of science. If the unitary field is an empirical reality, its mode of operation must have a mathematical representation. Perhaps the philosophers can aid in developing the mathematical foundation for unitary theory.]

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These sub-structuring processes (each of which is interrelated to the other) are related to the central structuring process to form a dynamic system of mutually transacting and interdependent sub-systems within a larger system to which it is also dynamically related. (By transaction the writer means that the differentiated order already present in the particular dynamic system determines in part what will be further developed in the system.) The dynamic system is our galactic group and its sub-systems are the individual galaxies; the larger system to which our galactic group is related is the galactic groups of the rest of the universe. The galaxies are the structural aggregates formed by the inter-galactic structuring process which aggregates are structured by the normalizing process operating in this structuring center to form the structural configuration we call the galactic group. The star clusters (within which are found individual stars with their retinues of planets) are the structural aggregates formed by the intra-galactic sub-structuring processes and which are structured, by the normalizing process operating in these interrelated structuring centers,

into the multiple star systems called star clouds to form the individual galaxies. Each sub-system of each larger system, although related to the larger system, nevertheless is distinguished in its operation and has a certain autonomy of action. (This independence of action permits galactic groups to approach and recede from one another, individual galaxies and stars to collide with one another, etc.) This leads to the following field theory view of the origin of the galactic group, of the individual galaxy, and of the origin of life upon our planet.[30]

[[30] If the primary cosmic particle emission is associated with any particular object or objects or with any particular region or regions in interstellar space, one would expect that the cosmic particles would arrive at our atmosphere at different intensities from different directions; but this is contrary to what is observed. The primary particles seem to enter the earth's atmosphere uniformly from all directions. Consequently, theorists holding to the idea that there are distinct centers of cosmic particle emission offer the hypothesis that the magnetic field of the earth and that of the sun randomize the direction of these particles and that this accounts for the uniform distribution of the cosmic particles entering our atmosphere. (It is a well known fact that the earth's magnetic field deflects these positively charged particles, for example, the intensity of the cosmic particles is less at the earth's magnetic equator in comparison to the earth's geographical equator.) A few decades ago this problem might have been thought unresolvable but within two years a space satellite will be launched by rocket scientists that will transcend the upper limit of the atmosphere to encircle the earth at a height of from two to three hundred miles. This space satellite will carry with it a modified and compact version of the Geiger-Mueller cosmic ray telescope, a transmitter and other instruments which will yield valuable information as to the direction of greatest cosmic particle intensity. This initial satellite will be followed by a long sequence of such satellites which will eventually transcend the earth's magnetic field. (This in itself will be no mean feat for the earth's magnetic field is believed to

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In the section "History of Field Theory," the hypothesis was put 197
forth, based on the recent discovery of the thirty elementary particles by modern nuclear physics that there are thirty qualitatively different quantum structured fields each of which has a characteristic set of properties; each field was conceived to fill the whole of the universe. We took occasion above to reject his hypothesis and postulated that there is but one unitary field (composed of a general type, three-dimensional free energy field structure) and that this field fills the whole of the universe. It is this structured field, its intrinsic properties and formative tendencies, that is responsible for all processes, and structural organizations (including the elementary particles) in the universe; this field is the basic substratum of the universe. [31]

The structured field as a whole is governed by the unitary process which tends to manifest its formative nature at seemingly fairly equal intervals throughout its extensity and manifests its overall asymmetry to symmetry one-way tendency in the one-way development of the individual galactic groups. Our local galactic group, this writer postulates, should be considered age-wise in relation to the structured field as a whole or, in

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to extend to a height of some twelve thousand miles, but only a beginning for the rocket scientists whose primary objective is the moon and possible inter-planetary travel.) This writer predicts that this cosmic ray information will show that the sun, novae, and other stars are all emitters of lower energy nuclear particles which is already fairly widely accepted. This writer also predicts that there will ultimately be identified two main sources of the very high energy cosmic particles. One will be close to the center of gravity of our galactic group and the other source or sources will be the emission nebulosities some of which lie not too far distant from our sun. However, the writer will not be at all surprised if a random distribution of these cosmic particles is initially found even beyond the earth's magnetic field. This may be the case because the sun may be surrounded on all sides by emission nebulosities—each one emitting cosmic particles at approximately the same rate and of approximately the same energy level. (The sun's and earth's magnetic field may simply serve to randomize further these already fairly uniformly distributed cosmic particles.) However, with sufficiently precise equipment, the above two primary sources of high energy cosmic particle emission should be clearly identified.

