An Analysis of the Primordial Soup Hypothesis with respect to DNA Structure and the Genetic Code

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ABSTRACT

The primordial soup hypothesis is currently the most popular origin of life theory. This hypothesis suggests that DNA and self-replicating organisms were formed out of a warm, aqueous environment on the surface of the prebiotic earth. However, recent studies have shown that the primordial soup hypothesis is not only lacking in factual support, it is also internally flawed. The primordial soup hypothesis is statistically impossible, and it does not adequately account for the origin of the specified complexity of the genetic code. The very nature of the genetic code requires an intelligence source. Universal experience shows that specified complexity is always the result of intelligence. Furthermore, the hypothesized chemical reactions that would have formed amino acids and proteins have not been reproduced in laboratory conditions which reflect the conditions of the prebiotic earth and atmosphere.

The inadequacy of the primordial soup hypothesis requires that another origin theory be proposed. Any new origin theory must be statistically more probable than the primordial soup, and it must also adequately explain the existence of the specified complexity of the genetic code without having internal flaws. The positing of intelligence as the origin of life satisfies these requirements. This theory is statistically more probable than the primordial soup, and it also demonstrates an intelligent source of the specified complexity of the genetic code. Thus, the intelligent-cause theory must be affirmed over the primordial soup hypothesis.

To Gary Habermas,

professor, friend,
who gave me the idea in the first place.

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CHAPTER 1

INTRODUCTION

> The origin of the first life of necessity is a highly speculative issue . . . . our inability to observe spontaneous generation in nature or to bring it about artificially in laboratory experiments show that life must have arisen under some conditions which no longer obtain at present and about which we can make only the vaguest guesses.[1]

Since the advent of the nineteenth century, scientists have attempted to find a possible and plausible solution to the question of the origin of life. Prior to the writings of Charles Darwin, Jean Lamarck, Julian Huxley and Louis Pasteur each investigated the field of origins, and developed individual spontaneous generation theories. Although their works are of historical significance, the theory that has most influenced modern origin theories was developed by Ernst Haeckel. Haeckel postulated the following: primeval organisms were heterogeneous, formless lumps of protein developed by the interaction between materials in the sea and special external physical forces.[2]

With the discovery and subsequent study of the DNA molecule in the 1950's, the theories of origins necessarily changed. Molecular reproductive methods were found to be uniform in all living organisms, and thus origin theories were expanded and modified to account for such uniformity. Further, the very existence of nucleic acids and proteins was expected to be accounted for by any theory of origins. The primordial soup hypothesis, in its very germane form, suggested that primitive nucleic acids and proteins existed together on the earth in a warm, aqueous environment. Stanley Miller and Aleksandr Oparin experimented with gases and various chemicals in order to show that in a controlled environment modelled after that of the primordial soup, amino acids could form spontaneously.[3] Such experiments have been cited for decades as giving credence to the primordial soup hypothesis.

However, at the 1986 Origin of Life Conference in Berkeley, the primordial soup hypothesis was acknowledged by many leading scientists as utterly lacking in factual support.[4] This event provided the window of opportunity for scientists to voice their objections. The following are some of the more common objections to the primordial soup hypothesis:

1. No trace of the primordial soup has been discovered.[5]

2. The proto-cell system hypothesized to have synthesized proteins in the primordial soup would have been prone to translational errors because of its primitive structure.[6]

3. Although in Miller's experiment, amino acids did form, these formations occurred in a closed system and a controlled environment. Information theorists have calculated the probability of amino acid formation in an uncontrolled primordial environment and have found such hypothesized spontaneous generation to be mathematically impossible.[7]

4. It is asserted that the primordial soup hypothesis cannot plausibly explain the emergence of the genetic code, nor yet can it account for the specified complexity of the code.[8]

STATEMENT OF THE PROBLEM

The current interest in the theories of origins necessarily proceeds out of the questions raised by such objections. As stated by Richard Dickerson, "It is one thing to propose scenarios for the origin of life that might have been; it is another thing entirely to demonstrate that such scenarios are either possible or probable."[9] It is my position that the primordial soup hypothesis, as a scenario, has not been adequately demonstrated as either possible or probable. The scientists who affirm the hypothesis have not adequately answered the objections that render inadequate the hypothesis, nor yet have they modified the hypothesis in order to satisfy the objections. Despite the many objections, the primordial soup hypothesis remains intact, taught as the leading origin theory in public schools and cited in the introductions of biology texts. It is my opinion that if the primordial soup hypothesis cannot offer a plausible, probable solution to the question of the origin of life then it must be rejected. The objections to the hypothesis, if they are valid and if the hypothesis cannot satisfy them, certainly call for the development of a new hypothesis.

