Evolution, Information, & Personality

Toward a Unified Theory of the Psyche

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Praise for
Evolution, Information, & Personality

"Not since Julian Jaynes' *The Origin of Consciousness in the Breakdown of the Bicameral Mind* has there been such a thought provoking account of human personality. Robert DePaolo's description how the mind evolved and its implications for psychiatry are ahead of our time - a must read for any student or professional in the fields of philosophy and psychology."

David Kamen, PhD. Clinical Psychologist,
Nashua Counseling Center

"A revolutionary treatise that includes an invigorating and thought provoking new therapeutic approach."

Deborah Whitaker-Duncklee, Transpersonal Therapist,
Author of Looking Glass Sky, The Widow's Walk, *and screenplays:* Coconut Grove and We are Stardust.

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Preface

If writing a multidisciplinary treatise is difficult (and this endeavor wasn't exactly a walk in the park) then I had to imagine how difficult it might be for the reader to assimilate the cross references to evolution, information dynamics and clinical psychology that characterize this book. Moreover, I had to consider that reading a book written in language derived from quantum physics, psychology and anthropology might prove to be a bit dreary, even for seasoned clinicians. So to preclude possible confusion this book was written with Information Theory in mind. That's why, for the sake of clarity, certain themes are repeated in successive chapters to serve as an anchor point for the diverse ideas that revolve around them.

As to the book itself, it is offered as an integrative theory. For those who favor linear determinism and the narrow treatment of variables one at a time, this might seem speculative. Others, with an interest not just in understanding who we are, but how we fit into a vast cosmos might find it intriguing. My only hope is that it fosters debate.

Chapter 1
Unification

It is incumbent on anyone espousing a unified theory of personality to connect all the dots; and not just those corresponding to the neurological, psychological and evolutionary facets of human behavior, but also to the universe from which the mind emerged.

In one sense, that statement might seem obvious. To paraphrase the late astronomer Carl Sagan, it is beyond dispute that human beings are made of "star stuff." Our chemistry, our atomic structure and perhaps the ultimate sources of our behavior, motivation and intelligence all derive from the cosmos.

In another sense, that statement might seem specious. After all, we are conscious, whereas the cosmos is not. We have motives and intent, we make decisions, have emotions, get jealous, and at least make an attempt at being faithful and honest. The cosmos does not. Or is that quite true?

If it is true, and there is a fundamental and irrefutable distinction between living and non living entities, and between consciousness and the rules governing the flow of information throughout the universe, then there would have been no point in writing this book. Obviously, the premise of this book is that there *is* a connection; in fact a root connection that determines the various manifestations of energy, gravity, motivation, shape, form, substance, meaning, language, and everything else. The central thesis here, is that whether living or inanimate, homeostatic or static, everything in the cosmos is more or less *informed*, and that the amount of information

and the potential to remain informed, based on the components and complexity of any given entity determines its nature - including the personality.

But what does it mean to be informed? In the usual sense, it means to receive a message from some other source. In scientific terms, it means much more than that. Certainly, information sources such as books, language and mathematics are part of a broad phenomena called *information*, but only because the messages they convey can be distinguished from "noise" in the background, or from within the input package itself.

Information, as defined objectively, means any signal or code that is distinguishable from other inputs, yet is redundant enough to be considered systemic, rather than random.

One of the first to expound on the particulars of Information Theory was Claude Shannon. He, Warren Weaver and others eventually defined the parameters of this process, including a way to measure the amount of information obtained in any given system.

To them, information is not static, is it instead dynamic. While subject to mathematical precision, it is also relativistic, because information is always defined as a reduction in uncertainty, and uncertainty has to do with the initial state of any given system or entity. If the entity has many variables without resolution or distinction - like a haystack - and some resolution is uncovered amidst that - like a needle - then the system would yield a high degree of information. On the other hand, if the system is low in uncertainty, ie. has already yielded some resolution; for example a word fragment such as….furnit… or eleph… then any further resolution, such as the addition of he letters… u-r-e or …a-n-t- will be said to have provided less information…or reduced less uncertainty Thus, the greater the uncertainty in any system the greater its information attaining capacity.