[31] This writer is postulating that the general type structure of the unitary structured field can take on different properties depending upon the manner in which these structures are combined and at a very basic level these properties manifest themselves in the quantum and elementary particles. In other words, the quantum and elementary particles already manifest the creative nature of the unitary process that forms them and, as structural aggregates of this unitary field, the quantum and elementary particles display the various aspects of the unitary process. The general type field structure may possess an asymmetry level which it never really relinquishes. Thus, these free energy structures in quantum structural aggregates and more complex organizations undergo a one-way asymmetry to symmetry tendency with the appearance of myriad structural properties. When these organizations are fully dispersed, the original asymmetry level of the individual free energy field structure reappears. This may be what happens when the "meson glue" in the atomic nucleus undergoes its final symmetrization and a star starts to become a nova.]

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other words, the place of our galactic group in the evolutionary sequence 198
should be considered in relation to the other galactic groups of the universe. The one-way development of the unitary structured field is represented by the evolutionary asymmetry to symmetry continuum of the galactic groups. This may be the significance of the galactic groups that are densely clustered with galaxies (and whose galaxies are devoid of the cosmic gas and dust) and also many of the single galaxies in space that are surrounded with globular clusters. Both may represent exceedingly old galactic groups. On the other hand, many of the nebulous gas and dust clouds in space and our own galactic group with its few galaxies, may represent the opposite extreme—galactic groups just in the process of forming or just in the first stages of maturing. All the rest of the galactic groups of the universe should fall between these two extremes illustrating that the unitary field operates as a whole as a balanced unitary process in which asymmetry is continuously being converted into structural symmetry (which appears as the formation of new galaxies and new galactic groups) and structural symmetry is continuously being converted into structural asymmetry (which is indicated by the gradual disappearance of individual galaxies and galactic groups) with the existence of a great spectrum of galaxies and galactic groups between birth and their final symmetrization.

Due to the appearance of this formative process, a gigantic isolable process is formed, [32] which, due to the intrinsic formative tendencies of the field, takes on the form of a gigantic structuring process. Asymmetry tends to disappear in parts of this isolable process by the free energy structures of the field coupling with one another to form more symmetrical structural aggregates. This is immediately followed by the normalizing process acting to restore these structural aggregates to the asymmetry level of the field as a whole. (As the field structures couple one after the other, the feature we call time or temporal order appears in these structural organizations.) If the asymmetry level is restored in these structural aggregates and the aggregates are not dispersed due to the action of the normalizing process, points of structural symmetry appear in the field within

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[[32] Isolable, that is, in the sense that this formative process is far removed by millions of light years in the structured field from other such formative processes. No process, however, is really isolable for each is a part of the same unitary field. Each of these processes must transact with one another via the spaces (fields) between such processes. The universe is thus a vast interrelated system of transacting sub-systems which means the universe as a whole is an open system.]

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the isolable process. Thus, the structural aggregates that remain are only 199
those which facilitate the restoration of the asymmetry level without being dispersed. The structural aggregates that remain are not only stable but, since their asymmetry level has been restored, they have the potentiality to undergo further structuring. More free energy field structures are coupled by these structural aggregates and if these are not dispersed, more complex structural aggregates appear in the field; the normalizing process, by continually restoring the asymmetry level of these structural aggregates, is continually causing the synthesis of patterns of quantum structures that facilitate normalization. Then, after a long period of this quantum structural development the thirty elementary particles, each with their characteristic set of properties, appear within this isolable process. This is pattern development on the second most basic level of the organizational hierarchy, two steps removed from the unitary field itself. The normalizing process continues its intrinsic structuring activity. (The first step is the combination of free energy field structures into quantum structural aggregates. The second step is the combination of these quantum structural aggregates to form the elementary particles of the atomic nucleus.)[33] After a long sequence of this quantum structural development, the thirty elementary particles (each of which display field properties) appear in tiny quantum structural microcosms within this isolable process. These microcosms are actually the beginning of atomic nuclei development. An entirely new set of properties are to appear at this next level of the organizational hierarchy with which we are already familiar, those of the chemical elements of the periodic table.

The proton, an aggregate of quantum structures which still contains a great deal of structural asymmetry (a part of which is converted into lower forms of structural asymmetry—heat and electromagnetic radiation—

as in the sun's nuclear fusion cycles) must be only the central point center in the quantum microcosm. There must be other points of differentiated structural symmetry such as the graviton which may only have a very small

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[33 It is of interest to note that nuclear particles, despite their small size and large mass, such as protons, must be extremely porous entities; that is, in reference to quantum and free-energy field structures. This "porosity" is due to the three-dimensional nature of the free energy and quantum field structures. Some of this "porosity" is diminished as symmetrization proceeds within the particle. If methods were available to measure this "porosity," it might serve as an indirect measure of a particular particle's age, provided a number of precautions were taken. Thus, via this method, one might be able to establish the relative age of cosmic ray particles to that of positive particles taken from the earth.]