If a new hypothesis is to be developed, then where will modern biologists and chemists turn in order to develop such a hypothesis? My position is that the very nature and structure of the genetic code in the DNA molecule and its marvellous design provides the starting point for the development of origin scenarios.

The genetic code is the great mystery of life. As such, its origin is the basis of the study of life and also the basis for much philosophical speculation. If the genetic code arose from spontaneous generation, then life is simply a product of chance, there is no ultimate plan and no ultimate goal. However, if the genetic code results from intelligence, then life is the product of a mind. In this paradigm, the mind provides life and the ultimate plan and goal of that life. These two paradigms provide very different answers to the questions of human existence and the purpose of human existence in the universe. Although scientists will acknowledge that such questions are beyond the scope of empirical data, and therefore better left to the speculations of philosophers, they seldom realize that their theories and hypotheses have direct bearing on how the philosophers attempt to answer these questions, and that their theories also have an effect on the answers, themselves.

STATEMENT OF METHOD

It is, therefore, the purpose of this paper to analyze DNA and proteins and their implications for the primordial soup hypothesis. This will entail an examination of information theory, DNA structure, protein structure, specified complexity, and the genetic code. My position is that an examination of the nature and structure of the genetic code and its precursors will show that the hypothesis in question does not embody the epistemic value of internal clarity.[10] The conclusion of the paper will be reserved to discuss the positing of a first-cause as an alternative to the primordial soup hypothesis, and the scientific and philosophical implications of such a position.

STATEMENT OF LIMITATIONS

It is beyond the scope of this paper to analyze or to discuss all the different theories for the origin of the DNA molecule. Thus, I choose to limit the discussion to the primordial soup hypothesis as the foremost of these competing theories. It is also beyond the scope of this paper to evaluate the evolution/creation conflict as a whole, or to discuss the controversy surrounding the concepts of ex nihilo and continuing creation. Further, it is not the purpose of this paper to defend the existence of God, or to set forth a complete argument for the same.

REVIEW OF THE LITERATURE

The most comprehensive, recent study examining the primordial soup hypothesis with respect to the information inherent in the genetic code and the probabilities of spontaneous generation is that of Hubert Yockey, Information Theory and Molecular Biology. Yockey seeks to show that the assertion that life arose as a result of spontaneous generation is clearly based on faith.[11] He delineates the rigorous calculations that, while making it virtually impossible for spontaneous generation to occur, led him to this view. Although there are many who would disagree a priori with his position, to date there has been no definitive challenge to his mathematics. If Yockey is correct, then the primordial soup hypothesis is certainly problematic and warrants further inspection.

The work of Stanley Miller and Aleksandr Oparin has been eclipsed by modern researchers. Oparin's work, The Origin of Life, must be referred to as the starting point of the modern research of the primordial soup, but one must remember that molecular biology has developed much since Oparin published his book in 1938. Although the papers of Oparin and Miller are of interest historically, modern research in the field offers more to our discussion due to the technological advances of time and the increased number of scientists examining the problem. As stated by geo-chemist Everett Shock, "The Miller . . . experiment was a strong foundation because it was consistent with theories at the time. The problem is that subsequent research has swept away a lot of those ideas."[12]

Such is also the case for the work done by James Watson and Francis Crick with the discovery of the double helix. Their work in the mid-1950's broke the ground for DNA research, but current articles and books on the subject provide better research and discussion for today's examination of origin theories.

