The conviction that Einstein's system of field concepts and equations would not serve as a foundation for the whole of physics came about in the early twenties. Since Einstein's relativity equations referred to space-time events on the astronomical level, field theorists gradually turned to quantum theory and the atomistic level in their search for more basic concepts that would more adequately denote the fundamental nature of the foundation concept, the field, and which would more adequately describe its fundamental mode of operation. As a consequence of this shift in viewpoints, De Broglie, a French theoretical physicist, in 1924 asked himself how the discrete states of Bohr's atom could be understood on the basis of wave-field concepts. He then derived an equation predicting that all so-called "discrete" atomic particles have associated with them waves of a definite wave-length. De Broglie was saying essentially that the "discrete" electron, for example, acts much like a photon so that under the proper experimental conditions it would be found that a beam of electrons would behave exactly like a beam of photons. The experimental confirmation of De Broglie's postulated wave-concept of the electron came three years later (in 1927) through an experiment by Davisson and Gremer.

In 1925, W. Heisenberg and E. Schrödinger independently worked out a new theory of the hydrogen atom (which was to displace Bohr's concepts) utilizing De Broglie's new concept of the electron conceived as a wave. Schrödinger pictured the single electron-wave, moving around the hydrogen nucleus, as a sort of wave-packet. (Planck, it will be recalled, had conceived of the photon as a wave-particle or a wave-packet of electromagnetic (field) energy of value hv. Now Schrödinger was applying the same conception to the orbital electron of the hydrogen atom.) This wave-packet, Schrödinger theorized, is formed in somewhat the same way that standing waves are set up and maintained in acoustical media. To interpret the electron as analogous to a standing wave, Schrödinger maintained that De Broglie's electron-wave must be pictured as having a considerable length so that it extends around the entire atom and perhaps overlaps itself to set up the "standing wave." Pauli later introduced the idea that only two electrons can occupy the same orbit at the same time and must have opposite spin. Thus the idea of the same electron-wave being reflected back upon itself (overlapping) to set up the "standing wave" was not necessary. Since there were only two electron-waves in any one particular orbit and these waves were moving 78
in opposite directions, the two electrons and their opposite spin were enough to set up the "standing electron-wave."

In this new De Broglie-Schrödinger view of the hydrogen atom, the quantum theorists were saying that the electron is not to be thought of as a "discrete" particle located at some point within the atom but as an elongated bell-shaped wave-packet whose mass and charge are being spread out over the whole orbit of the electron. But, nevertheless, by utilizing the statistical properties of the bell-shaped "standing electron-wave" that was now supposed to represent the actual state of the electron within the atom, mathematical (statistical) equations could still be developed that regarded the elongated electron as essentially a discrete particle.

> The particles then would be more or less temporary entities within the wave field whose form and general behavior are nevertheless so clearly and sharply determined by the laws of waves that many processes take place *as if* these temporary entities were substantial permanent beings.
>
> *Schrödinger*

From the statistical properties of the bell-shaped or normal probability curve, it was known that most of the electronic charge and mass of the electron could be conceived of as heavily concentrated (symmetrically distributed) about the statistical mean of the wave. This, of course, would correspond to the "packet" which formed the amplitude of Schrödinger's "standing electron-wave." And similarly, from the same statistical knowledge of the normal probability curve's distribution, it was known that the mass and charge of the electron would drop to practically zero just outside of the region of maximum distribution. This region of minimal charge and mass on both sides of the packet would correspond to the waves (two tails) which formed the nodes on both sides of the packet in the "standing electron-wave." A further consequence of this "standing electron-wave" concept of the electron was that if such an empirical distribution of the electron actually existed, the amplitude or "packet" of the standing wave would have maximum motion whereas the nodes or "waves" of the same would have minimum motion. This implied that the wave-packet electron could be precisely localized in space and time on the quantum level. If such a view could be experimentally verified, that is, if the new mass-points or "packets" could be precisely localized, the resulting equations would yield a new type of field physics which justifiably could be called "wave-mechanics" or "quantum mechanics." Despite the widespread misuse of these terms, the new concepts were not verified by experimental investigation. This in fact 79
shut the door for once and perhaps forever on any future doctrine of "mass-points" which supposedly can be localized precisely in space and time.[10]

In order to derive mechanical laws for the prediction of quantum space-time events, we would have to be able to determine both the present positions and the velocities of Schrödinger's wave packets as well as their direction of motion. Experimental quantum physicists, however, found that the combined position and velocity of these Schrödinger wave-packets, taken individually, could not be observed with certainty nor could the path of any one wave-packet be predicted. That is, the physicists found that if we know accurately the position of the wave-packet, there will be an error in our determination of its velocity and vice versa. Thus, it was realized that not only the orbital electron but that all objects of atomic size fluctuate continually, i.e., they can not maintain a precisely defined position for a finite length of time. (The new viewpoints were soon to be applied to the nuclear particles which were about to be discovered.) These fluctuations are not predictable so the laws of the new quantum physics reveal only the statistical behavior of atomic systems over a period of time. These fluctuations are regarded as not affecting the classical field at all; they become apparent only when the effects of an electromagnetic field on a single atom are measured.

Schrödinger's wave-packet hypothesis thus failed to be experimentally verified for it proved impossible to associate definite motions with these packets. Thus, an "uncertainty principle" and statistical laws became the fundamental concepts of the new quantum physics. It is for this reason that it is often said that the twentieth century is one of chance and uncertainty. In place of the nineteenth century determinism and strict mechanical causality, we have chance and uncertainty as explanatory doctrines. Instead of maintaining that the past and future of any object can be revealed by measuring its position and velocity, it was now maintained that the only thing which can be predicted is that it be statistical.