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point center in the nucleus (the minuteness of the point center perhaps being the reason why the graviton has not yet been detected) with a long chain of coupling quantum structures trailing from the nucleus. Gravitational attraction may be nothing more than the changing structural configuration of two bodies containing large numbers of these gravitons. That is, the quantum gravitational structures trailing a structural aggregate couple with other such gravitational structures trailing other structural aggregates. The external manifestations of this symmetry configurating activity is observed as "gravitational attraction" and, after Newton, the magnitude of this "force" or configurating tendency varies directly as the product of the masses and inversely as the square of the distance between the two aggregates. This writer postulates that it is the normalizing process which disperses the graviton into the small point center in the nucleus and the long chain of gravitational structures trailing from the nucleus. "Gravitational attraction" then is conceived to be the symmetry tendency of the gravitational field. This implies that, as the normalizing process decreases its level of structural asymmetry in a particular system, the trailing gravitational structures will be gradually pulled back into the nucleus. This may well be what is happening in the population II stars. As the asymmetry level slowly decreases in these systems, the gravitational attraction between the outer perimeter and the central core gradually begins to decrease causing the star at first to swell up and become a red giant. The outer perimeter finally breaks completely away and eventually becomes a cold white dwarf, while the remaining central core forms the intensely hot white dwarf. The latter eventually become the exploding novae.

There must be a point center in the nucleus representing the magnetic field which may be the positron. It is here postulated that the normalizing process operating in the quantum structural microcosm (which contains the thirty elementary particles) disperses not only the graviton but also an electromagnetic point center in the microcosm to form the positron (which remains in the nucleus as a point center) and the electrons which revolve around the nucleus as orbital electrons. (In other words, this writer is postulating that orbital electrons originally came from the nucleus.) But the electrons and the positrons also display a strong configurating symmetry tendency to recombine again which is a manifestation of their symmetry tendency. The strong electromagnetic field between the nucleus and the orbital electrons may be due to both the

dispersing normalizing process and the symmetry configurating tendency between the electron and positron.[34] The spin of the orbital electrons must be due to the individual quantum structures of which the electron is composed, and the angular momentum of the orbital electrons around the nucleus must be due to a balance between the dispersing action of the normalizing process and the symmetry configurating tendency of the 201
electrons and positron. (Thus the property called angular momentum may also, like gravity, be a configurating property of quantum structures—the asymmetrical and symmetrical motions of the individual structures being converted into angular momentum.) The quantum jumps of the orbital electrons are the electrons jumping toward their symmetrical configurations once again. Structural asymmetry inducted into the system furthers the dispersing action of the normalizing process; the electrons jumping toward its most symmetrical configuration again when the source of structural asymmetry is removed (and emitting photons on the way) is following its unitary tendency. This implies that in the historical development of the atom, the orbital electrons of an atom first describe an erratic orbit around the nucleus due to the dispersing action of the normalizing process. These orbits become increasingly elliptical as the quantum structures of the atom increasingly display their unitary tendency. Thus, since the normalizing process initially has the greatest influence in the developing system, the motions of the system will be

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[[34] It is well known that if a high energy photon (gamma) ray is driven into the space between the nucleus of an atom and its orbital electrons—which area is known to contain a very intense electromagnetic field—the photon is transmitted into a pair of positrons and electrons. This transmutation is ordinarily interpreted as the creation of matter from energy. This action, the writer postulates, is not a transmutation but a transformation which actually illustrates that the electromagnetic field is acting both as a normalizing process and as part of the symmetry configurating field between the positron and the electron. The area between the nucleus and the orbital electrons is a region of a highly structured field between two point centers of differentiated structural asymmetry—one in the nucleus and the other revolving around the nucleus. When the photon enters this area a tiny isolable process is formed. The electromagnetic field, acting briefly as a normalizing process, inducts electromagnetic structural asymmetry into the photon; the photon is dispersed into its electric and magnetic components—the pair of electrons and magnetons or positrons. The symmetry configurating nature of the field then manifests itself which results in the ejection of the particles from the atom. That is, the particles can not go toward their respective coupling centers despite having a great deal of asymmetry because the electron and positron of the atom are already in their most symmetrical configurations under the conditions existing in the atom; the field, therefore, acts as a repelling force on the two particles. No new matter is created. What is already present as components simply manifests itself as points of structural asymmetry of a particular type; hence, when the two particles meet they combine to form the high speed photon, again illustrating what is called the reversibility of microscopic processes. Such processes are reversible because they have simply undergone a transformation of form—no new quantum structures have been coupled to yield new quantum structural aggregates with new formative tendencies.]

