WARNING

THE MATERIALS AND WORKS MADE AVAILABLE BY C&M ONLINE MEDIA INC. THROUGH BOSON BOOKS ARE COPYRIGHTED.

YOU ARE PERMITTED TO DOWNLOAD LOCALLY MATERIALS AND WORKS FROM BOSON BOOKS AND TO MAKE ONE (1) HARD COPY OF SUCH MATERIALS AND WORKS FOR YOUR PERSONAL USE.

FEDERAL COPYRIGHT LAWS, HOWEVER, PROHIBIT ANY FURTHER COPYING OR REPRODUCTION OF SUCH MATERIALS AND WORKS, OR ANY REPUBLICATION OF ANY KIND.

ILLEGAL COPYING OR DISTRIBUTION OF MATERIALS AND WORKS OBTAINED FROM BOSON BOOKS CONSTITUTES COPYRIGHT INFRINGEMENT. ILLEGAL COPIES OF SUCH MATERIAL AND WORKS CAN BE SEIZED AND DESTROYED. FURTHERMORE, MATERIALS AND WORKS CREATED BY YOU OR OTHERS USING COPYRIGHTED MATERIALS OBTAINED FROM BOSON BOOKS WITHOUT THE WRITTEN AUTHORIZATION OF C&M ONLINE MEDIA, INC. ALSO CAN BE SEIZED AND DESTROYED. COPYRIGHT INFRINGEMENT CAN BE INVESTIGATED BY THE FBI. CRIMINAL CONVICTIONS MAY RESULT IN IMPRISONMENT OR A FINE OF UP TO $250,000, OR BOTH.

Published by **Boson Books**
3905 Meadow Field Lane
Raleigh, NC 27606

An imprint of **C&M Online Media Inc.**

For information contact
C&M Online Media Inc.
3905 Meadow Field Lane
Raleigh, NC 27606
Tel: (919) 233-8164; Fax: (919) 233-8578;
e-mail:boson@cmonline.com
URL: http://www.cmonline.com/boson/

CONSILIENT THEOLOGY

ON THE NATURE OF GOD

by

JESSE RILEY

FOREWORD

Consilient theology is offered to those who, like myself, have been uncertain about the nature and existence of God, and who require some acceptable basis before believing. This includes agnostics, atheists, and those nominal agnostics like myself who pray for safe landings and express thanks when they are realized but who ordinarily do not concern themselves about God. It is not for those who have strong beliefs and definite and strongly affirmed ideas of God, nor for those who have and accept spirituality.

INTRODUCTION

A vast majority of the American people say they believe in God. Karen Armstrong describes literally hundreds of different concepts of God [1]. Not just the God of Judaism, of Christianity, of Islam, but also the God of mystics, of philosophers, of reformers. Although almost half of American scientists are said to believe in God, Armstrong does not write of their beliefs. I conjecture that, largely, scientists believe in the God of their individual religious traditions. Just what God do I intend to write about? The Creator that I have become convinced exists—and one that I have not heard or read about.

The God I have found, and am comfortable with, I discovered through what I consider a rational process—rational in the sense that "Big Bang" cosmology is rational. My conviction provides a basis for considering some of the beliefs about mainstream Gods as I understand them. It is these beliefs that make up the religion of most people.

I have an affinity for philosophical thinking. And I have a materialist orientation toward experience which inclined me toward engineering and science. My interest in the phenomenon of life and an understanding of molecular and cellular biology have led to a conceptual model in which God exists in a different dimension than we humans and is not ordinarily perceived. This God is the creator of life and the evolving creator of the forms of life.

Life is demonstrably a matter of the properties of atoms and atom constructs—molecules, and the energy which powers changes. The evidence for this is summarized in the study by Rensberger [2]. Living things are characterized by the capacity to subsist in a moderate range of environments and to reproduce themselves within a moderate range of variance.

Intent was necessary for the creation of life. Materials were available. Design and construction were required. The actualization of the intent required perception, comprehension, conceptualization, specific goals, and an extraordinary understanding of what might be done with atoms and molecules.

The very existence of living things is evidence of intent. Our present knowledge of chemical, physical and biological phenomena attests to the brilliance of the design of living forms; the resourceful utilization of the properties of matter. The variety and complexity of

living forms gives indication of the enormous capability of the Creator. Chemists have come far in understanding the composition of forms of matter, animate and inanimate. The working out of the DNA code, the language in which the blueprints and specifications for all living forms are expressed, makes clear the capability and knowledge of the Creator, architect and builder.

These considerations make clear a minimum set of attributes of the Creator. It is my aim to share the evidence which is the basis for my belief and to consider a variety of religious matters within the framework of these attributes.

CONTENTS

Chapter 1

THE ROLE OF MAN—THE PERCEIVER, THE WONDERER; THE NAMER; THE CONCEIVER AND CONCEPTUALIZER, THE IMAGINER; THE THINKER, THE RIGOROUS THINKER; THE OBSERVER; THE SYSTEMATIC OBSERVER; THE SCIENTIST

For me to understand such matters as life, God, atheism, belief, truth, explanation, and understanding itself, it was necessary to begin with a critical consideration of man, he who would consider, he who would understand.

We are born into the midst of what we come to perceive as a long progression. Our parents and home are the first given. Then we find that there is an out- there. In it are other homes, other people. Other children. Depending on our circumstances there may be churches, schools, stores; or igloos and seals and walruses; or bush and huts and wildebeast. We soon understand that what is out there was there before we arrived.

Among our heritages there are usually: a language; a culture which in our early years defines what we eat, what we wear, how we play and how we address others; ideas as to what is right and what is wrong ranging from intransigent to indefinite. As we grow older we may encounter a religion which is the active center of our life—or is merely something that other people believe. And there is what we learn and how we learn it. And what we are supposed to do and what we actually do about our sexuality. And how we manage to subsist and be sheltered. And—depending on the community in which we live—a monolithic social order or a plethora of social options. Whatever the specifics, we are provided words representing not only the objects of our perceptions, but also representing ideas; systems of thought which, so frequently, we accept uncritically and are, without our being aware of it, determined by. These heritages largely provide our thoughts about life, whether or not we believe in a God or gods; and how we perceive such concepts as truth, explanation, understanding. We may, as our experience increases, decide whether to reject or embrace parts of our heritage. In any event we have an endowment which almost unavoidably affects us. It was received before we were in a position to approve or disapprove, accept or reject, or winnow through discriminatingly. A first step in freeing ourselves from the less useful, or actually onerous parts of our heritage, is recognizing that we didn't acquire them by choice.