In the preceding paragraph, we have the crux of the difference between Whyte's field-process viewpoint (which we shall shortly develop) as to how the foundation concept, the field, operates and how the mechanical system of Newton and the field doctrines of Faraday and Einstein conceived their foundation concepts to operate. Both the Newtonian mechanics and the two now classical field theories assumed that the fundamental mode of operation

[[10] Heisenberg, for example, in his uncertainty principle, points out that because of the atomistic nature of our measuring apparatus, we could not ever be sure that we have observed the same particle twice.]

of the foundation concept must of necessity be described by a mathematical 80
law which was the idea that events in time and space could be precisely determinable and their relations directly represented by mathematical equations. For example, as we will recall, the laws of classical mechanics were applied to single, large, complex systems. The location and speed of their center of gravity gave the necessary quantities to substitute in the Newtonian equations. Thus, in classical mechanics the past and the future path of these large aggregates such as the planetary bodies could be determined and predicted via the use of these laws. And similarly, the spatial (field) states could be treated as points (represented by vectors or tensors) which could be precisely localized in space and time and their (interdependent) interactions described and predicted by the field equations of Maxwell and Einstein. But the idea of mathematical law broke down on the level of quantum wave-physics because it was proved impossible to predict the position and velocity of the single particles that composed these larger systems. Newton's laws thus became seen as really the statistical resultant of a vast array of quantum space-time events none of which, when taken individually, are themselves predictable. The theory of relativity broke down when it was applied to quantum physics because it could not account for these fluctuations; in the classical field theory they were statistically obscured. This is perhaps the fundamental contribution of the new quantum wave-physics to field theory: the rejection of the notion of mathematical law—the idea that the operation of the foundation concept, the field, must of necessity be described by laws which interrelate concepts which, in turn, refer to precisely localizable mass points of spatial states in space and time. This rejection of the notion of mathematical law may be taken as the final transition from the doctrine of materialistic-mechanism to the doctrine of the field-process as the foundation for all of science. It is the quantum viewpoint that we must accept as a basic fact of nature an "uncertainty principle" and the notion that the laws of nature are inherently statistical, the latter of which Whyte rejects. Whyte, however, does not reject the random fluctuations which were experimentally adduced facts. He simply rejects the notion that statistical laws and concepts describe the

field's fundamental mode of operation. These "random fluctuations," or asymmetrical motions, are not due to "heat motion" as Schrödinger envisions but are intrinsic, random, or asymmetrical motions due to a field as Thompson proved them to be. They, in fact, assume a central role of importance in Whyte's concept of the unitary process whose operation governs the unitary field. Thus, what is a tendency toward a maximum of 81
"statistical disorder" and apparent uncertainty in quantum physics, takes on the character of a particular form of order when these so-called random field motions are seen in their proper perspective in the large context of the unitary structured field. Whyte holds (by utilizing the "faith of the pure scientist" we developed above) that quantitative technique and the notion of mathematical law obscure a much more fundamental concept of field than that offered by quantum physics and a much more fundamental principle upon which the unitary field can be conceived to operate.

Thus, after the research of the quantum wave-physicists in the late twenties, Bohr's discrete orbital electrons which supposedly moved along sharply lined, mono-planed trajectories (orbits) and which jumped from one discrete energy level to another gave way to a view of the electron as a "diffuse quantum state of motion" which moved along equally diffuse trajectories and energy levels, all in three dimensions. Actually all that the new view was saying was that the field structures composing the electron could be either spread out or be made to "bunch-up" either of which depends upon the speed of the electron. [11] If the velocity of the "particle" or field bundle increases, the spread-out-field electron will become more and more discrete up to the limiting velocity of light. We can use this field bundle interpretation of the atomic "particles" to extirpate the "wave" concept from field theory. (The wave concept, as was suggested above, is actually a legacy left over from Maxwell's mechanical conceptions of fields.) One can conceive of either the orbital electrons or nuclear "particles" as being composed of these spread-out bundles of field structures so that these "particles" will also yield "wave" properties such as the Gaussian distribution curve. In the case of the photons, one can propose an analogous scheme plus the additional fact that there must be space between successive photons. Thus, both the spread-out nature of the photon (which would be at a minimum) and the spaces between each successive photon would account for all the wave properties of light. Thus, the "wave" concept would be cast into a purely conceptual role without any empirical referent.

We will also utilize below the conception of the atomic "particles" as spread-out bundles of field structures to assert that our planet must be a

[[11] In unitary concepts, the quantum view of the electron as a "diffuse quantum-state of motion" becomes instead a bundle of smaller field structures (each field structure being smaller than any nuclear particle thus far discovered) which can be spread out over space and each of which possesses its own intrinsic motions.]

very young planet compared to other astronomical bodies some of which 82
must be vastly older than our own solar system. This concept of the relative youth of our solar system, we will find, is much at variance with the mechanistic-materialism, spontaneous generation view of the origin of our solar system and the universe. This latter view still dominates the purest of the pure sciences (astronomy) to this day. This geo-centric view of modern astronomy (in relation to the age of the universe) maintains that our solar