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asymmetrical and as the intrinsic quantum structural asymmetry of the 202
system is progressively converted into structural symmetry (by the mutual polarization, orientation, alignment, and approach of the individual quantum structures to one another), both the shapes and motions of the

systems assume a more symmetrical configuration. Assuming that the electrons of an atom first describe erratic and then elliptical orbits around the central nucleus then, as the structures of the electromagnetic field between these point centers (and of course the quantum structures of the point centers themselves) undergo their intrinsic one-way asymmetry to symmetry tendency, we would expect that: the orbits of the electrons would become increasingly circular; the electrons would approach closer to the nucleus, the density of the atom thereby increasing; the angular velocity of the electrons would decrease. The increasingly circular form of the electrons' orbits and their decreasing angular velocity and the increasing density of the atom are all due to the increasing symmetrization of the quantum structures comprising the atom. The atom, like the photon discussed above, displays the arrow of time characteristic of a universe in process. All quantum structural organizations undergo a one-way asymmetry to symmetry tendency; hence, all configurational properties of larger structural organizations, since they are comprised of quantum structures, display the same one-way tendency.

The process of nuclear evolution proceeds in the isolable process and if the patterns are stable, further action of the normalizing process leads to the development of more complex patterns of nuclei. (A certain proportion of the hyper-stable nuclei at each step in nuclear evolution may be set aside and converted into stable atoms.)[35] Each nucleus acts as a tiny system; that is, the normalizing process acting in each nucleus tends to build

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[35 High energy electrons, according to this view, would be present in the same isolable process that is forming the atomic nuclei. The 21 centimeter radiation being picked up by the radio telescopes may be generated by these high energy electrons as they make their quantum jumps toward these high energy nuclei; as Ryle suggests: "It seems probable that the radio energy is generated by the motion of high speed electrons in a magnetic field." (As their orbits straighten out, that is, become elliptical, these electrons generate the photons of the visual spectrum.) These high energy electrons may be a source of stellar radio radiation in addition to the radiation from hydrogen gas. Interestingly enough, the emission nebulosities in our galaxy have already been identified as sources of radio radiation. It is possible then, that sources of cosmic particle emission may be identified even without leaving the face of the earth for, if the above view is correct, in many cases the sources of cosmic particles and radio radiation would coincide. This offers the exciting possibility that the radio telescopes may be picking up radiation from processes of creation and final symmetrization and from other processes involving great quantities of energy such as the clashing gases of the "colliding galaxies," the latter of which

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up in hierarchical order a pattern of nuclear structures that promote 203
normalization. At each step of the process, nuclear patterns of all possible combinations must be formed; the nuclei that form the unstable configurations are dispersed by the normalizing process and imparted the tremendous velocities that we observe in cosmic particles. [A very high temperature may not be necessary for the nuclear building process. Since one electron volt is equivalent to somewhat more than 10,000 degrees centigrade, a high level of structural asymmetry (energy) is present in the normalizing process which may be equivalent to a body of trillions of degrees of temperature.] The hydrogen quantum microcosm must form a great number of unstable combinations which, when dispersed by the normalizing process, yield the energy range for the hydrogen nuclei which

we observe in the proton portion of cosmic particles.[36] (The same situation apparently holds for atomic nuclei of every atomic weight.) Apparently, due to the unstability of nuclei of atomic weights 5 and 8, only a small proportion of the hydrogen nuclei continue to pass this barrier to form nuclei of the rest of the elements found in the periodic table. The nuclear evolutionary process, once past this point, continues until iron and its neighbors in the periodic table are formed. The meson coupling structures either must be particularly strong or the iron microcosm must lend itself to

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is an established source of radio radiation. The creative processes would be located at or near the center of galactic groups, at point centers where new groups and galaxies are forming and within the vicinity of the emission nebulosities in the various types of younger galaxies. The processes of final symmetrization would be located in any system with large numbers of exploding novae; namely, in systems containing population II stars. The creative processes and those of final symmetrization are likely to be sources of both cosmic particles and radio wave radiation—the former with perhaps the more energetic cosmic particles.

[36] When low-energy protons are accelerated to an energy level of one Bev, the proton mass doubles. At nine Bev, the proton is ten times its normal mass. This increase in mass with velocity is called the relativity effect. (What seems to be happening is that the accelerators are actually generating highly asymmetrical quantum structures which the low energy protons couple, the proton thereby acquiring both the mass and motion of the asymmetrical quantum structures. The nuclear physicist is actually forming "matter" from "energy" and may be able to form, by using higher energy accelerators, the thirty elementary particles.) But the nuclear particles in the above isolable process must already have both tremendous velocities and fantastic mass densities. It is part of this mass that must be converted into structural asymmetry by the dispersing action of the normalizing process all at once, thus imparting the tremendous velocities to the cosmic particles. Such conversions of unstable particles of varying mass may account for the spectrum nature of the cosmic particle energy. Some particles must acquire a very large unstable mass to give so great a forward velocity of 100 million Bev—which actually is 200 million Bev for, according to momentum principle, 100 million Bev is shot off in opposite directions.]