The mathematical correlate of information is the *bit*, which stands for *binary digit.* It signifies that, like an atom or a particle, information has a lowest common denominator. It

is the couplet "yes-no." Each resolution provides a yes or a no, and when uncertainty is high, those yeses and no's tend to have greater impact on the process of discovery. For example if the question was asked: *Who was the President of the U.S. during the Civil War, Lincoln or Buchanan*…and someone answered…*Lincoln,* that would comprise a single bit of information. On the other hand, if the question was asked…*Which American President is considered the greatest of them all*…and the answer was *Lincoln,* it could comprise more than one bit. That is because there are many presidents from which to choose. Even if one narrowed it down to FDR, Theodore Roosevelt, Jefferson and John Kennedy, the answer *Lincoln* would offer five bits of information by its elimination of the others. The second question contains more uncertainty and that is the reason why any response would have reduced more of it, thus provided more information.

While Information Theory was first developed around World War Two, when the Brits used it to break the Nazi communication code, its range has expanded well beyond those parameters, such that a cosmologist like Heinz Pagels was able to see its relevance in the operations of the universe. It is now used to explain a great many phenomena that pervade the cosmos, and, interestingly, attempts have been made by Pagels and others to link it to a very important universal constant - energy.

The relationship between information and energy is analogous to the relationship between space and time, or energy and mass. The factor they have in common is *entropy*, which is defined as a state of decay; not one devoid of energy, (because energy cannot disappear, it can merely change to another form), but without *manifest or focused* energy. In other words a potential, rather than actual state. For example, the current universe has precisely as much energy as it had prior to the formation for galaxies, stars and planets and always will. However the way in which that energy is manifest can and does change dramatically.

A state of entropy means the system is flat. It contains no

information, no codes and therefore no systemic functions. Death is entropy, black (the absence of color) is more entropic than blue or green. Genes that never mutated would be entropic, whereas those that can mutate at least carry more information and more systemic, useable energy. Thus, when the information content is low, the energy content is also said to be low.

When it comes to abstract processes such as language, things get a bit more complicated. Words in themselves do not contain mass or energy. They are obviously just symbols. Yet they act upon physical entities, most notably the human brain, and have the same effect on those physical entities as would a physical object or process.

For example, if language became stagnant, with no slang, modifications, nuance, idioms, or periodic influence from foreign languages, the listeners and speakers would lose energy, and lapse cognitively toward a state of entropy. The attention spans, the zest with which ideas were expressed, the emotional reactions to the spoken word, would all flatten out, until such time as language would lose its usefulness as a tool for communication and relationship-building. It might even reach a point where it suffered a cultural death, that is, unless someone came along and added gestures, intonation, new words, idioms and other novel features. The point is, the relationship between information and energy holds true, even when abstractions are involved.

The information process can also be exemplified diagrammatically. For example, if one views it as being akin to the bleeps on a heart monitor or an EKG, the various grades of information and entropy might look like the following:

_____ No information (state of absolute entropy)

_____----_____---- Some information (novelty plus redundancy)

_____----_____----_____ Higher information content (more encoding)

__----___----___----___ Higher information content - but proceeding toward entropy, because the code is itself becoming repetitive.

___----___***___----___*** Re-information.

The new code (**) is introduced to break up the monotony of prior code (---) and override entropy. Thus, the energy in the system ___---*** remains high.

An ideal information system would be one not only high in information content at any given point in time, but one built to last and self regulate, and with an on-going capacity to accommodate new codes. Such a system might look like this:

___---___---___***___***___----___***___^^^___^^^___---___---___***___***___^^^

Yet, in operating this way, the system would run risks. Since all information systems need a point of stability from which codes can deviate, a code-heavy system might either become so de-stabilized as to lose its integrity or become itself monotonous, thus plunging into a state of entropy - or as it is also referred to… a state of *equilibrium*.