system and the universe have much the same age. We shall assert below that Bohr's concept of the atom, in reality, represents a temporally limiting case of the atom, that when it is infinitely old. Thus, a very young atom has very diffuse orbital and nuclear "particles" and very diffuse, rapid, and irregular motions and energy levels. As the atom becomes older, by a process we will describe below, the diffuse particles become more and more discrete and the diffuse trajectories and quantum energy levels become more and more fine-lined and mono-planar. This view suggest that as an atom becomes old, it (and any stellar aggregate containing such atoms) becomes more dense (compact), slower moving, and more regular in its intrinsic motions so that at the end of the intrinsic tendency, the symmetry of form and structure and motions proposed by Bohr's concept of the atom becomes a reality. Thus, maximum symmetry of form and motion is a characteristic of physical old age. This view, of course, is also quite contrary to the expectation of quantum statistical thought which expects an equipartition of statistical disorder of atomic motions after an infinity of time has elapsed in the universe. The view of an evolutionary increasing density of "matter" and an increasing symmetry in form and slower motion seems at first glance to be contrary to the Lorentz-Fitzgerald Contraction hypothesis which states that as a particle increases its velocity, an increase in mass occurs and not the reverse. We will see below that the "aging effect" attributed to the physical level of the organizational hierarchy and the Lorentz-Fitzgerald Contraction are due to two different processes and, hence, are only in apparent contradiction to one another.

In summary, the main contribution of wave physics was to lead to the interpretation of the nuclear particles in terms of more fundamental field structures whose intrinsic motions can not be individually predicted in space and time. This removed for once and all the Newtonian foundation concept of discrete mass points and the last unchallenged legacy of mechanistic-materialism, the Pythagorean and Newtonian idea of natural and
mathematical law: the idea that space-time events of the foundation concept 83
must of necessity be predictable in order to have a valid field theory. Thus, the uncertainty principle and the idea that randomness was a fundamental feature of this new foundation concept of the field led Einstein to state the view: "It is agreed on all hands that the only principle which could serve as the basis of quantum theory would be one that constituted a translation of the field theory into the scheme of quantum statistics." This point of view was to lead to Einstein's final attempt to derive a unitary theory and also led to the rise of "quantum field theory" both of which we shall briefly trace. Whyte, however, in 1949 was to refute this view of Einstein's. According to Whyte, field theory should be translated into the empirical scheme discovered by the quantum physicists but not into their conceptual scheme which has failed unitary theory by becoming infinitely complex.

Now for a brief résumé of nuclear physics and quantum field theory. Becquerel discovered radioactivity in 1896; Hess, among others, discovered cosmic rays in 1911; Lawrence developed the first cyclotron in the early thirties. All of these were important steps in the development of the fascinating new field of physics which is now called nuclear physics. We will have occasion below to develop various aspects of nuclear-physics but in this section, the relation of the nuclear particles to quantum field theory will be the subject of our interest.

As will be recalled, at the turn of the century one of the two major problems of physics was to explain "matter" in terms of field theory. This was actually the problem to which De Broglie, Schrödinger, et al. were addressing themselves and which led to the development of wave-physics. But as we have just seen, one of the very fundamental components of matter, the electron, disappeared—as it were—under the very eyes of its theoretical-experimental investigators and seemed to elude a unitary field theory. Now what happened to the other particles of matter, the nuclear particles, that were to be interpreted in terms of field theory?

For a brief period in 1932 when James Chadwick discovered the neutron, it seemed that all physical matter could be explained in terms of three elementary particles: the proton, the electron, and neutron. Nature was very simple. The 92 kinds of atoms consisted of various arrangements of these three particles. To be sure, since the quantum theory specified that energy as well as matter was made up of highly dynamic discrete units, there actually were two other "elementary" particles: the photon, the "energy" unit of the electromagnetic field or light, and the graviton, the unit of the 84
gravitational field (which has yet to be observed). But it was thought in 1932 that the former three particles could account for all physical phenomena.

However, it was not long—later in the same year in fact—before a fourth particle, the positron, was discovered. By interaction with the strong electromagnetic field that exists between atomic nuclei and orbital electrons, photons were converted into pairs of electrons and positrons thus demonstrating Einstein's equivalence of mass and energy. Today there are known some 30 different nuclear particles and each is thought to be the manifestation of qualitatively different fields. [Editor's Note: Since the writing of this book in 1960, many more nuclear particles have been discovered.] Thus, as research progressed and as more and more "fundamental" nuclear particles kept turning up in the Wilson cloud chamber, the attempt to explain all nuclear particles and nuclear phenomena on the basis of proton-neutron interaction became increasingly artificial. This realization led to the development of quantum field theory. Yet there are some mechanical theorists who to this day (1958) maintain that all particles in the atomic nucleus are to be explained as the result of proton-neutron interactions. Systematic positions die hard, in science as well as elsewhere.

First, what is quantum field theory and how does the operation of the quantum field produce or account for the nuclear particles? As was mentioned above there have been 30 different nuclear particles discovered thus far and each is believed to be a manifestation of a qualitatively distinct quantum field. The quantum fields are regarded as being unstructured or continuous entities which have a permanent existence and determinable properties. It is believed that these fields, in contrast to classical fields, have a rest mass and can travel with any velocity not exceeding that of light. The quantum fields are regarded as being short-range fields less than the size of an atom whose effect can only be felt for this distance. (When "looked at" with large-scale apparatus, the quantum field is exactly like a classical field, i.e., Maxwell's field, for on a large scale the quantum fluctuations average out to produce no effect.) Interaction is the mode of process in the present conception of the quantum field with the 30 or so field-representative particles the units of interaction. These quantum fields are believed to fill the whole of space; in fact, the entire universe, including the classical fields, is believed to consist of such fields. Thus, the universe from the point of view of quantum field theory is considered to be a "balance" of the spatial states and particles produced by these underlying quantum fields.