The second step is an increasing awareness of alternative heritages. It may come in being exposed to "higher" education. And/or it may come in one's own exploration. One hears the ideas and opinions of others; one may debate them. One reads the works of a variety of others; comprehends, critiques them. One begins to appreciate the vast multiplicity of human inventions: ways of subsisting, ways of relating; insightful essays; histories; the creations of arts, sciences, technologies; and that which literally comes after such knowledge, *meta*physics. On this path one encounters not only different subject matters and disciplines, but also different values. So many ways of living life! The emotional; the intellectual. The sensual; the ascetic. The active; the passive. The spiritual; the materialistic. The greedy; the unselfish. The rapacious; the compassionate. The passionate; the detached. The superficial; the penetrating. The frivolous; the serious. The daring; the meek. The fatalistic; the volitional. The creative; the traditional. The credulous; the critical. The blatant; the covert. The public; the private. The dominant; the submissive. The neutral. This catalog of implicit values is not complete—and it does not even touch on combined values such as the rapaciously sensual; the meekly fatalistic. Nor is there a common word for the combination of Love, Power, and Justice [3], yet it is an exalted value.

With a range of new values and new modes-of-being to contemplate—some may appeal to one, or seem to embody who one is, or who one seeks to be—the heritage can be replaced with something from one's expanding experience. Such a point may occur a number of times in a lifetime. One may choose to be one's own person.

****

It is apparent that early man invented language. Sounds were associated with important objects and situations. There was probably an early word for danger, for man, woman, child, for you/me. Words were invented for food sources; for animals which could be threat or prey. For weather conditions; rain, drought, hot, cold, cloudy, sunny, windy, calm. For shelters: cave, hut, tepee, tent.

And words were found for feelings; liking, disliking, loving, hating, fearing. At some point humans became aware of other inner experiences—not just feelings. There came an awareness of thought, of relationship.

Questions were asked which did not have answers in personal experience. I *know* the deer is dead *because* I stabbed it with a spear. But *why* does the sun rise and set? *Why* do black clouds form in the sky? *Why* are there then flashes of light? Why do I grow old?

At some point representations of experiences, cave drawings, began. And, later, representations of words. There was the invention of pictographs which, with modifications, survives. There was also the more abstract phonetic approach, the representation of sounds by symbols. Written languages widened the possibilities for contemplation and elaboration as well as communication.

The Greek and Hindu gods and their activities were the imaginings [4] of some creatively gifted persons. In the minds of the many to whom they were communicated these religious imaginings took on the quality, the persuasiveness of actual sensory perceptions. Abstract ideas became a commodity. They were as real as the persons one knew.

Abstract thought and the language which expressed it also flowered in Greek philosophy . A flood of imaginings and corresponding concepts—gods for example—arose, were given names. Much of humankind, for better or for worse, came to regard thoughts as being as real as actual experience. Thus began a fascinating, complex, hard-to-deal-with, consequence-ridden phase of human existence.

Parallel, but different, imaginings, conceptualizations, occurred in the religions of Egyptians, Jews, Christians. The emergence of ideas not empirically verifiable led to endless contention because one of the concepts which had developed was that of *truth*. We rely on such truth. We affirm it.

When an individual, who is not delusional nor under the influence of drugs, honestly reports a perception of one or a combination of the five senses, sight, hearing, smell, taste, touch, *the truth is being told. Such perception is ordinarily verifiable.* This rose is the color we call red. That rock is hot. The thunder is loud. The melon is sweet. There is little contention concerning this kind of truth.

There is also a wide range of feelings, which may or may not be honestly communicated, and may or may not be verifiable, but for which the criterion of truth is still relevant. Truth becomes an even more uncertain matter in the realm of ideas. "I <u>believe</u> God is", can be a true statement. But "There <u>is</u> a God", is different. There are those who state that they experience God. Others ask them to prove it. Except for theorems in a postulational system like Euclidean geometry, proof means the verification of a perception by other observers. (For those affirmers

of God who do not share the concept of validation by disinterested perceptual verification, the battle is on.)

The question of *truth* cannot be confined to elemental perceptions. We have an awareness of our minds at work. We ask questions for which we, with access to own resources, may have no answers. Where do we come from; how were we created? Is there life after death? Is this sense of self we have independent of our bodies? Do we have a soul? If we do, what becomes of it when we die? Will we be with our loved ones? . . . How far are the stars? Is there life on them? Are they trying to tell us something? Do they affect our lives? . . . Both religion and science provide answers. Where lies truth?

When a person makes a statement about an internal perception the concept of truth is again in difficulty. A tired soldier says to his commander "I can't go on." Does the soldier really feel this way or is he malingering? A man says to a woman "I love you." Does he have a feeling that might be so described or is he trying to mislead the woman in order to use her? The man may not know. Many feelings are ephemeral, ambiguous. What is truth in this context? How can it be verified? If one knows the other person well enough there may be a sense of whether the speaker has been honest. For jurors there's the challenge of deciding which of conflicting witnesses is telling the truth. Judging the truth of assertions of feeling is far less likely to result in a valid outcome than the verifying of a simple perception.

Imagining, fantasizing, can be a delightful wish-fulfilling experience. Or it can be sheer terror. It may become a substitute for experience or it may be no more than a pleasant diversion. It may also be a powerful tool. A shared, inculcated fantasy may be joined in by a mass of people resulting in very substantial material consequences. Were not the Crusades the acting out of a fantasy? What about Elvis sightings, Elvis adoration? Aryan supremacy? Black inferiority? The consequences of such fantasies are verifiable though the fantasies are not. "Truth" is claimed by fanatacists. Prestigious endorsement is verification enough.

To recapitulate, language describes experiences or purported experiences. In the realm of the sensory, verification is possible. Truth is relevant. In communications of the subjective there can be honesty as well as untruth. Truth is a measure of the honesty. But verification is no longer direct and simple. It is conjecture.

*****

Does truth apply to ideas? What about the ideas of science? Science is based on verifiable observations, truths. But science is more than observations. Science seeks to explain so that we may understand. Science makes "hypotheses." Hypotheses lead to predictions. If all possible predictions are confirmed, the hypothesis becomes a "theory." And any number of hypotheses have led to verifiable predictions. But since there is no assurance that all possible consequences of an hypothesis have been thought of, there can be no confirmed theories.