How does the ideal system operate in light of that problem? It does so by having a point of stability so encompassing that it can accommodate an ongoing introduction of new codes without losing its stability. Consequently, the more elastic the stability factor, the better. The stability factor is like a rule, or a theme. The codes are a variation on that theme. It is that relationship that determines whether an entity has manifest energy or is in decay, whether it is alive or dead, healthy or ill, perceptible or imperceptible, creative or stagnant, fulfilled or depressed - even whether or not it actually exists.

Unusual Couplets

To further clarify what information means in a universal sense, consider the following comparisons of things not ordinarily viewed as similar, but with much in common. Take human language and gravity, an odd couple if ever there was one. In what ways can one consider them both informed? With regard to language, it was mentioned above that a repetition of the same words over and over again, or a potpourri of words with no semantic code would have little meaning for a listener. Beyond the words, there would have to be intonations and emphases to give greater weight to some parts of the message than others in order to convey maximal meaning. The fewer the variances, the greater the monotony, and

the less information will be conveyed. In addition, less energy, in the forms of vigilance, attention and reciprocity, would be expended.

But distinction is not itself a code. Nor is it necessarily information. An unusual string of words could stand out from other words, but add nothing systematic or comprehensible to the message. That would not provide any increase in information. For example the passage….

*I am a reasonable person, because I use reason a lot, and reason is a good thing to use, which is why I am not an albino…*carries little information content. This is true for two reasons: first the "reason" foray is repeated and not encoded by a distinct concomitant. The distinctive phrase…*I am an albino*…has no relationship to the central theme, thus it is random verbiage. Yet, if the passage read…*I am a reasonable person who believes in weighing options before making a decision…*that would be more informative, because the option clause stands out from the reason clause yet adds to its meaning. Put another way, the latter sentence provides the two things an informed system needs to be informed; some degree of sameness and some degree of novelty that both operate within an integral system. In this case the system is comprised of the grammatical rules of the English language and the broader cognitive rules (what Noam Chomsky has labeled the *universal grammar)* that emanate from the cognition indigenous to all human minds.

Now consider how that pertains to something as apparently distinct from human language as gravity.

Beyond the physical aspects of gravity as they were first understood by Galileo. Newton and finally Einstein, lies something even more fundamental. Einstein's General Theory of Relativity characterized gravity as a dent in the fabric of space. It was a brilliant idea, not just because of its complexity, but also because of its simplicity. While Newton calculated the "what" Einstein determined the 'why" and did so in a way that could be understood by a fourth grader. His premise was that space, time and mass are all intertwined. Therefore one can look at space as a material thing. Not a

void into which things came and went, but an entity with perhaps less mass in certain locations but with mass, nonetheless. Since it is material, one can look at space as a stretch of cloth with balls rolling around on top. In that scenario, the smaller balls will tend to "sink" toward the larger balls when in close proximity.

Yet while modern physicists are in the process of further describing the cosmos in material terms with the discovery of gravitons, ie, the particles which facilitate this process, it is not the final word on gravity.

To find that ultimate gravity-maker requires a detour from the physical world espoused by Einstein; not into the spiritual world (this is not a prelude to a creationist argument) but into an abstract world, where a principle, not a thing or set of interactions makes the universe go.

The root of gravity is considered here to be *information.* For example, if all objects in the universe were of precisely the same mass, then there would be no dent in the fabric of space as objects came closer together. Such uniformity in mass would make the universe highly uncertain (or entropic) and low in information content. Even a few quirky asteroids of variable mass wouldn't make much of a difference. In either case the universe would be so non-systemic as to lack anything resembling existence. Consequently, we could have to galaxies, solar systems, planetary systems, seasons, weather patterns, or life forms.

So the initial question regarding gravity is not whether the galaxies came about through the design of a god, or through a deterministic process, but what transformations in information were needed to move from a monotonous, uncoded *something*, to an informed system capable of self sustenance and longevity.