How are the nuclear particles produced and how are they regarded 85
from the point of view of quantum field theory? Simply put, the particle is considered to be a manifestation of a quantum field undergoing certain "peturbations" or, in other words, when the homogeneous field undergoes spontaneous changes, energy properties may be manifested but a nuclear particle may also be the end result of the (spontaneous field change or) "peturbation.". Thus, in this manner, the individual quantum fields by their spontaneous "peturbations" generate the 30 or so nuclear particles. The temporal and spatial origin of this spontaneous generation of nuclear particles is not clear in quantum field theory. Presumably the creation of these particles occurred at the beginning of creation but continues at the present time in the nuclei of atoms on our planet. According to quantum field theory, everything exists in a quantum field only in discrete units called quanta. When the theoretical details of these quanta are worked out mathematically, it is found that their properties correspond exactly to those of the 30 elementary particles. Thus, a knowledge of the particles provides the physicist with the mathematical properties of the individual quantum field. When this knowledge is applied or theoretically treated with quantum statistics, it is found that the properties of the 30 or so elementary particles also emerge from the theoretical treatment. Thus, this cyclic argument is regarded as "proof" that each field has its own geometric characteristics which, when the field undergoes spontaneous changes, appear as the individual nuclear particle. The particles, moreover, of a given particular quantum field are all completely identical and indistinguishable. The number of these particles is also not fixed for they are continually being annihilated, created, or transmuted into one another. Thus, there is no detectable identity or sameness; there is no way to mark a particle for identification. So just as the orbital electron was found to be an undefined entity which could not be localized in space and time, so the nuclear particles were found to be undefined entities in the sense that they could be precisely localized in space and time. The nuclear particles, then, from the viewpoint of quantum field theory, are regarded as more or less temporary entities within the quantum field whose form and general behavior are determined by the spontaneous laws of change of the quantum field.

Thus, the nuclear particles in quantum field theory came to be regarded as temporary, diffuse concentrations of fields which are generated by spontaneous changes in the underlying quantum fields. This implies that matter is created (and can be destroyed) by the spontaneous action of the quantum field. Perhaps the main contribution of quantum field theory to field theory was to increase the reality of the conception of the field. The
field was now conceived as being prior and primary to, and to generate, the 86
hitherto regarded permanent, stable and solid mass particles of mechanical

theory. The field, despite its random fluctuations, now had definite and determinable properties and permanent existence. All of these contributions play an important role in Whyte's unitary theory.

The quantum field, however, was assumed to undergo no internal change beyond the "peturbations" that produced the field particles. In other words, the quantum field does not have an internal structure so that the quantum fields themselves are not considered to be made up of small structures which we could call "quantum field structures." The quantum fields are considered to be unstructured, homogeneous entities that every so often spontaneously generate one of the 30 or so elementary particles within the atomic nuclei. It is these 30 particles that interact with one another to produce all physical phenomena. Both Whyte and this writer will challenge this viewpoint and offer the point of view that the foundation concept—the field—at its most basic level is a highly structured entity, that is, composed of three-dimensional field structures that not only have intrinsic motions but intrinsic formative properties as well. The field of Whyte's undergoes internal structural change which is manifested in the one-way tendencies we call evolution, development and learning. The mode of process that mediates this internal change in the unitary field we will call transaction below which is quite a different mode of process than that of interaction which has limited value as an explanatory doctrine. We will also offer the hypothesis that there are still two smaller levels of structures which have yet to be discovered and which mediate the most fundamental changes within the unitary field. For example, we will postulate that all nuclear particles are made up of field structures which we shall call "quantum field structures" which in turn are made up of the most fundamental structures of all, the free energy (or unitary) field structures. We will describe how the quantum field structures may be discovered, by isolation from the genetic or psychological systems of living organisms. We will, moreover, not deny the transmutation and annihilation of nuclear particles in the laboratory but we will deny that new particles are being created in the Wilson cloud chamber or in nuclear explosions as the experimental physicists envision it. In these processes transmutation or transformation of field structures takes place but not the creation of new particles. Creation of these particles, however, does take place but only where the "free energy" concentration density is highest, somewhere near the center of our galactic group and, on our planet, in the
genetic and psychological systems of living organisms. In reference to the 87
latter point, we shall assert below (and thereby reject the DNA side-base-as-biological-order hypothesis and any theory dealing with the nerve impulse as a fundamental neuro-psychological parameter) that the human genetic and psychological processes are also based on quantum field structures which utilize tremendous quantities of energy per structure in bringing about the synthesis of quantum structural aggregates. The hypothesis of the creation of particles in our galactic group will reject the mechanical interpretation of the origin of our solar system which is called "the dust cloud hypothesis." We will offer a point of view which links the universe and our solar system in a continuous chain of orderly evolution on the one end and will link the origin of the earth with the origin of life in the same orderly sequence on the other end of an evolutionary continuum. This continuum is due to the developmental tendencies of the unitary field.

The main limitations of quantum field theory, as was intimated above, is the immense complexity of the statistics that must be used to explain the phenomenon on hand, namely the structure of matter. One can, for example pick up an immensely complex tome in this field and find that the entire book is exclusively devoted to the explanation of the water molecule. The writer of this tome then almost pridefully informs the reader that it would take years of laborious calculation to describe and predict the properties of an ammonia molecule, even with the high-speed computer and the quantitative techniques on hand, so that such determination of molecular properties is left up to the experimentalist. Thus, quantum field theory with its vast quantitative complexity and its increasing qualitative complexity (the increasing number of fundamental particles and hence the increasing number of quantum fields) led Whyte and a number of other theorists to suspect that there must be something gravely amiss in the underlying assumptions of quantum field theory.