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a particularly orderly arrangement for these nuclei are the most stable of 204
all nuclei and are far more abundant than the elements above and below them (with the exception, of course, of hydrogen and helium) in the periodic table. (The orderly nature of the iron nucleus seems to be the most likely explanation which is reflected in its magnetic properties; the meson-coupled-positrons may not easily move about in their microcosm and hence, when ordered by an external field, they tend to stay ordered giving rise to the property of magnetism.) The form building process continues until the heavy U_{238} is formed which seems to be the upper limit of the stable atomic nuclei. This atom is not really stable as evidenced by its ejection of beta and alpha particles and gamma rays. As the intrinsic one-way asymmetry to symmetry tendency forms unstable patterns with the U_{238} nucleus, the normalizing process disperses the unstable pattern. The lower weight elements are the new stable patterns and the beta-alpha , and gamma particles and rays are by-products of the action of the normalizing process. The formation of stable patterns and the ejection of these particles in solar bodies such as the earth is simply a continuation of the same process begun in the galactic isolable process. (The relative proportion of the elements formed by isolable processes such as the above,

and hence the relative abundance of elements found in the universe, may be determined by the above intrinsic barrier at atomic weights of 5 and 8 and by the intrinsic stability of the nuclei themselves. The above barrier, for example, may determine the rough ratios of hydrogen to helium to the heavier nuclei. Since there would be many more hydrogen and helium nuclei present, we would expect more stable hydrogen and helium atoms to be formed even if their intrinsic stabilities are less than those of the group of elements around iron. Then in the one-half of one percent of heavier nuclei permitted to pass this barrier, we would expect the iron group to be more abundant than the other elements because of the relatively greater stability of their nuclei.)

Quantum and nuclear evolution are due to the normalizing process operating on the free energy level synthesizing patterns of structures which facilitate normalization, but the normalizing process also operates in the larger context, in the isolable process as a whole, synthesizing patterns of structures that facilitate normalization. Thus, since the normalizing process operates in all quantum structural aggregates in the isolable process, it has an organizational influence over all of these individual quantum and nuclear aggregates and causes the synthesis of larger patterns of structures that facilitate normalization on all scales of size. The quantum configurating symmetry tendency we call gravitational attraction is continuously active in each nuclear aggregate which causes these nuclei and atoms gradually to combine so that huge aggregates of these nuclei and atoms are accumulated. The normalizing process, however, is just as continually active on the large scale synthesizing patterns of structures that facilitate normalization. Therefore, with the subsequent gradual accumulation of these huge aggregates of nuclei and atoms, the normalizing process begins to arrange (structure, organize, etc.) these aggregates into cyclic organizations that facilitate normalization on this larger scale. As these huge aggregates are moved out the region of the isolable process which we shall call the inter-galactic structuring center, this center continues to send structural asymmetry to each of these aggregates via sub-structuring centers in these larger structural aggregates which permits them to continue their differentiated growth. (It is the normalizing process of the unitary field acting as part of the inter-galactic structuring process which ultimately unifies these aggregates or galaxies into a cyclic system forming the galactic group. Gravitational attraction between the various galaxies may determine the diameter of the galactic group which in most cases seems to be several million light years.) Subsequently, gravitational attraction working within each of these huge aggregates causes further aggregation--irregular in form, wildly turbulent in internal motion with only a few stars interspersed here and there. The first stars to be formed would light up the proto-galactic group and would look like a huge gas and dust cloud. This proto-galactic groups, it is here postulated, is a system of proto-galaxies each one of which is moving away from the inter-galactic center and each one of which is on its way to differentiate into an irregular galaxy. 205

The proto-galaxy together with the normalizing process of the inter-galactic structuring center forms a unitary process. In this way each

quantum structural aggregate of the proto-galaxy shares both tendencies of the unitary structured field. Each structural aggregate in the proto-galaxy continues to operate on the principle of decreasing asymmetry which, when acting in cooperation with the normalizing process, manifests itself in the one-way development of the structural aggregates within the proto-galaxy, the main attribute being an increase in structural order and organization of the individual quantum structural aggregates which is reflected in the shape and motions of the larger systems of which the quantum structural aggregates are a part.[37]

[[37] The age of a particular galactic group, it was postulated above, must be considered in relation to the unitary field as a whole. In other words, the position of the individual galactic

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206 All proto-galaxies further differentiate to become irregular galaxies such as the Magellanic Clouds of our galactic group. These galaxies may be poor samples of irregular galaxies for they, according to some theorists, may be already well on their way to becoming spiral galaxies. The initial number of stars in these irregular galaxies may roughly correspond to the average number of stars in the globular clusters of a particular galactic group—taking into account, of course, the stars lost by way of becoming exploding novae. Each sub-system (proto-galaxy) of the larger system (proto-galactic group) continues along its one-way path of increasing order and organization.