In order to address that question and adhere to the central thesis of this book, consider two other disparate concepts as presumed subcomponents of information: The Big Bang and the origin of life.

When it comes to a discussion of the Big Bang, also known

as the *moment of creation,* things get tricky. For one thing, the laws of physics as they are now understood, weren't in play at that moment. Actually, nothing was in play - not even the concept of a moment. The question is often asked: "What caused the Big Bang?" This conundrum has been addressed by everyone from theologians intent on proving the existence of God, to physicists in search of the quintessential quantum principle that could explain why this massive explosion, or gradual expansion (depending on which version one accepts) occurred in the first place.

In a sense, the question is ill-suited to a brain like ours, which evolved in an already systematized universe featuring time, space and motion and mass. Another problem is that at the *point* of creation - let's stay away from the word "moment" for the time being - there *was* no space, no time and no distribution of mass to create any sort of object relations. Since, as Einstein demonstrated, time is integrated with space and movement, and since the tiny cosmic egg that eventually gave rise to the cosmos did not expand *into* space, but instead created space as it expanded, then there cannot be said to be a moment of creation. Time came after the Big Bang, so there was no "when," nor any sense of a beginning or an end.

In a sense, that same argument can be applied to a deterministic analysis of causation. In order to have cause and effect, there must be at least two entities. One is an *independent variable*. It acts on a second kind of variable that is typically referred to as *dependent*. But with no mass differentials and no space through which a cause could exert itself, the notion of cause and effect at the point of creation might be considered incongruous as well.

Still, one could ask, even if the prototype universe was not bound by the laws of physics: Isn't there some way to conceptualize what happened at the point of cosmic origin?

Turns out there is one principle that transcends even the pre-expansion domain of physics. It was deemed the "theory that decides" by Werner Heisenberg and while not quite a godhead, it just might fit Einstein's mold of what a God of

order and law would be: not a figure with a specific height, weight and disposition, but a governing principle that was there from the beginning, will be there at the end, and is responsible for every creation, be it physical, cognitive, linguistic, moral, genetic or biological. It is the fabric that weaves quietly but pervasively through all particles, atoms, elements, chemicals, biological organs and social systems. It is information, and more specifically, the arrangement of items such that they have a systematic combination of synthesis and divergence (or themes and variations) that allows them to continue on, thus allowing for periodic changes without dissolution of the overall integrity of the system.

But why should information content be so important; especially since Einstein also said that energy is what makes the universe go? Indeed, energy is said to be one of only two constants in the entire universe, the other being the speed of light. Since nothing can exceed the speed of light and since energy can never disappear, they would more likely serve as anchor points of the cosmos.

While at face value that would seem to make information less important a factor in the origin and development of all things, a closer look at the relationship between information and energy disconfirms that assumption.

If one were to dig a little deeper and ask whether or why there needs to be a constant such as the speed of light, it might be difficult to come up with an answer. To say; "That's just the way it is" might suffice for the empirically minded research scientist. Yet if one looks for the *why* as well as the *what*, it isn't nearly enough. Since it is reasonable to assume the universe would be different without that constant, it would seem perfectly reasonable to ask why a constant helps make our universe what it is.

The speed of light is a background phenomenon that by its unsurpassable nature, enables other features of the cosmos to vary without undoing the laws that govern motion, time and space. For example, if light could be exceeded, the concept of time would change dramatically. It has been shown

that as the speed of any object increases, its mass increases and time begins to slow down. Traveling at the speed of light would preclude aging, cause time to move backwards and increase the mass of objects so much that any creature unfortunate enough to be living in a cosmos without that constant couldn't possibly be born, die, evolve or even travel reliably from one destination to another.

So, constants like the speed of light, and energy conservation provide the stability that allows for variations, and thus give rise to supernovas, emerging galaxies, life forms and higher intelligence.