In 1949, Albert Einstein was to make his last attempt to lay a foundation for all of science. In his work of 1949, he felt he had made two more strides toward a unitary theory, which were published in *The Canadian Journal of Mathematics* (published for the Canadian Mathematical Congress by the University of Toronto Press) and in the third edition of *The Meaning of Relativity* (Princeton University Press, January, 1956). The General Theory of Relativity had been a result of Einstein's dissatisfaction with the classical theory of gravitation. The new (1949) theory was, in turn, a result of his dissatisfaction with the General Theory of Relativity. He felt that the dualistic nature of both the electromagnetic and gravitational fields was a major weak point in the theory (and was the reason the two fields remained 88
unconnected), the dualism being that part of matter (the sources of the field, particles and charges) and field. The other weak point, he felt, was the strange and artificial mixture of geometric and physical concepts. While the field had a geometric counterpart, mass or energy had none.

In order to be really unitary a theory should be based on only one of these two concepts and the other of the two should be satisfactorily explained in terms of the one. Einstein's aim was to create such a pure field theory so that the existence of matter should be deducible from field equations alone.

> What is regarded as matter is situated in regions in which the field is especially strong. Motion of matter means that the regions in which the field is especially strong change with time. Hence, a resting electron has to be represented in a unitary electromagnetic theory by a small region, inside of which the field is very strong and outside of which it dies out quickly. Such a region, with a strong, but finite field represents concentrated energy—that is matter.

Since a good field theory of necessity interprets matter—or particles—in terms of fields, the laws of fields would have to be changed in order to admit solutions representing matter. Einstein believed that "such a theory, if successful, should disclose to us the properties of elementary particles from which atoms are built, and at the same time explain the motions of planets, stars, and galaxies." In the old theories, the existence of matter was an independent assumption. Thus, as the above quotation indicates, Einstein conceived of matter as a concentration of fields much like the quantum field theory conception of matter. This conception would thereby remove the dualism between matter and field. Since mass, which is equivalent to energy in Einstein's system, is really a concentration of fields, matter thereby achieves geometric properties. Thus, when matter is transformed into energy, in reality, a concentrated field is released and spontaneously manifests its geometric properties. Thus, Einstein reached substantially the same conceptions with this new field theory that quantum field theory reached with quantum statistics. However, as Whyte points out below, the same criticism directed against the mathematical complexity of quantum theory must be directed toward Einstein's new theory.

Introduction to Whyte's field-process system

The twentieth century has been marked by tremendous progress in the filed of biology which came about through a combination of European 89
theoretical genius and American brilliance in experimentation. The field of biology, it should be remembered, is a broad field which at one end includes much of biochemistry and which at the other end includes most of psychology with the exception of social psychology. Research, already started in the nineteenth century, led, in the twentieth century, to the experimental conclusion that all living things are based on a nucleoprotein system and that the ATP-free energy mobilizing and transporting system is an almost universal means for the utilization of free energy in all living systems. Again, in the field of microbiology, a process was uncovered which was found to run through all biological processes with one exception, that one exception being neuro-physiological processes which involve the nerve impulse doctrine. Let us briefly learn the nature of this process.

A receptor or any other biological process in its resting state is maintained at a high level of free energy by the ATP system. Upon stimulation, the free energy is released and is used to perform a function and/or to form a structural aggregate of some sort. But as soon as the process or receptor is deprived of its high free energy by the stimulus, a catabolistic (oxidative) process almost immediately restores the receptor or process to its high level of free energy again. In the meanwhile, the function or structural aggregate is used to perform some behavioral function or to further some developmental process within the organism. A good example of this process is that of muscular contraction on the micro-biological level. In its resting state, the fibril of the muscle is composed of two large molecules, actin and myosin, intimately related to ATP which is at a high level of free energy. Upon stimulation, the actin and myosin molecules combine; the free energy of ATP is used to affect this synthesis. In the process of synthesis, the new molecule of actomyosin changes its shape which results in the macro-molecular movements we call muscular contraction. Thus, in this case, the free energy of ATP was utilized both to form a structural aggregate (actomyosin) and to perform a function (muscular contraction). The curious feature of this fundamental biological process is not the downswing of the process for it is nothing more than an illustration of the second law of thermodynamics: any process or system in a high state of free energy, when activated, will spontaneously release its free energy which, if properly harnessed, can be used to perform work. The curious feature of this fundamental process is the upswing of the process or the restoration of the

high level of free energy in a process or receptor. To all appearances, this seems just as spontaneous as the downswing of the process. But, of course, thermodynamics tells us nothing about the upswing of the process. An 90
argument subsequently ensued in the literature over this point. Szent-Györgyi maintained that the upswing of the process was the spontaneous process and his rival protagonists maintained that the downswing of the process was the spontaneous process. The debate continued for some time with both sides finally agreeing that both phases are spontaneous processes! In the meantime, L. von Bertalanffy noted that on the macro level of biological evolution there seemed to be a uniform tendency toward the maximizing of free energy in these systems over the long course of phylogenetic evolution. (J. W. S. Pringle later found the same tendency to hold for the evolution of biological systems on the micro-biological level.) Yet, this is the reverse of what we should expect from the entropy aspect of the second law of thermodynamics which states that no matter how efficiently we conduct a process, some energy will be made available; that is, the system must tend in the long run toward a state of random molecular and atomic disorder. Yet, here in living organisms we have a system of processes that has been operating and evolving over the course of billions of years and the reverse of the entropy expectation is the result. Thus again, the upswing of this fundamental biological process appears as a spontaneous process and as an intrinsic tendency in living organisms. Can it be possible that living organisms elude the laws and principles of thermodynamics or that living organisms ingest “negative entropy” as Schrödinger puts it? Neither position is correct, Whyte, Bertalanffy, this writer, and a number of other theorists maintain. Living organisms do not elude the “entropy principle” nor do they ingest “negative entropy.” The first point will be mentioned here and discussed more fully below. Living organisms ingest substances of high free energy value; free energy is not “negative entropy.” It is basically different from entropy. These theorists also point to the fact that the current laws and principles of thermodynamics may not be the same laws and principles of thermodynamics that existed four and one-half billion years ago when living things began their rise on this planet. In other words, these theorists maintain that four and one-half billion years ago both physical and biological systems manifested the upswing of the fundamental process which appears now exclusively in living organisms. The physical theorists forget that a long span of time separates the two levels of the organizational hierarchy. For the last four and one-half billion years both physical and biological systems could have manifested their own separate developmental tendencies so that now both systems operate on apparently 91
dissimilar thermodynamic principles. The discrepancy disappears, however, when the time factor is taken into consideration and this time factor takes on the appearance of what appears to be a gradual evolutionary rise in catabolistic (free energy release) level. That is, as the free energy level of the physical sphere gradually lowered, the catabolistic level of living organisms remained the same (through the development of the catabolistic molecular apparatus and the physiological auxiliaries such as the organ and hormonal system, the fluid matrix, etc.) and thus was gradually raised in relation to the external environment. When this change is taken into consideration, it is realized that the laws and principles of physics and biology are identical but that the laws of biology are more fundamental than those of physics.