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group in the evolutionary sequence must be compared to the rise of the galactic groups of the universe because it was the unitary structured field operating as a whole that formed the inter-galactic structuring process and governs the growth of the galactic groups as a whole. And similarly, the age of the individual galaxy in the individual galactic groups must be considered in relation to the inter-galactic structuring process or, in other words, the position of the individual galaxy in the evolutionary sequence must be considered in comparison to the rest of the galaxies in the particular galactic group because it was the inter-galactic structuring process that formed them and which governs the differentiated growth of the individual galaxy as a whole. For proto-galaxies to grow and differentiate they must remain related to this central source of asymmetry and facilitate its symmetry tendency (facilitate the normalizing process). There must be at least four different ways a proto-galaxy approaches its one-way asymmetry to symmetry final symmetrization: 1) By the normal asymmetry to symmetry change of its individual quantum structural aggregates—the galaxy remaining related to its source of asymmetry throughout its existence. This group must include the majority of galaxies in the universe. 2) By falling out of relation, in some way, with the central process that furnishes structural asymmetry. This may be the case of the unusual spiral galaxies that contain neither gas nor dust. 3) By an abnormal internal make-up of the proto-galactic group which allows the individual proto-galaxies to approach rapidly their final symmetrization. This may be the case of the single galaxies in space that are surrounded with globular clusters. 4) By falling in an abnormal environment such as a region where many proto-galaxies are very close to one another. It appears that only one of the proto-galaxies secures the asymmetry supply and the others do not mature. This may be the case of the globular clusters that surround the larger galaxies. In any serious attempt to arrange the galaxies of a particular group into an evolutionary sequence or to determine their respective ages, these individual differences in the manner of the galaxy's birth, its external environment and unusual past occurrences must be taken into account. (This

hold for the galactic group as a whole, for the individual galaxy, for the star cloud, for the star associations, and for the individual stars.) All of these may have individual differences; any approach which deals with only the averages of such aggregates such as the average luminosities of the various galactic groups may well be obscuring vital differences that should be taken into account. It seems a paradox to this writer that the expanding universe view is called "the evolutionary universe" where as a hypothesis of spontaneous generation lies at its very core while the steady state universe is often referred to as a static universe view when an evolutionary hypothesis lies at its core. Perhaps the word "universe" itself is at fault. The universe, according to the unitary view, is the unitary field and its system of sub-systems (galactic groups). As these galactic groups evolve and change so does the universe evolve and change. There is no universe other than this unitary field and its system of sub-systems.]

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The irregular form and turbulent motions of the irregular galaxy begin to smooth out due to the quantum configurating symmetry tendency of the individual quantum structural aggregates manifesting themselves, converting structural asymmetry to structural symmetry which yields the more regular large scale shapes and motion.[38] Due to this decreasing asymmetry at the quantum level, each star acquires more orderly movements and begins to rotate faster and faster. (That is, the angular momentum of the larger aggregate is acquired from the angular momentum of each quantum structural aggregate of which it is composed. As the configurations of the quantum structural aggregates change, becoming more symmetrical, the shape, motion and angular momentum of the larger system takes on these corresponding features.) Then (after Oort), "The increase in rotational velocity would increase the centrifugal force. Eventually, when the centrifugal force came to equal gravitational attraction, the system would cease its contraction in the plane of rotation. However, in the plane perpendicular to this (i.e., the plane through the poles of the spinning system) contraction would continue. Thus we would end up with a disk shaped galaxy." Gradually, the tendency toward maximum symmetrization within the stars of the disk gains the upper hand and these structural organizations, no longer facilitating normalization, undergo a one-way path to maximum symmetrization forming population II stars, with the structural asymmetry now being channeled to that part of the galaxy which still facilitates the normalizing process and continues its differentiated development forming what we observe as spiral arms.

(Some of the proto-galaxies have come to a position in close proximity to one of these maturing galaxies. They too continue their differentiated growth but it seems that the one which matures first subsequently receives all the asymmetry supply; these proto-galaxies fail to mature and form the globular clusters which the writer has postulated to be abortive galaxies. That is, if each of these proto-galaxies, now globular

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[[38] We might briefly contrast the statistical-atomistic point with the unitary view as to the origin of these orderly features. In order to account for the appearance of these orderly features, theorists using the statistical view assume that disorderly gas particles collide and convert some of their motion to heat which is radiated away; it is the slowing down of these motions which tends to smooth out the irregular shapes. Unitary theory, on the other hand, holds that the different motions are due to differences in the configurational properties of the quantum structural aggregates. In other words, the differences in form account for the differences in

motion and not the other way around. As these forms change, different motions manifest themselves—cosmological evolution is far more orderly than the statistical-atomistic view otherwise implies.]

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clusters, had been positioned in a different environment, each one of these 208
stellar aggregates might have formed a galaxy.)