As will be discussed in more depth later, information is a process with two components; noise and codes. Noise refers to monotony or non-distinctions among the elements contained in the process. Codes refer to novelty, changes, and quirks that pop up - sometimes out of the blue - in accord with the probabilities that govern the quantum world. Yet these quirks can be assimilated by the whole. In other words, with change and constancy comes not only information, but also maintenance of the overall integrity of the system.

Are there processes that contain no information? Perhaps, but none that we can see, because in order to exist and continue existing, any item or object must have this combination of synthesis and system-friendly divergence. If all it does is change, it will never develop into something permanent. It if has only constancy, it cannot grow, evolve or sustain its energy because, as discussed earlier, energy and information are connected.

Any system that is flat, ie has no variances, is said to be in a state of entropy (which means decay). It will still have potential energy, but absent a code, that energy cannot be expressed without an outside source introducing variance, or a new code into the process.

When an item or object has a built-in capacity for system-friendly variation, including mutations, adaptations, learning capacities and other malleable features, or in the case of inanimate objects, if its mass includes differentials among atoms

(as all objects do, with a nucleus serving as constant, and with variations in the form of neutrons and protons providing the codes) then the item or object will have manifest energy.

Therefore, any item with information also has a capacity to express energy. If it's in a state of entropy it cannot. All systems in nature tend to run down to a state of entropy, but the rate at which this occurs will differ, and it is the resources available to postpone entropy (specifically its information-sustaining content) that determine the existence, viability, and resilience of any given entity. In psychological terms, all the positive experiences we refer to, such as creativity, fulfillment, and success result from the byplay between energy and entropy - as Freud stated long ago.

When it comes to discussing the origin of the universe, even astrophysicists have difficulty coming to grips with what happened at the point of creation. They do agree on some things; for example that the proto-universe was incredibly small, incredibly hot and incredibly massive. Yet even within this agreed-upon set of assumptions, questions remain.

It is perfectly understandable that the entity would be hot. After all, particles move, and with very little space they would have to move very rapidly. That would have led to regular collisions. When that happens, the accumulation of mass becomes intense but also fleeting. Particles will only congeal for brief moments, then break up again, leaving this hot, rapid cosmic egg little more than a plasma-like entity.

Yet if mass is equated with energy, and if mass in the cosmic egg was fleeting, where would the energy come from to create the Big Bang? Furthermore, if the Big Bang created space and time, how could there be a moment when it actually happened? Time is necessary for a transition to occur. Without time, there can be no *before* and *after.*

Beyond that, with almost no space (which, like time, came with the Big Bang rather than preceding it) how would particles expand - from where to where? In effect, the absence of physical laws known today might suggest that the creation

of the universe was impossible. Put more succinctly, how does one get something - and a very, big, grand and complex something - from nothing?

Physics does not handle those questions very well, though it might in the future, especially with a fusion between it and Information Theory. The latter not only handles the problem, it simplifies it. It only requires one condition for the emergence of the universe; something that might be called the *creation differential*.

This is not a new idea. The great info-cosmologist Heinz Pagels likened the universe to a computer, operating by information principles. Others have looked at it in the form of a set of algorithms, defining, creating and sustaining the cosmos in a way that could be described through mathematical equations. Yet with a few exceptions, little has been written about how the process works. In that regard, consider the following.

Return to the cosmic egg. We know it was hot, and that the heat was caused by a rapid movement of particles, which, due to their speed, could not congeal into more massive particle combines, and due to the heat generated by that very speed, would break up even if they could do so temporarily.

But now let's introduce an "originator" requiring no mass, motion, space, time, beard or sandals, that by its non-material nature, could create, without being part of the creative process - a bridge between physics and transcendence. Let's further assume that *information* is that originator.

In the cosmic egg, suppose a differential cropped up probabilistically. Maybe a small pocket of the pinhead had a slight drop in temperature, which was enough to slow down a few particles whose charges brought them together into a slightly larger particle combine. That in itself would have produced both temperature and mass differentials within the cosmic egg.

With that, other events would have kicked in. For one thing, the more massive particle combine would have begun to attract smaller ones, as gravity began to assert its influence.