Thus, in substance Whyte, et al. are asserting that the laws and principles of modern thermodynamics are less fundamental today than the basic process to be found in biological processes which includes all there is in thermodynamics plus the upswing of the fundamental process.

The twentieth century also witnessed a great surge of research activity in psychology. This period started with a mechanical psychology called "structuralism" which stemmed from Wundt (and ultimately from "mental chemistry") and was formally introduced into America by Titchner of Cornell University. In 1914, behaviorism with Watson marked a completely mechanistic doctrine without mentalistic elements. Although the legacy has it that behaviorism is still the dominant system in American psychology, in actual fact behaviorism and mechanistic-materialism have long ago yielded to a process-psychology which is called "functionalism."

Over the past thirty years two seemingly independent systems have arisen in psychology; one is called Gestalt psychology and the other functionalism. About thirty years ago, W. Köhler expurgated the last elements of mentalism and dualism from Gestalt psychology and replaced them with field concepts so that this system today is known as "field theory" psychology. Two central ideas have emerged from these two systems: one from field theory psychology and the other from process psychology or functionalism. The idea from field theory maintains that an organizing field (process) exists in our nervous system which works on the field principle of least action.[12] Most of the research of field theory has been done in the branch of psychology which is most firmly established—that of perception. The field doctrine, however, has spread to all branches of psychology and to

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[[12] Gestalt psychology had both the organizing field and the process concepts implicit in its doctrine, but the field concept was the one made most explicit.]

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many branches of sociology including education. That some sort of organiz- 92
ing field (process) exists in our nervous system with demonstrable laws of organization (patterning) that can be summarized by the principle of least action is accepted as a fact by virtually all psychologists. The central idea from process psychology, on the other hand, is called the principle of reinforcement which, in an abbreviated form, states: whenever a response of a motivated organism is followed by a reinforcing state of affairs, there results an increment in the habit strengths of the temporally coincident stimulus components to evoke the response. This principle of reinforcement was established by a school of functional-behaviorists headed by Hull and now by Spence, et al. of Iowa University. There is some dispute as to whether reinforcement is necessary for learning per se or just necessary for the performance of what has been previously learned (Tolman) but the principle of reinforcement in either sphere is accepted by the vast majority of psychologists. The important point for us is this: when one reduces both central ideas of the two dominant systems in psychology to their most fundamental biological terms and puts them together, the two aspects of the basic biological processes, discovered on the micro-biological level, reappear in the field of psychology. Köhler's principle refers to the downswing of the fundamental process and the Hull-Spence principle refers to the upswing and development tendency of the fundamental process.[13]

[[13] The downswing of the fundamental process, in reference to the intrinsic pattern-forming tendencies in our perceptual system, has been summarized by Musatti. Musatti is referring to the intrinsic formative (pattern forming) tendencies that go on in our perceptual nervous system when we are presented with a more or less random array of dots and lines as a stimulus.

> Musatti (1931) combined these principles (grouping principles of perception) into one comprehensive law of homogeneity. Homogeneity with respect to place is proximity; with respect to quality, similarity; with respect to movement or change, common fate; with respect to direction, good continuation. As to the factors of set and past experience, we may think of homogeneity between what is presented now and what has been prepared for the immediate or more remote past.
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> Woodworth and Schlosberg—*Experimental Psychology*

In other words, Musatti is saying that our nervous system patterns (organizes) external stimuli according to an over-riding principle of homogeneity which has aspects: stimuli close together in space and time are organized into a homogeneous pattern; stimuli with similar shapes, colors, etc., are organized into a homogeneous pattern; stimuli of the past are related to the stimuli of the present and are organized into a homogeneous pattern. Thus, our nervous system intrinsically operates to reduce the asymmetry within sensory stimuli with respect to space, time, quality, motion, and direction, and between the past and present by forming

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So here is the situation of several almost independent lines (that are still 93
unconnected today) of experimental investigation in the field of biology all pointing to the existence of a fundamental process within living systems. Perhaps, were it not for the tremendous prestige of physics, this process would long ago have been recognized as being a more fundamental doctrine than some of the longest enduring and best established laws and principles of physics, those of thermo-dynamics. The first theorist to realize the significance of *both* aspects of this fundamental process in biology for the advancement of field theory was L. L. Whyte.