Many scientists and writers about science are either unaware of or indifferent to the strict constructionist convention that a theory is an ideal, undemonstrable intellectual objective. "Theory" is a commonly encountered word in contemporary discourse [5]. In much current usage it is apparent that the writer or speaker regards "theory" as the probable truth about the subject. Most people appear to be conditioned to believe that truth is an attribute of a theory. When there is conflict between the proponents of different theories how is it decided which one is true?

A better contemporary formulation avoids this absurd situation. The empirical observations of science are usually made in the context of a conceptual framework. The findings, the results of the observations, are used to build a **conceptual**, frequently a mathematical, **model,** also termed a **mechanism**. (The new term, "conceptual model," avoids the ambiguities of "theory".) The test of the model is the correct representation of the empirical findings and the correct prediction of subsequent findings. This is the test of *adequacy*. When predictions are not realized the model fails, i.e. it is no longer *adequate*. It is then subject to being revised or replaced by a more adequate conceptual model. Where two models provide adequate representations and explanations of the observations there is little basis for choosing between them.

"Science", as it is personified, has been through three models of light: particles, waves, and wavelike packets. In their times each of these models was taken to be the "truth" about light. Much was achieved by the use of each model. Each later model subsumed the observations "explained" by its predecessors. It's much less awkward and contentious to evaluate the adequacy of a conceptual model than the truth of a theory. We can move more adroitly if our feet are not set in concrete.

This is the path I found myself taking in trying to answer the questions which mattered most to me. I feel that by looking at man's nature, history of intellectual development, and available intellectual tools I am in a much better position to approach these questions. I suspect

the same will be true of other seekers of a credible understanding of questions not answerable by direct observation.

So, until it fails, a conceptual model deserves to be taken seriously. A large part of our knowledge is in the form of conceptual models. They provide satisfying and readily recalled explanations. The model I here present regarding God as the Creator of Life and the Evolver of its major forms is very persuasive to me. It assimilates the sciences of chemistry, molecular biology, cellular biology, paleontology and evolution *vis-a-vis* the origin and nature of life. It resolves the conflict between creationists and evolutionists. This is satisfying. But, like all the others, this presently adequate formulation **is** a conceptual model. As long as it remains adequate—cheers. I like to note the longevity of Newton's formulations regarding mass, acceleration, velocity, distance, force, energy, and work. Except for cosmologists, Einstein's relativistic correction hasn't changed a thing!

Chapter 2

THE NATURE OF LIFE

In the introduction I mention my godless years and my feeling of inadequacy to address the question of the nature and origin of life. About twenty five years ago I read about the "antiprobability" concept of the famed physical chemist and biologist, Pierre le comte duNouy [6]. He had come to the conclusion that random chance could not account for the phenomena of life. This was an intriguing notion. Ten years or so later I found myself wondering if there *could* be a god. I recalled antiprobability. Perhaps duNouy didn't want to use that word. He didn't develop the antiprobability idea further. I kept churning. I found myself increasingly open to the idea that there might be a god, that my agnostism, satisfying as it was in recognizing some of the absurdities of established religions, might be pointing my head in the wrong direction. And then my good friend Greg called to suggest I might be interested in a book called *Life Itself* by a Boyce Rensberger. This is a most remarkable book and I urge that it be read by those who are uncertain about the nature of life. Is there a vital essence, spirit, soul? The behavior of living things doesn't support this conclusion.

Molecular and cellular biologists, able people in the hundreds, have studied living matter with a variety of perception-enhancing instruments and now provide a convincing, but enormously complex picture of what life is. Perception-enhancing? We humans are limited in the range of sounds which we can hear—and this range differs with the individual and within the life of the individual. We are limited as to the range of colors we see, that is, the range of electro-magnetic frequencies which form visual images. Our sense of temperature and temperature differences is notoriously unreliable. Thermopiles can accurately measure differences of a ten thousandth of a degree. We are limited as to how small an object we can resolve. Just as microphones, amplifiers and oscilloscopes reveal the sounds of the insect world, and the sounds of blood moving through vessels, microscopes, ultra-microscopes, electron microscopes and thermographic cameras provide a new world of images. Phase contrast microscopes, responding to extremely small differences in refraction, reveal structures otherwise not visible. Dyes provide striking color distinctions in what would otherwise be an undiffferentiated, colorless field. Electron microscopes cover a broad range of magnification—down to images of molecules. We cannot see through many substances, which we call opaque. Ultrasound lets us "see" the embryo in the womb; the X-ray not only shows us bones but reveals bone density and strength. MRI, (magnetic resonance imaging), CAT (computerized axial tomography), PET (proton emission tomography) and similar instrumental procedures make it possible for us to observe the active

areas in the brain, the vascular (blood vessel) system; reveal abnormal growths. Technology has opened wide the portals to the teeming activity of the living cell, a world to which we otherwise would be blind.

These enhancements of the senses provide an inexhaustible supply of new, verifiable facts, a basis for ever broadening and deepening conceptual models and what we call understanding.

With this formidable source of information, molecular and cellular biologists have studied the basic unit of life, the cell [7]. In short, scientists have found life to be an energy propelled group of chemical processes to which there correspond physical effects, independent motion being the most basic [8]. Life stops when the cell gets too cold—chemical reaction rates are temperature dependent. But life resumes when the cell or cells are brought back to normal temperature. The freezing of gametes—eggs, sperm—for storage and transport, are the most familiar example. Life also requires water. Spore forms are lifeless when dry, return to function when moist. There are also somewhat more highly evolved multicellular animals which return to life after, say, a four year drought. The phenomenon has been well studied although it is not widely known [9]. It is called cryptobiosis. Tardigrades, small arthropod like animals, normally are composed of 80-90% water. They have been dried to a water content of 0.05%, stored dry for indefinitely long times, and resumed living when placed in water.

The individual human cell contains thousands of parts. It is a jumble of activity [10]. Most cells have a nucleus. Nuclei are enclosed in a membrane similar to that which encloses the cell. The nucleus contains the genetic material, DNA (deoxy-ribonucleic acid). The DNA provides the instructions for forming and operating all parts of the cell; it also supervises the process of cell division [11]. The DNA, by appropriate transcriptions on messenger RNA (ribonucleic acid), instructs organelles in the cell called ribosomes how to construct the many proteins of which the cell is mostly composed. The protein molecules of the cell have a broad range of forms and functions. For example, actin provides the continuity in muscle cells, myosin provides the pull. Other protein molecules act as motors, transporting cargos of essential components from where they are synthesized or received to where they function. The cell is powered by sugars and fats from ingested food, the energy conversion taking place in organelles called mitochondria. The cell-enclosing membrane is composed of a double layer of cholesterol and phospholipids. The membrane contains many passageways called receptors, through which only specific substances: blood soluble D-glucose molecules (which, assembled as glycogen, are our primary fuel); amino acids; sodium, potassium and magnesium ions; etcetera, may enter or

leave the cell. Similarly, wastes are carried out. The enzymes which carry out the many chemical processes are proteins, as are the receptors.