Now, regarding the galaxy as a whole, the observed speed of movements can be explained by unitary theory. Due to the increasing symmetrization of the quantum structural aggregates within the stars of the disk of the spiral galaxy, this central core becomes a densely packed, slow moving systems of stars. Between this dense core and the outer spiral arms are rapidly moving, closely coiled, former spiral arms containing stars which are of middle age as far as the conversion of their intrinsic structural symmetry goes. In the outer spiral arms the movements are again slower but because of the high level of structural asymmetry in the spiral arms, not because the structural asymmetry has been converted into structural symmetry, which seems to be the case of the stars of the central core and those stars between the spiral arms which have probably fallen out of relation with the normalizing process. Eventually the galaxy reaches a certain point in its differentiated growth where it, as a sub-system of the larger system, no longer facilitates the restoration of the asymmetry level of the normalizing process, whereupon the central structuring process gradually ceases to channel a high rate of asymmetry resupply to the spiral arms. The unitary tendency of the galaxy as a whole now gains the upper hand. This leads to rapid symmetrization in the formerly slowing moving arms which at first causes these outer spiral arms to move faster and faster, the centrifugal force flinging these arms far out into space (so that they may actually penetrate other galaxies) and elongating the central disk so that the system takes on the form of a barred-spiral galaxy. But eventually the structural asymmetry in the spiral arms is converted into structural symmetry, the spiral arms begin to close up, and the elongated bar nature of the central disk begins to assume a more globular form. The galaxy as a whole follows a one-way path toward its final symmetrization taking the form of an elliptical galaxy. These elliptical systems are now in highly symmetrized states and have converted their intrinsic structural asymmetry into structural symmetry. This, however, is not their end for they are still governed by the normalizing process of the structured field. The star inhabitants [star members] of this now symmetrized dead star city [star group], one by one, as their interior nuclear structures lose their coupling meson structures, undergo an exploding nova stage and pass out of the galactic group into the structured field of the universe. At some far distant period they will again congregate into stars and galaxies elsewhere in the universe, and will once again sparkle with primordial beauty and the radiance of youth such as now characterize the blue stars of our Milky Way. 209
There is a continual cyclic creative and final symmetrization process in the universe, the rate of formation of new galaxies and galactic groups just compensating for the asymmetry to symmetry change in other galaxies and galactic groups so an open system, steady state universe is maintained—ever changing and yet ever the same.

In summary, the basic evolutionary characteristics of the individual galaxies in a galactic group[39] are a consequence of the fact that the normalizing process of the inter-galactic structuring process acts in cooperation with the symmetry tendency of the quantum structural aggregates in the various galaxies in synthesizing patterns of structures that facilitate normalization. If the normalizing process predominates in a particular galaxy, the irregular galaxies are manifested—these are the middle age spiral galaxies. If the symmetry tendency predominates, an increase in rigid symmetry manifests itself to yield the elliptical galaxies—these are the oldest galaxies. The irregular, to the spiral, to the elliptical galaxies represent a one-way decrease of structural asymmetry. The continuous creation, one-way development and final symmetrization, and the creation again of galaxies and galactic groups in the universe indicates that the unitary field as a whole operates as a balanced creative-formative process.

3. THE ORIGIN OF OUR SUN AND PLANET

Thus, in this way it is here postulated that our galactic group originated, operates and evolves. At or near the center of gravitation of our galactic group, there is held to exist an inter-galactic structuring process from which region the earth receives cosmic particles of perhaps the highest energies. Through this center channels a mighty river of life-providing structural asymmetry from the structured field of the universe to the sub-structuring process in the various galaxies of the galactic group. And out of this inter-galactic structuring center pass components from exploded novae to the rest of the universe. As the structural asymmetry channels into this inter-galactic structuring center, it undergoes quantum and nuclear evolution which creative process further continues within the

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[39 Since there is a constant flow of asymmetry into the central structuring process, new galaxies must be constantly forming in the more favorable regions of the younger galactic groups such as our own. We should be able to identify such regions with our radio and other telescopes that have yet to be developed.]

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various sub-structuring processes of the various galaxies in the galactic group. The evolutionary creative processes going on in these sub-structuring centers, the closest of which may not be more than 5,000 light years from our sun, may be the major source of the higher-energied cosmic particles that enter the earth's atmosphere. 210

This writer tentatively identifies these sub-structuring processes with or localizes them in the vicinity of, the "emission nebulosities" which are gigantic clouds of gas and dust known to exist in the arms of all spiral and large areas of irregular galaxies. The emission nebulosities in the galaxy Andromeda have recently been studied by Baade who describes his work and the nature of his findings as follows:

> When I (Baade) examined the first red exposure of the Andromeda Nebula that resolved the central region, I was very surprised to discover two large clouds of luminous gas in a spiral arm which happened to cross the field. I had previously photographed the same regions on blue-sensitive plates, and those plates had not shown the clouds. Moreover, Hubble, in his earlier survey with blue-sensitive plates, had been unable to find a single luminous nebulosity in the