WHYTE'S FIELD-PROCESS SYSTEM

What follows is a brief development of Whyte's viewpoints based primarily on his work *The Unitary Principle in Physics and Biology*. Because Whyte's system marks the introduction of the process concept into experimentally established fundamental thought for the first time in history, his concepts are so novel and subtle that we shall follow a similar pattern of exposition throughout the remainder of this work. We shall either quote or directly abstract from Whyte and then proceed to interpret the concepts that Whyte presents. In this way, the errors in interpretation fall upon this writer and not upon Whyte's work.

[a more uniform and homogeneous perception—all within the same perceptual structure. (The same principle is known to operate on the tropistic and cognitive levels of the human's nervous system.) This tendency of our nervous system to form the "good" or "homogeneous" figure is also known as the principle of least action for it can be shown that such figures contain the minimum of energy as compared to other figures that our nervous system may have formed from the same stimulus. We will note below that this Gestalt principle of homogeneity is identical to Whyte's concept of symmetry formation on the local level (of the field) with the difference that the former is known to take place in psychological processes and the latter is postulated to take place on the most basic level of physical processes. So Gestalt psychology was already postulating in 1931 that a field process operating on a basic principle of symmetry or homogeneity exists in our nervous system.

Hull's principle of reinforcement in unitary terms (see below) can be stated thus: whenever a response of an organism in a state of normalizing distortion (which is a state of motivation or a state of need, emotional or feeling tension) is followed by the restoration of the norm (the restoration of the level of asymmetry or high level of free energy), a form of one-way development occurs which we call learning. Continuing in unitary terms, the normalizing process, in facilitating normalization (the reduction of tension related to a need, emotion, or feeling which is reinforcement) selectively develops a pattern of structure, which in this case appears as learning. So whenever a response of an organism in a state of normalizing distortion occurs, and is followed by a restoration of the norm, one-way development or learning results.

Thus, combining the two psychological principles, we have in perception structural symmetry (perception) formed which is used by the organism in fulfilling its wants or in facilitating the attainment of its norm. Learning and a modification of the organism's environment are both consequences of the two principles working together.]

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The year 1949 can be taken as the advent of a new explanatory hypothesis in all of science. The year 1895 marked the end of the explanatory era of mechanistic-materialism. The year 1949 marks the beginning of the field-process concept as the basic explanatory hypothesis. Thus, the years between 1895 and 1949 might best be viewed as a transitional era between these two basic explanatory doctrines. But the case of the field-process doctrine as a basic explanatory doctrine has yet to be proved. Thus, in all that follows concerning unitary theory, it is well to keep in mind that Whyte has accepted as the fundamental assumption underlying his system, the hypotheses that a process doctrine can serve as the basic explanatory conception to unify all of scientific thinking and, in fact, to unify all of human thought. (Whyte has already applied his new system to physics, biology, history and art as an explanatory doctrine.) We should not, however, confuse Whyte's viewpoints with the half-mystical ideas of Heraclitus nor with any defunct notion of vitalism or orthogenesis stemming from dualistic philosophy, despite the fact that both of these sources were either the conceptual ancestor of, or at one time were closely related to, the process doctrine. Whyte derives his basic concepts from the most advanced concepts and thinking in the fields of mathematics, physics, and biology and never wanders outside of the conceptual knowledge of these established disciplines. To capture the subtlety and erudition of Whyte's "great leap forward",[14] one must read the above primary reference source.

Lancelot Law Whyte, an English synthetic theorist, begins his work by pointing to the vast mathematical complexity of modern fundamental explanatory doctrines. In 1949 he put forth the criticism that, in the progressive development of physical theory, simplicity has been lost. The mathematics involved have been extremely complex, indeed, almost intractable. For instance, in the new theory which Einstein developed, the geometry of the world is characterized by a general tensor of the second order with sixteen (6 + 10) functions. This in place of the six functions which characterize Maxwell's theory and the ten functions which

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[[14] This writer means to equate Whyte's innovations with Newton's accomplishment for both men introduced a new fundamental system of thought (that is, compared to what preceded these systems) into scientific thinking. To be sure, all the ideas present in Whyte's system were present in the Zeitgeist. But so were the fields of mechanics and astronomy already developed for Newton and the doctrine of mechanistic-materialism can be traced back to the classical Greeks. The mere fact that ten years have passed during which only a few theorists have realized the fundamental significance of Whyte's epoch-making work, more than anything else, testifies to the originality, daring and uniqueness of his work.]

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characterize General Relativity. Quantum field theory also necessarily 95
involves mathematics of the same order of magnitude. Both relativity and quantum theories, moreover, neglect the presence of any formative tendency in nature and must, in fact, resort to complex interactions (mathematically derived) in order even to allow for the one-way character of process.

While current quantum field theory is still based upon the assumption of a four-coordinate system, Whyte feels that the next advance in fundamental theory must have its basis on a simpler principle whose definition does not involve the necessity of a four-coordinate system and which does not neglect the fact of the one-way character of process. The reason, he feels, that recent physical theories have broken down—for instance, General Relativity when applied to quantum fields—is that each refers to only one aspect of some more basic principle.

> Atomic Theory, Classical Dynamical Theory, Field Theory, Relativity Theory, early Quantum Theory and Quantum Mechanical (Statistical) Theory...each of these theoretical methods may have owed its success and its limitations to the fact that it took account of certain limited aspects of the unitary process.
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> Whyte—*The Unitary Principle*

What is (mathematically) needed is a mathematical representation of the one-way development of a new type of structured field which would represent the history of a complex system. This field would directly represent the process of the system.