The reproduction of cells involves a three dimensional dance [12]. It starts when the cell reaches sufficient size. Its normal functions become dormant. The chromosomes make duplicates of themselves. The membrane of the nucleus dissolves. The chromosomes assemble in a median plane. Two groups of micro tubules emanate from opposite centrioles. One set of chromosomes attaches to the microtubules connected to one centriole The other set behaves like a mirror image. Each set moves along its mictrotubules, ending in a group at the centriole. The cell starts to cinch itself in so as to leave a complete set of chromosomes in each half. The chromosomes group together, become surrounded by a nuclear membrane. Division into identical daughter cells takes place. Function is resumed.

Rensberger quotes Duke University cell biologist Harold Erickson. "The secret of life is not a secret anymore. We've known for twenty or thirty years now that life is not more mysterious than the chemical reactions on which it is based. There's an incredibly complex set of chemical reactions, but they're all logical and understandable. We don't yet understand all of them but we do understand a lot of them and it's not hard to see that eventually we should know them all. (Note that molecular biology is only about 60 years old. The structure of DNA was first published by Crick and Watson in 1953.)

So between cellular biologists and molecular biologists life is adequately explained in chemical and physical terms. Put the right chemical structure in a suitable environment at an appropriate temperature and it operates. It **is** an extraordinarily complex structure and one we humans can't make. It metabolizes, it sustains itself, it reproduces. No mysterious vital element is required . . . It is a marvelous achievement, this scientific explication of life, almost as remarkable as life itself. Now, what about the origin of life?

New cells originate by the division of older cells. For the first forms of life, monocellular—bacteria and algae—daughter cells had precisely the attributes of the parent cell. In more complex forms cell specialization occurred. Daughter cells may develop different attributes than the parent. The fertilized human egg is a single cell, but behold our complexity: skin, nerve, sensors, muscle, bone, teeth, hair, blood, organs [13]. We are made up of about two hundred different kinds of cell.

Chapter 3

THE ORIGIN OF LIFE

It is unlikely that a small, relatively simple virus, viruses are all DNA or RNA, was the first form of life. Viruses require a cell host for sustenance and proliferation. That would make the much more complex cell the probable first form of life.

What molecular and cellular biologists have learned about life is taking place in the unfolding present. But past life, according to paleontological findings, began about 3.5 billion years ago. No scientists were on hand to observe it. However there is a so-called "scientific" answer as to how life began: All the necessary chemical building blocks, atoms, were presumed to be present; carbon and hydrogen in the form of methane; nitrogen and hydrogen as ammonia; oxygen and hydrogen as water; phosphorus as phosphate; sodium, potassium and calcium as water-dissolved ions. Lightning-strikes, possibly ultraviolet radiation, caused reactions of some of the gaseous chemicals resulting in the formation of amino acids, the building blocks of proteins. It is the lockstep belief of the most communicating of the evolutionists that the operation of random chance resulted in the formation of proteins in the primal sea. And some countless chance events later, look at all the time available, Presto! LIFE.

That's an intriguing conclusion. But it isn't science. It is *scientism*, the assumption that insufficiently supported speculation by scientists can take the place of observation and critical thought in developing an adequate conceptual model. There was, at least, a credible first step. Harold Urey had concerned himself with the composition of the early atmosphere and concluded it contained ammonia as a component. Stanley Miller, one of his graduate students at the University of Chicago, exposed an atmosphere containing ammonia, methane and oxygen [14] to high energy ultraviolet radiation and found that amino acids had formed. Carl Sagan, also doing doctoral research at the University, carried out an experiment with a similar atmosphere to which hydrogen sulfide was added. It was exposed to lower energy ultraviolet radiation. Again amino acids formed.

There is a great variety of protein molecules ranging from water soluble to hair and horn. Protein molecules are extremely large. If we assign a hydrogen atom a weight of one, proteins range from about 30,000 to over 200,000. . Chemically decomposing a variety of proteins has yielded the major building blocks, 21 different amino acids. Protein molecules are twisted and folded in characteristic, chemically significant patterns. The structure of a protein determines its

function—as binding oxygen in hemoglobin, or catalyzing a specific reaction as with enzymes. The postulation, that proteins, formed by random reactions of amino acids, became organized, again by random chance, into living forms, has neither observational nor reasoning basis. The further postulation that these forms, exposed to radiation and chemical influences, mutated into survivable, ever more highly evolved forms is equally unsupported.

The evidence for mutation within species is substantial. But the development of new families, like arthropods, by mutation from, say platyhelminths, has no evidentiary support. There **is** an evolution of phyla, families, yes. But through mutation? There is no supporting evidence. Step changes within a species after which the variant remains stable for centuries are known. Eldridge and Gould call this "punctuated equilibrium [15]". The paleological record indicates relatively brief periods in which many new species emerge within a family. This is followed by long periods in which the new species do not change. So, regardless of claims, or uncorrected misunderstandings, Darwinian evolution does not provide evidence for a gradualist emergence of new families or new species.

Some scientists have become interested in calculating the probabilities of the various steps in the *scientistic* notion of the emergence of life. A review of the findings of these origins-of-life-researchers has been made by Stephen C. Meyer [16]. The nearer one gets to the cell, the more vanishingly small the probability of random occurrence becomes. The formation of amino acids—no doubt about a favorable probability. All twentyone? Well, perhaps. The formation of the specific proteins found in prokaryotes, the apparent first living cells? An extremely long shot. The design of the many specific functions and structures of the prokaryote? The calculated probability is vanishingly small.

Consider the DNA double helix and its alphabet and vocabulary. Four nitrogen bases constitute the letter elements. A sequence of three nitrogen bases makes up a letter (called a codon). The 24 possible arrangements of these four nitrogen bases make up the 24 codons. A sequence of such letters makes a gene, the design of a protein. RNA copies the text (as a negative), moves out of the cell nucleus to a protein-building device. The molecular device builds the called-for protein molecule [17]. Does this seem like the operation of *random* chance? Did chance create the DNA instruction manual and its ingeniously contrived letters, words and sentences? Did the incredibly complex chemical architecture and engineering of the hundreds of millions of species which have existed result from chance? Did chance devise intelligence,

systems of values, religiosity? All this the result of random chance and viable mutations? No way!