By emerging as an opposing force, gravity would slow down the movement of other particles. That would have made it possible for a few more particles to combine. This would be followed by even more cooling because heat is a function of the speed at which particles and atoms move, and large particles would move more slowly. With that differential in heat, mass and speed, would come an increase in particle to particle influence…or communication. The declining speed of movement inside the egg and the differentials in mass would transform the cosmic egg from a state of extreme uncertainty to one containing a higher information content. That would lead to greater influence of some particles over others, not just by gravity, but also by temperature influence. Furthermore, whatever collisions occurred would be among more resilient particle combines, which would mean the egg was becoming more stable, yet ironically, ready to explode. In other words, the Big Bang could be defined as both the origin of cause and effect and the origin of communication within the egg itself.

Mass would have been the key, because as the mass of particles increased, so would their energy potentials. It's not as if the cosmic egg lacked energy. It had precisely the same quantity of energy that is available in the universe today, because energy is a constant. Yet its energy was not as manifest or focal,. Since the cosmic egg was in a state of entropy, (conceivably because it had run down from a prior existence), it lacked a systemic energy focus. Perhaps the reason why the laws of physics as we know them today only came later was because the cosmic egg was so uniform, non-distinct, flat and uninformed, that its energy was not directed toward a specific locus or toward some physical resolution. In order for universal expansion to happen, the cosmic egg had to first be informed, or encoded. In that context, the term "Big Bang" might reasonably re-named "The First Distinction," which does not require either a creator or a moment in time.

Interestingly, this concept does not lie in the domain of either science or faith. Information is not tangible, though it can be measured mathematically. Yet neither is it spiritual,

because as far was we know it has no will - unless *will* is also a component of information dynamics. (This is an interesting possibility that will be discussed later).

The Subatomic Paradox

Of course, any theory of the cosmos worth its salt would have to address a prevailing mystery that haunts the house of astrophysics. It is something known as *quantum weirdness*.

What exactly is quantum weirdness? Suffice it to say it is a process in which the behavior of a non living thing (a particle) acts like a living thing, featuring memory and what might be construed as a quasi-homeostasis. The phenomenon was first discovered in an experiment that attempted to send a single photon through a light beam splitter, run the semi-photons through a way station, and re-gathering both halves of the photon at the other end. Initially the researchers figured that if light is a physical entity, it should obey physical laws pertaining to mass, displacement, motion and momentum. More simply put, if you split a photon in half, one part should arrive at the way station on the right, the other at the way station on the left. Interestingly, that's not what happened. Instead the resilient photon somehow managed to reintegrate itself despite being cut in half. In effect, it refused to be broken down any further. Why did the photon "insist" on remaining whole? Perhaps because its non-malleable nature is what holds the universe together - in other words, its constancy makes information and energy possible. If everything could be broken down, the relationship between noise and codes could not exist. Thus there could be no information in the universe, and consequently, no universe.

It might be tempting to say the photon has a mind of its own, except it has no mind, at least in the way one typically defines the word "mind." So what's going on? Is the universe as material as Einstein and Newton surmised, or is it endowed with a fundamental, info-energetic quality that also provides the template for life, emotion and all other aspects of nature?

One interesting hypothesis comes from a superb writer, Timothy Ferris, who has suggested, somewhat facetiously, that the photon might have some kind of memory of what the universe was upon its inception, and cannot deviate from that state.