What Whyte is actually saying is that he rejects (as inadequate) the mathematics which have previously been used by physical theorists. A new mathematics is needed which would represent all the properties of a new type of field and would then describe both the field's process and entire history in its present form. This new type of mathematics, the mathematical representation of the unitary field, should yield as necessary consequences all the above sub-theories plus the formative and evolutionary tendencies observed in nature. Whyte is also implicitly rejecting the qualitative complexity of quantum field theory. That is, he is rejecting the view of quantum field theory that: "there are some 30 different particles and each is thought to be the manifestation of qualitatively different quantum fields..." and that "...these fields fill the whole of space; in fact, the entire universe including the classical fields, is believed to consist of such fields" as the foundation concept for all of science. In its place Whyte proposes that there is but one structured field, composed of a general type, three-dimensional polarized field structure, and that this field fills the whole of the universe

and, in fact, this field is the universe. This is the new foundation concept 96
for all of science which Whyte calls the unitary field.

Thus, while Whyte holds many of the general aims of Einstein and others pursuing a unitary theory, he contends that the current theories are much too complicated and must instead be based upon a simpler foundation concept and a simpler principle.

Now, in developing the idea of the new foundation concept, Whyte points out that the physical systems possessing a measure of stability—such as ultimate particles or atoms of crystals—are characterized by their properties of symmetry while physical forces and fields are distinguished by their asymmetry. Thus, the only reliable inference from the physical observation or measurement of a field is the absence of some element of symmetry. For example, the presence of polar asymmetry with certain quantitative properties may properly be inferred from the observation of an "electrical " phenomenon while any theories of "charges," etc. may or may not be correct. From this view, then, a physical field represents asymmetry. Any process resulting from the field is then the decrease of asymmetry. The "forces" of the field result from the tendency of the field to approach its characteristic symmetry. In this view the particle concept is accepted as valid but only in so far as it represents spatially separated point-centers within extended spatial field patterns. The "classical" field concept is also accepted for its extension of "observable spatial relationships over finite regions," but only for a field in some stage of evolution. Both concepts, moreover, neglect the presence of any formative tendency and must, as we have mentioned, resort to complex interactions to allow for the one-way character of process. Yet, such creative-formative and evolutionary tendencies are everywhere observed on all three of the major levels of the organizational hierarchy.[15]

Whyte then makes another innovation, to which we have already alluded, in his development of the new foundation concept. Rather than being homogeneous, the field is considered to be structured: it is a system of polarized parts displaying a tendency toward its characteristic symmetry.

[[15] We shall cite an example in the physical sphere. In looking out into the universe, we do not observe the harmonious universe that Copernicus and Kepler led us to expect nor do we find that the universe is running down as the thermodynamic theorists of the nineteenth century led us to believe. (Copernicus's solar system, incidentally, was actually a revival of the Pythagorean natural law concept which Copernicus used to overthrow Aristotle's and Ptolemy's "crystalline sphere" concept of planetary-orbital motion.) Instead we observe a universe in evolutionary change, in a continual cycle of: creation, youth, old age, death, and rebirth. The evidence for creative and evolutionary processes in the universe is the reason that current astronomy is called the "new astronomy."]

This tendency is present in all parts of the field as well as in the field as a 97
whole. Thus, there can be two aspects of this tendency toward symmetry: a local tendency toward symmetry of the part, and an overall tendency to bring each part into conformity with the whole. The level of the whole with which other parts are brought into conformity is called the "norm" and the process is the "normalizing process." On the surface there may appear to be two separate and different processes but both are actually two aspects of one unitary process-—one tendency toward symmetry. The basic field principle as he states it is "Asymmetry tends to disappear and this tendency is realized in isolable processes." This he calls the Unitary Principle.

Now let us discuss the nature of Whyte's foundation concept and draw out its implications in some detail. As was mentioned above, an important property of the unitary field is that, rather than being continuous, the unitary field is considered to be structured; that is, it is discontinuous or composed of three-dimensional field structures which are not interconnected or combined with one another on the most basic level of the unitary field. Whyte, then, by an extension of the theoretical considerations that were also mentioned above, equates the salient property of the field—its asymmetrical motion and its asymmetrical geometrical properties—with the thermodynamic entity, free energy. That is, the asymmetrical properties of the unitary field are identified as being due to its free energy properties which the unitary field displays in each and every part and in the field as a whole. Thus, each and every individual field structure of the unitary field as a whole is conceived of as possessing all the properties which have been established and ascribed to "free energy" by the experimentalists of thermodynamics and physical chemistry (including the property of intrinsic asymmetrical motion.) This unitary viewpoint implies as a necessary consequence, that at the most basic level of the organizational hierarchy (which itself is really a differentiated expression of the unitary field) there remains to be discovered a general type, free energy field structure which is the basic unit of the unitary field. This unitary viewpoint also implies that, at the next step up in the complexity from these basic general-type free energy field structures (the unitary field structures), there also remain to be discovered a number of "quantum field structures." These field structures are combinations and concentrations of the most basic free energy field structures. Perhaps some of the 30 or so thus far discovered nuclear particles (or fields) constitute some of these "quantum field structures." This writer, however, will take the 98
position below that the present experimental techniques used to discover the nuclear particles are much too crude to yield the discovery of much smaller "quantum field structures." In other words, the position here will be that none of these "quantum field structures" have as yet been discovered but that their discovery is only a question of time because all that is needed is ingenious experimental techniques to isolate such structures from systems which produce and utilize them all the time—namely living systems. Thus, it is here suggested that the "quantum field structures" form a level of structural complexity intermediate between the basic free energy field structures and the nuclear particles. This means that the 30 or so thus far discovered nuclear particles are composed of these "quantum field structures" which, in turn, are composed of the basic free energy field structures. It is to these yet undiscovered levels of structures of the first and