> whole Andromeda Nebula!. . .To get a clearer picture of the situation I made a new survey of the Andromeda Nebula on both red and blue plates. The result was the discovery of nearly 700 emission nebulosities on the red-sensitive plates. They show a striking arrangement—strung out like pearls along the spiral arms. This restriction to the arms is not surprising, because such a nebulosity must be excited by a hot star of the Population one type, and these stars occur, as we know, only in the spiral arms.
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> Baade—*Scientific American*
> September, 1956

Some of these emission nebulosities have been also identified as sources of radio waves:

> A comprehensive survey with this instrument (radio telescope), completed early in 1955, located 1,936 radio stars. . .Thirty of them give indications of being part of our system: their diameter is comparatively large; they tend to be concentrated near the plane of the Milky Way, and several have been identified with gaseous nebulosities within the galaxy.
> The remaining 1,906 are "point" sources, distributed uniformly across the sky. Very few of them can be identified with visible objects, and these give us no enlightenment on the population as a whole. . .
>
> Ryle—*Scientific American*
> September, 1956

Thus, emission nebulosities are present in the central plane of the spiral arms of our galaxy which are known to have spectra identical to those observed in the galaxy Andromeda. This writer tentatively identifies these emission nebulosities as, or within the locale of, the sub-structuring processes of our own galaxy. In view of the outline of quantum and nuclear evolution drawn above, the writer suggests that these emission nebulosities are comprised of both stars in the making and the by-products 211
of the sub-structuring processes which leave gas and dust clouds behind in the spiral arms after the sub-structuring processes have moved to other regions. The sub-structuring processes may be moving down the spiral arms; that is, outward from the galactic center, building up the spiral arms as they go and leaving emission nebulosities behind which are observed as Baade's "string of pearls." The by-product gas and dust clouds originate perhaps as lower energy cosmic particles emitted by the sub-structuring process, which remain the vicinity of the structuring process and thus now serve to mark the regions where the structuring processes have been located in the past and where structuring is going on at the present time.[40] Subsequently, however, the byproduct gas and dust clouds are dispersed by their own internal motions and move at random throughout the galaxy, an inch of this cosmic dust falling on our planet every century; the dust and gas ultimately follow the same route out of the galactic group as do the components of the exploding novae. The sub-structuring processes themselves may not be localized in the visible structure of the galaxy at all. They may be out in space—just above or below the emission nebulosities. What the physicist has heretofore regarded as an empty vacuum may well contain the most significant events of the universe.

Much the same sequence of events as described above for the inter-galactic structuring process must transpire in the sub-structuring processes. Quantum and nuclear evolution and the arrangement of larger patterns of structures into cyclic organizations that facilitate normalization is effected by the normalizing process but, instead of forming proto-galaxies, proto-suns and proto-planets are being formed. The greater stability, the greater number, and the greater gravitational attraction (in comparison to hydrogen and helium) of the atoms of the iron group apparently cast this group of atoms

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[[40] The emission nebulosities marking the regions of the currently ongoing structuring processes should be sources of both high energy cosmic particles and radio radiation. The other regions containing only by-product gas and dust clouds should be sources only of radio radiation. Oort and his colleagues have succeeded via the radio telescope in tracing out the spiral arms of our galaxy with radiation picked up perhaps from these residual emission nebulosities. This researcher points out that what we observe and call the Milky Way is actually faint luminescence coming from these emission nebulosities (the luminescence being due to the light of adjacent stars) in a galactic arm of our spiral galaxy. Thus. we and all our ancestors before us have been observing—without knowledge and hence without understanding—a celestial drama that must strike close (in the evolutionary sequence) to our very creator—that which developed our starry cosmos, which developed our sun and planet, which developed life upon our planet, which at this very moment develops our personalities and which provides us with the creative potentialities to develop a great world civilization.]

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into roles as the central core in the aggregating process. The normalizing process working in the sub-structuring process as a whole gradually begins to organize these larger aggregates into cyclic organizations that facilitate normalization on the scale of sun and planets. As these aggregates grow in size, the normalizing process gradually moves them out of the sub-structuring centers into the galactic structure itself. These proto-suns and planets, although apparently cold clouds of dust and gas, are actually nuclei and atoms in a high state of evolutionary development with a high level of energy. That part of the structure of the galaxy into which these proto-suns and planets are initially moved, this writer identifies with the emission nebulosities. (These proto-suns and planets may be the objects in the emission nebulosities that produce the heavy spectra of the iron group.) As these cyclic structures are moved out into the galaxy, each aggregate is further compressed by gravitational attraction which initiates thermonuclear reactions in the larger aggregates and transforms them into systems containing single, double or triple stars. (About one billion single star systems like our own solar system exist in our galaxy—double and triple systems of stars are thus far more numerous.) The smaller aggregates of these cyclic organizations also undergo gravitational contraction but do not attain the temperatures necessary to initiate the thermonuclear reactions, and hence these aggregates only pass through a molten stage and then cool to form the planets, satellites, asteroids, comets, etc. such as we find in our solar system.[41] (These future objects of solar systems must initially possess a

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