Chapter 4

RAW MATERIALS—AMINO ACIDS AND SUCH

Present dating studies place the age of the Earth at about 4.5 billion years. The earliest life forms, prokaryotes, single celled organisms in which the DNA is attached to the cell wall rather than bundled inside a nuclear membrane, go back an estimated 3.5 or so billion years. These organisms, called prokaryotes, were anaerobes, living in an oxygen-free atmosphere, not depending on oxygen for metabolic processes. Eukaryotes, single celled organisms in which the DNA is contained in a nuclear membrane, are thought to have originated much later, about 1.6 billion years ago. The atmosphere was more like that of the present—it contained oxygen. Eukaryotes are aerobes; they live in an oxygen-containing atmosphere, require oxygen for metabolizing.

I suggest that at the beginning of life God, as now, worked with what was present. I do not think that the God of life, with which I am concerned, created or affected the prelife environment. [Once there was life the physical environment was increasingly affected.] The evidence on which I base my conceptual model does not speak to the creation of the physical universe. I have no basis for conjecturing on that beginning. Nor do I have a basis, other than contemporary chemistry, for explaining how the properties of atoms and molecules got to be what they are. I find acceptable the current astronomer/physicist explanation of the formation of the earth, its atmosphere, and the changes both have undergone. These explanations start, as the reader knows, with the Big Bang, the formation of elements, the still continuing outward dispersion of matter, the accretion of suns, of systems of planets, the gravitational capture by planets of atmospheres as well as solid flotsam and jetsam, and the continuous process of change, be it fast or slow, of all that we observe.

It is credible that a variety of organic compounds formed in an atmosphere which contained water, methane and nitrogen. Lightning and high frequency cosmic radiation would be likely sources of the energy for forming highly reactive atoms and molecular fragments from these gases. These atoms and molecular fragments would combine to form small molecules. These small molecules would equilibriate between the gaseous atmosphere and liquid water. The concentrations of the small molecules in these two media would depend on the temperature (which determines the vapor pressure), the size of the small molecule, its affinity for water, the relative amounts of atmosphere and water, and the totality of other substances dissolved in the water. When the surface of the planet was much hotter than it is now (the interior is still molten)

all the water on the planet was in the vapor phase—steam. As the surface cooled to just below the boiling point of water, condensation, the formation of liquid water occurred.

Methane is very slightly soluble in water. It is even less soluble in water containing dissolved salts. Nearly all of the methane present in the presumed circumstances would be in gaseous form, in the atmosphere. Oxygen as such would not be present in appreciable amount. But oxygen would be generated by the splitting of water (the water molecule is made up of one atom of oxygen, two atoms of hydrogen) by lightning or high frequency cosmic radiation. The single oxygen atom resulting is highly reactive; the oxygen in our atmosphere is much reduced in activity by being present as a diatomic molecule. Methanol would be the product of the reaction of single oxygen atoms with molecules of methane. Methanol is quite soluble in liquid water. Although it is quite volatile, more of it would be dissolved, even in salty water, than would be present as a vapor. If an atom of oxygen reacted with a gaseous molecule of methanol, the product would be formic acid. Formic acid is less volatile than methanol and quite as water soluble. It is, however, volatile enough to be subject to further lightning and cosmic radiation initiated chemical change. An oxygen atom reacting with a formic acid molecule would result in molecules of carbon dioxide and water. Carbon dioxide is liquid-water soluble but more volatile than methanol or formic acid. Carbon dioxide is the end of the line. It cannot be oxidized farther.

A methane molecule, jolted with sufficient energy, could break into a methyl free radical and a hydrogen atom [18]. Free radicals are highly reactive. If it encountered a similarly generated formyl free radical, the two would combine to make acetic acid. By a similar process increasingly large organic acid molecules could develop: propionic, n-butyric, isobutyric, n-valeric, n-caproic, etc. An ammonia molecule, jolted by lightning or high frequency radiation, could break into an aminyl free radical and a hydrogen atom and react with a free radical formed from acetic acid to make glycine, an amino acid. Amino acids are water soluble. If formed in the atmosphere they would soon be rain-borne into the sea. The sea would be a repository for lightning and cosmic radiation produced low volatility molecules.

Though the atmosphere seems a more likely locus for such free radical reactions, it would seem that free radical reactions would also occur in the liquid phase, particularly at the interface with the atmosphere. On paper, at least, many of the larger, more complex amino acids could be created by this mechanism. It would be a low yield, slow, slow process. But that's all right. There were hundreds of millions of years for it to take place.

This very probable set of happenings, I think, provided God with the set of water dissolved amino acids which are the building blocks of proteins, the major constituent of living things. Proteins are polymers. Polymers are commonly formed by the chemical linking of small molecules termed monomers. When constituted of just one kind of small molecule the product is termed a homopolymer. Polyethylene is a homopolymer. If two kinds of small molecule are present, the product is a copolymer. These two components can be equal in number and alternate along the polymer chain. PET (polyethylene terephthalate, Dacron), is such a polymer. Or the constituents may be a variety of different small polymers with sequences and branches of A and B and C polymers, etc. Proteins are uniquely different from other complex polymers in that the sequence of amino acids in the molecule is unique and characteristic of the protein type, The specific sequence determines folding geometry (see below).

The simplest amino acid, glycine, has a weight of 75 in terms of a hydrogen unit weight of one. In hydrogen units, proteins range in weight from about 30,000 to 300,000. They contain from roughly 200 to 2000 amino acids. Although the sequence of amino acids in the chain identifies a specific protein, sequence is not the only significant characteristic. The molecular chain spontaneously folds, forming a clump. The folding pattern and resultant clump architecture are unique and characteristic for individual protein molecules. The physiological function of the clumped protein depends on its unique configuration.

There are present in the body, in much smaller amounts than proteins: glycogen, a starch-like polymer of the sugar, D-glucose; fatty acids and triglycerides (the reaction product of three fatty acid molecules with a glycerine molecule); phospholipids (produced from phosphoric acid, glycerine, two fatty acid and one of a number of nitrogen containing alcohols or inositol); iodine, sulfur-containing compounds; ions of sodium; chlorine; iron; calcium; magnesium; and a number of less prevalent substances such as copper, zinc, selenium, manganese, chromium, molybdenum, cobalt; fluorine; arsenic, alumium, bromine, tin, silver nickel, mercury, boron, It may be that not all of these are essential—the roles of some are not known. But they are present [19]. There is a reasonable expectation that all the foregoing constituents were in the primal soup. The concentrations did not need to be high. Living things have quite a capacity to pick up needed nutrients and concentrate them as much as appears to be required—though deficiency diseases occur with crops raised in soils in which essential minerals are lacking.