Ferris is a physicist's physicist, but in that account he was inadvertently making the case for an information-based approach to cosmology, which would hold that without a constant (beyond light and energy) there could be no capacity to deviate from that system without everything coming unraveled. As discussed earlier, information is prerequisite to manifest energy, and it is a function of constants and system-friendly deviations. Without that topography, there would be entropy, no manifest energy, and no capacity for change, growth or movement. Therefore the information-based answer to quantum weirdness would be almost like that of natural selection. To wit; .the reason photons do not break down further is because the universe exists. If everything, including the smallest units of matter, could be broken down further, and all of the cosmos was malleable, it would eventually end up with no information, no manifest energy, no systematic interactions like gravity or electromagnetism, therefore no mass and no….nothing. That suggests quantum weirdness makes the logical, non-weird, lawful aspects of the universe possible. The quantum particle is, in effect, a grounding variable in the same way that grammatical rules enable humans to vary the words, expand and modify and integrate languages without loss of meaning. As Pagels implied, perhaps the world is nothing but a vast and ongoing conversation among bits of information that emerge from (and require) a background of noise- or codeless stability. In other words, the universe has, in the broadest sense of the word, *meaning*.

Such musings on the origin of the universe might seem oblique and complex, but with respect to the origin of life the answer is much simpler. Once again, both the "what" and "why" questions could be asked, this time without need of the mumbo jumbo that comes with discussion of the pre-ex-

pansion universe. We know that chemical bonding in some aquatic milieu led to the origin of the first life forms, but why did these primordial biological factories emerge in the first place? The answer might be surprisingly simple.

In information terms, life is hardly miraculous. In fact the odds on it emerging on earth were pretty fair from the outset. Why? To some extent, the answer lies in a single word - carbon. Carbon is one of the most information-friendly elements on earth, possibly serving roughly the same purpose as the resilient photon particle. The structure of carbon is so redundant, its capacity to attract other chemicals so prolific, that due to its presence, it is almost inconceivable that life would not have evolved on earth at some point.

Despite the variations in form and function among organisms, all have a carbon base. That provides two bio-consonant advantages. First, it is much easier to get chemical complexity with carbon, so that proteins and sugars (which build organs and provide energy respectively) could piggy back on this versatile compound to make a bio-factory.

Second, having such a chemical constant makes mutations more possible and informative, because the stability of carbon allows for the formation of complex chemicals that can change substantially without undoing the integrity of the system.

Once life was underway, propelled as it were, by RNA-DNA communiqués, it is not hard to see why it began evolving rapidly. Genetic mutations are codes manifest within a bio-system, stable enough (mainly due to the carbon base) so that small changes, and sometimes big ones would not undo the way the organism functions.

How does Information Theory coincide with natural selection? At the very least, it complements it, and might supersede it as an explanatory instrument. One way to describe how, is to imagine that an alien came down to earth to observe and take notes on all life forms. The question could be posed: With absolutely no earthly bias, would he be struck more by the differences among organisms or by their simi-

larities?

If his extra-terrestrial graduate school training in biology was more information-based than ours he'd probably note that all organisms have the same basic tubular structure, that nutrition comes in one end and waste comes out the other. He'd jot down that most have photoreceptors guiding them toward light, and a dermis of some sort to provide insulation, record tactile inputs from the environment and gauge temperature. Most important, he'd observe that all of earth's life forms operate more or less by a homeostatic mechanism, which in mammals, corrects for vagaries in air temperature and in other animals, for limb repair and disease control factors without undoing the integrity of the organism. If our alien observer had some knowledge of genetics, he'd realize that there are substantial similarities in the cells of a fish's fin and the limb of a mammal, in the cells that make up the eye of an octopus and that of a human. And if by chance he were sympathetic to the central thesis of this book, he might report back to his superiors by saying: "I noticed many similarities and differences among the lie forms on earth, and I can only conclude the one factor they have in common is that they all adhere to a central template consisting of themes and variations. In other words they are informed to varying degrees."

Another, even more interesting conclusion he might reach is that since all systems in nature (biological or abiotic) are presumed to operate by information dynamics, then one must conclude that the distinction made between living and inanimate objects might not necessarily be valid.

He might reason that if organisms are a product of the environment, and are comprised of many of the same chemicals, then, rather than a clear distinction between life and non life, one can view life as representing a giant leap in the information content of any given entity, (typified in the themes and variations process seen, for example in homoeothermy, homeostasis, infant development and genetic mutations), whereas non living things have low information content. Furthermore, if that is indeed the case, one could conclude