Chapter 5

SOME THOUGHTS ABOUT GOD AND GOD'S WORKS

No one of us was there at the very beginning. Which means thoughts on the origin of God must needs be speculative. The model I have deduced on the beginning of life suggests no thoughts on the beginning of God.

As to whether there is something in dominion over the inanimate world, I know of no evidence pointing to such a conclusion. Similarly I can not speak of the origin of the cosmos. Whether there is one God or a multiplicity of gods with different domains I have no basis for saying.

In my thinking about the **origin** of life, its multitudinous forms, and, in higher forms, its environment-responsive and experience-adaptive nature, only the extraordinary Creator, whom I call God, is considered. In thinking about the **adaptations** and **initiatives** of species and of individuals it is *they* who are considered.

If we live in a causal universe something had to want there to be a first living cell, the one that subsisted, grew, and performed the initial division into two cells. As remarked foregoing, that something had to have an extraordinary capability as chemist, physicist, engineer, designer, constructor. That creative something, which had to function for life to result, we may call God, the Creator.

Some prescientific people were as intelligent as the best of our scientists. Although they lacked the means of developing the evidence as to the nature of life which we now have, their reasoning led to the same conclusion. There is something which created life. They included the universe in creation.

I can't address the origin and function of the universe because I'm confining myself to conclusions based on the chemical and biological evidence with which I am acquainted. I can see God working within the physical universe as it existed. I propose no conceptual mechanism, reach no conclusions regarding the origin of the universe. If one acknowledges the existence of matter and its attributes one can make conceptual models of the universe. Present day cosmologists seem accepting enough of the big bang model and the consequences that they

would expect from that initial explosion. (I have trouble with the something-from-nothing aspects—the incredibly large mass, incredibly great energy of the cosmos resulting from the separation of less than a pinpoint in the void into matter and antimatter, into positive and negative.)

These creative prescientific individuals, driven by intense interest, answered the question of origin in an abundant variety of ways. Some common themes are to be found. But there are also many differences which have been and still are taken very seriously. Enough so to war over.

The leaders of many institutionalized religions have not helped. They have been so adamant in upholding their particular sets of beliefs for several reasons. The claim of truth, seriously and forcefully asserted is persuasive. Especially if a person's accepting that "truth" confers benefits, real or imagined. (You will be irresistible with this perfume . . . The girls will be so delighted to go out with you in this flashy car . . . You will be viewed kindly by St. Peter if you tithe. . .) You have a soul. To save it you must do this! Or that! Saving one's soul by truly effective practices is a matter of first importance! Several things result. The religious institution grows if the accessible public finds the institution's claims are persuasive. The larger and more powerful the religious institution, the more pleased are its leaders. And the larger and more prominent the institution the more some individuals will be moved to join it. The stronger the insistence on the "possession" of the truth the quieter any whispers of doubt, whether in the leadership or the followers. There is also family "tradition". Religious "truths" may be taught early on. And, yes, have we not heard of coercion?

The rich mix of differing and conflicting beliefs and institutions is so remote from what would have happened had there been from the beginning a convergence of thought on the origin of life. If genesis had not become a concern until now, how different religion would be! If man had not had prior religious thoughts, and had had no concern as to how life began, genesis would have been a straight forward scientific hypothesis. Science, though there are divergences, basically tends to convergence. There is convergence in molecular and cellular biology. As mentioned foregoing, the origin of life by random chance and the evolution of phyla based on the natural selection of chance mutations is extremely improbable. Some cause, prior to life, would seem, inevitably, to be required. It is difficult to conceive of an alternative to the kind of capability here described which I, following tradition, call God, the Creator.

Something which our senses do not detect (but of which some people have had intimations over historic time) created self-sustaining and self-perpetuating forms of ever more complex nature. Our kind is a part of the current state of that sequence of creations.

We are built with a sense of causality. God created life and its many modifications with an awareness, a capacity to experience life in terms of cause and effect. Chemistry, God's province, is a macrocosm of cause and effect. We experience cause and effect from our earliest awarenesses. As infants we cry. We are responded to, cuddled, fed, warmed, cooled. Cause and effect come with our mother's milk and are continuously reenforced with causal sequences thereafter. Cause and effect are in our play, our work, our sustenance, in relating to others, in our dealings with the external world. One must be a schizophrene, a pathologically detached individual, not to be aware of, reliant on, cause and effect.

We may be so accustomed to cause and effect, so take it for granted, that we may become unaware of it. My conceptual model of God, the Creator, relies on cause and effect to induce God's existence. There would not have been a first living cell without a Creator.

We also have a sense of quantity. God is intimately involved with number, as are chemists and physicists. God invented codons, the three "base" letters in DNA. There are 24 such letters, a coincidentally similar number to the number of letters in most alphabets. DNA instructions are the ultimate in the quantitative. Errors do happen—but that doesn't take away from the underlying quantitation. It seems apposite that mankind, the species best suited to comprehend the Creator, is made up of many individuals for whom number is important; for some an obsession.

Working within the reasonable confines of an hypothesis or conceptual model which finds an extraordinary creative force as the origin of all forms of *life* on Earth, based on the findings of molecular and cellular biologists and paleobiologists, I find no *basis* for speculating on the *origin* of this force. (It's not a lack of interest!) In my thinking about the origin of life, its multitudinous forms, and, in higher forms, its environment-and-experience-adaptive nature, only the extraordinary Creator, who may be called God, will be considered.

A wonderful record of what paleobiology is able to tell us is given in a treatise edited by Gould [20]. The first life is thought to date back about 3.5 billion years. It was then that God

found physical and chemical conditions right to start making something that could subsist and reproduce.

The earth was hot. The waters were much more saline than now. God designed the cell. It was to build itself and sustain itself with material from its environment. It was to be able to reproduce itself. This called for an instruction manual, DNA. God also created RNA polymerase, messenger RNA, RNA ribosome, transfer RNA, and the amino acid sequences, i.e. proteins, with which to build the cell. God used this means again and again to create new living forms. We, and all other organisms which have lived, share this same means of genetic transmission—DNA. (It is thought that human DNA has a portion identical to that of the first cell—which like an estimated 95% of human DNA goes unread in the process of fertilization and growth.)

God did not start out with the image of man, or the zebra, as the goal toward which God worked. God began at the beginning and devised ever new and increasingly complex forms. God evolved in the process. God was so intrigued with the results of God's work that God continued with ever greater enthusiasm and creative capability.

Based on present knowledge of very ancient fossils, bacteria were the first form of life. Even though we can't be certain, it is likely that the first living thing was a single cell, microscopically small, containing DNA or RNA but no nuclear membrane. Based on contemporary findings, a representative bacterium could be about 1 micron (a millionth of a meter, a ten thousandth of a centimeter) in diameter and 2 microns long. It is true that there are much smaller and much larger bacteria; spherical bacteria, long bacteria, spiral bacteria, but, for this order of magnitude purpose, a bacterium with a volume of 2 cubic microns will do. Let us take the bacterium to be 10% protein, 90% water. It will weigh 2 micrograms with a protein content of 0.2 micrograms. If we take the average atomic weight of an amino acid to be 7 grams and the number of atoms per gram-atom as 6.02×10^{23}, our bacterium will, excluding water, contain 12×10^{15} atoms. If we assume an average amino acid molecular weight of 100, a cell will be made up of 1.2×10^{15} amino acids. The number of protein molecules in a cell, for an assumed average protein gram molecular wight of 100,000 grams, will be 1.2×10^{11}. This is indicative of the number of items God worked with on the first bacterium. To put this in a little perspective, 10 gigabytes of computer memory are 10×10^{12} bytes.

As mentioned foregoing, DNA holds the specifications for each kind of protein in a cell. That means, at three bases per codon—which specifies an amino acid—God needed only 3000 codons to specify a protein of 100,000 molecular weight. Things <u>can</u> happen very rapidly. Some

bacteria have a 15 minute mitotic cycle. Proteins can be produced at a rate of about 13 million per second.

The fossil record indicates that there have been hundreds of millions of species. **Identified, current** species number about 1.5 million. Estimates of the **current total** range from 5 to 50 million. Using the present classification system, there are at least 50 phyla (A phylum is a group of related forms which differ significantly from other phyla, as fishes do from birds [21].) Some present academic views would have phyla as well as species arise from evolution. Darwin had reasonable evidence to indicate that speciation (new species development) may occur adaptively, conceivably spontaneously. But speciation doesn't explain new phyla. Only if one is a convert to evolutionism, the unsupported belief that the Darwinian approach can explain *everything* about life, past and present, including its origin, can one believe that a process which explains differences which may occur *within* a phylum, i.e. between species, provides an explanation for the differences *between* phyla; the sequence in which phyla appeared; or the origin of life. The interpretation that paleological findings are evidence of evolution is not persuasive. There is the persuasive alternative conceptual model. God developed as a creator in the making of a great variety of life forms, devising ever new functions and structures for them.

It required complete understanding of chemical possibilities and the chemistry of the environment to do this. And, as viewed by us mere humans, an incredible capacity for dealing with vast numbers of atomic and molecular entities. . . At the time in question, ocean ruled. There were some scattered volcanic islands. The atmosphere was dense with carbon dioxide and methane. Instead of oxygen, there was noxious hydrogen sulfide [22]. It was an environment in which very few (but some) contemporary organisms live: hot, saline, dark, oxygen free. But this was the time when and the circumstance in which God created the first living cell. The class, of which it is a member, has appropriately been named *archaebacteria*. These ancient cells, many of which exist today, were fueled by chemical energy, not light. That chemical energy was to be found in the soup of chemical compounds in the sea, chemicals including amino acids and carbohydrates, which form when energy discharges, lightning, radiation, pass through an atmosphere containing carbon dioxide, ammonia (hydrogen and nitrogen), water vapor (hydrogen and oxygen), methane (carbon and hydrogen), and hydrogen sulfide.

God had a long time, about a half billion years, in which variants of *archaebacteria* were created—and in which quite probably some viable spontaneous mutants occurred.

God also improved on cell structure. DNA, rather than floating around in the cell, was placed in a permeable membranous sac forming what we term a nucleus. RNA, an inverted copy of DNA formed in the nucleus, supervised the synthesis and operation of cell components. This new class of cells is named eukaryotes, a major step beyond the nucleus-lacking prokaryotes. Some eukaryotes, kinetoplastids and euglenids, represented the first inclusion of mitochondria, the energy suppliers for aerobic forms.

During this period the earth was cooling, the atmosphere changing and options increasing. God created eukaryote variants which, with their greater potential, came greatly to outnumber prokaryote variants. In this category were blue green algae and fungi which could live in the increasingly sunny atmosphere. These plants metabolized carbon dioxide and as a result contributed oxygen to the air, opening up a new metabolic cycle, the oxidation of carbon containing molecules.

God also experimented with eukaryote groups in the form of layers, "plasmoidal slime molds: amoeboid cells that aggregate into multicellular stalked reproductive bodies", and "labyrinthulids: heterotrophs that form colonial networks [23]." This step was most important—the beginning of multicellular structures. And there was a related beginning in the separation of cellular functions.

Somewhere in this continuum of creation came cells that could devour other cells, could make use of the chemical synthesis and photosynthesis by which these other cells subsisted. Predation began. It makes possible the utilization by active living forms of the accumulation of substance by other forms, whether active or inactive. Predation was an invention essential to subsequent, more complex life forms.

Collagen binding cells appeared 2.5 billion years ago. The first development of embryos from a hollow ball of cells took place about 2 billion years ago. Body cavities and blood circulation appeared about 100 million years later and segmentation about 200 million years after that.

Jelly fish and corals, diploblasts which embody two tissue layers and a nerve net, entered the scene about 650 million years ago. A veritable explosion of phyla began about 100 million years later: seventeen triploblasts emerged. Triploblasts are characterized by endoderm, mesoderm, ectoderm, the basis for organ systems. Fourteen triplobasts developed mouths, three

developed mouth and anus. These invertebrates, with which we have much in common, appear to have given rise to protofishes about 510 million years ago.

Plants, as opposed to plant-like monocells, appeared later. They are placed in the Silurian period starting about 438 million years ago. Existing species of fish date back about 408 million years. Reptiles appeared about 290 million years ago. Mammals, with their many differences, first appeared about 70 million years ago.

Hominoids, man-similar creatures, represented by *proconsul*, entered the scene about 27 million years ago. Hominids, which are thought to be human predecessors, came on about 4 million years ago. They include *homo habilis*, about 2 to 1.6 million years ago, and *homo erectus*, 1.8 to 300,000 years ago, There were time overlaps between hominids, but none survived. *Homo sapiens*, as our kind is known, appears to have been present over the last 400,000 years. One branch, neanderthal man, at home in Europe, appears to have lived from 200 to 35 thousand years ago. Cro-Magnons displaced the Neanderthals, and are considered to be the same species as modern man. They are thought to have arisen 150 to 100 thousand years ago in some as yet unidentified part of Africa. In aboriginals we find survivors of some earlier strains but, based on genetic evidence, the similarities among present day humans greatly outweigh the differences.

These findings represent much research, much interpretation, and to the extent that the past is prelude, may be subject to much revision.

Does God determine the makeup of each human being? There is overwhelming evidence to indicate that individuals are not cookie cutter replicates of their parents but are surely genetically connected. There are plausible interpretations of changes in the structures of individuals of a species over time which suggest accommodation to changing environments: the differences in skin pigmentation between those living in hot climates and those in cold; the skeletal structures of arboreal and savannah dwelling apes, etc. Did God work out the accommodation to each different situation? No. God, early on, after adapting prokaryotes and eukaryotes to differences and changes in environment, built in accommodation mechanisms. This can be seen in the great variety of genetic heritages in a species: canine, bovine, equine, human. The wolf represents an averaging out of canine potentials. Individual breeds, chihuahua, St. Bernard, demonstrate the range of genetic possibilities by concentrating on specific characteristics. In sexual reproduction there is a mixing of different genetic contents. Some genes from each parent drop out in the offspring, some survive. Where there has been no systematic effort to "breed true" over a number of generations, siblings may differ enormously. Under

pressures to adapt, the evolutionary principle of survival of the fittest is indeed operative. Living things are a combination of the phyletic origins created by God as modified by response to experience.

Creationists and evolutionists both have pieces of essential insight. If only they could see that in the combination of their insights there is a fruitful resolution of their conflict and a wonderful realization that life is the work of a creative and evolving God who has endowed so many species with the wonderful attribute of accommodation to the circumstances of the physical world as they are encountered.

Many have a sense of God not based on consideration of findings in the sciences. In a science society the science culture does not encourage an individual to be open to a sense of God, to consider God as an explanation. Nevertheless a substantial fraction, about 40% of scientists (as contrasted to 90% of the general U.S. population), admit to a belief in God which does not appear to be based on their science experience. In some cases, what fraction I do not know, this belief may be the result of early indoctrination.

In summary, consideration of my experience has led to ascribing to God these attributes and acts:

> God existed before life, is the creator of life and the enormous variety of life forms. God continues to create.
>
> God is able (at the very least) to perceive and comprehend everything on this earth. God's perceptions range from the atomic and molecular level to the macroscopic; from the individual to the aggregate. This encompasses all the processes of living and being including internal states such as feeling and thinking.
>
> God is able to manipulate individual atoms to form molecules.
>
> God has (to us mere humans) an incredible understanding of the potential functions of specific atoms, molecules, and molecular structures. Consider the range in material properties from soft gels to hard teeth.
>
> God is a physicist as well as a chemist. Consider the structural dynamics, hydraulics, thermodynamics, electronics, optics.

God utilizes a speed and multiplicity of operations beyond human comprehension. Consider the bacterium which in 15 minutes synthesizes the 13 million protein molecules which constitute 1 new cell. Then consider the making of a human infant which at birth contains on the order of 10 billion cells.

God has developed an incredible capability in designing functions. A prokaryote ingests nutrient chemicals by diffusion through its circumscribing membrane. Then consider our highly specialized digestive system. And there are a number of in-between systems to satisfy nutritive needs. All made from specialized protein molecules.

In single celled creatures oxygen is supplied by diffusion. Mammals inhale/exhale, exchange carbon dioxide for oxygen, pump hemoglobin-bound oxygen to all parts of the body.

God has gone from the soft blob of the bacterium to exoskeletons to endoskeletons with fantastic results.

And God has made three levels of brain function and structure. And what a change has resulted. Language. Thought. The arts. The appreciation of beauty. And finally values, love, compassion.

Quite aside from sensing God from evidence and reason, I, like I suspect many others, intermittently have a sense of God's approval, disapproval, neutrality. Immanence is a shared experience and indicates to me that God remains in touch with his work.

Endnotes

1 *A History of God*, Karen Armstrong, Ballantine Books (New York, 1991)

2 *Life Itself*, Boyce Rensberger, Oxford Univ. Press (New York, Oxford, 1996)

3 *Love, Power and Justice*, Paul Tillich, Oxford University Press (1954)

4 Imagining is a relatively sophisticated mental function. It goes beyond perceiving and conceptualizing an external object or sensation. It is indicative of the perception of the creation of mental images which may have their origin not only in similarity to perceptions of the actual, but also in perceptions of the products of an active mind.

5 Dictionaries average about ten definitions for the word "theory".

6 *Human destiny*, Pierre LeComte duNouy, Longmans Green (1947)

7 *Life Itself*, Boyce Rensberger, Chapter 1

8 Ibid, Chapters 2 and 3

[9]Ibid, pp. 249-255

[10] Ibid, Chapter 4

[11] Ibid. Chapter 5

[12] Ibid, Endnotes

[13] *Exploring the Human Body: Incredible Voyage.* National Geographic (1998)

[14] Recently it has been argued that this primal atmosphere did not contain oxygen.

[15] *The Book of Life, An Illustrated History of the Evolution of Life on Earth,* General editor, Stephen Jay Gould, W. W. Norton and Company, p. 32, 100 (New York, London 1993)

[16]*The Origin of Life and the Death of Materialism*, Stephen C. Meyer, The Intercollegiate Review—Spring 1996, 24-43

[17] *Life Itself*, Boyce Rensberger, Chap. 5

18 Methane, CH_4, is stable; the valence forces of the carbon are satisfied. The methyl free radical, CH_3, with incompletely satisfied carbon valence forces, is highly reactive.

19 *Let's Eat Right to Keep Fit,* Adelle Davis, Chapter 23, pp. 199-213 (Harcourt, Brace and Company, New York 1954)

20*The Book of Life, An Illustrated History of the Evolution of Life on Earth,* General Editor, Stephen Jay Gould (W. W. Norton & Company, New York, London, 1993)

21 *The Book of Life,* J. John Sepkoski Jr., Edited by Stephen J. Gould, pp. 51-53

22 Ibid, 38 and 39.

23 Ibid, 60.

END