In 1976, Chen Kang Kai published a superb overview of prebiotic development entitled Genetic Evolution. Kai discussed more recent developments in the primordial soup hypothesis and also some of the problems encountered with the hypothesis. His research is of great value to the question at hand. John Farley also published an overview of the history of origin research and current advances to the field in The Spontaneous Generation Controversy from Descartes to Oparin.[13] Thaxton, Bradley and Olsen's The Mystery of Life's Origin: Reassessing Current Theories also provides a valuable source for this work.

Furthermore, one should not examine the primordial soup hypothesis without reference to Leslie Orgel's The Origins of Life: Molecules and Natural Selection, or Glen Rowe's Theoretical Models in Biology: The Origin of Life, the Immune System and the Brain. Richard Dickerson's paper "Chemical Evolution and the Origin of Life" also lays the groundwork for an accurate assessment of the question.

The works of other scientists and philosophers who have examined the question of life will also prove instructive to our examination. J. P. Moreland's Christianity and the Nature of Science, and Norman Geisler and J. Kerby Anderson's Origin Science provide a philosophically based answer to the question. Michael Denton's Evolution: A Theory in Crisis is the personal investigation of a medical doctor. Sir Fred Hoyle and Chandra Wickramasinghe are astronomers who discuss the origin of the universe in Evolution from Space. Henry M. Morris is the director of the Institute for Creation Research, and his work is entitled Scientific Creationism.

Although I shall chiefly refer to the sources delineated above, I will also refer to Vernon Blackmore and Andrew Page's work Evolution the Great Debate, and various works relating the study of information to biology, such as Lila Gatlin's Information Theory and the Living System, and Peter Calow's Biological Machines: A Cybernetic Approach to Life.

DEFINITION OF TERMS

Because of the technical nature of this paper, I believe that the following explanations of basic molecular biology to be essential in ensuring the reader's familiarity with the terminology and topics at hand:

All contemporary organisms consist of at least nucleic acids and proteins.[14] The nucleic acids carry the genetic code which ensures heritable continuity, and the proteins act as catalysts, making it possible for the system to use the chemicals in their environments to transmit the heritable information.[15] Nucleic acids are the only molecules within the cell which can self-replicate.[16]

Deoxyribonucleic acid (DNA), contains four chemical sub-units called bases. The structure of DNA is that of a double helix, comparable to two strands of rope that are intertwined, with the bases linking the strands together.[17] The entire double helix may be copied by unravelling itself into two separate strands, the resulting severed links between the bases can then pick up complementary molecules and form two new identical strands. By this uncoiling, each spiral in the helix acts as a template for a new spiral. This mechanism is known as "semi-conservative" replication. As the bases can only fasten onto their counterparts, the new manufactured spiral is identical.[18]

Amino acids and nucleotides are optically active, that is, they contain asymmetric carbon atoms which allow them the capacity of rotating a plane of polarized light.[19] If the molecule rotates light clockwise, it is called dextro (D); if it rotates light counter-clockwise, it is called levo (L). A mixture of the two configurations results in no rotation and is thus said to be racemic.[20] Only L-amino acids are present in naturally occurring proteins and only D-nucleotides are present in naturally occurring nucleic acids.[21] A DNA molecule composed of D-nucleotides spirals in a clockwise direction, and a DNA molecule composed of L-nucleotides spirals in an anti-clockwise direction. But a DNA molecule cannot contain both D- and L- nucleotides, as this would form an irregular structure unable to replicate or function.[22]

The genetic information in DNA is "transcribed" into an RNA which codes for a protein. Each amino acid in the protein is specified by at least one "codon" or sequence of three adjacent nucleotides in the RNA. Since there are four different bases in the nucleic acids, sixty-four different codons are possible.[23] Of these sixty-four triplets, three of them are terminator codons, which give signals for the termination of protein synthesis, the remaining sixty-one codons each code for one amino acid.

The protobiont genome is the hypothesized self-replicating, metabolizing precursor to all other living, replicating organisms. The primordial soup hypothesis asserts that the protobiont gave rise to the complete genetic code of modern organisms.

Mutations are a change in the genetic code of an organism. It is generally thought that most, but not all mutations are harmful for the organism. However, this "rule" has been the subject of much debate. Some scientists argue that no known mutations are beneficial to the organism, while some scientists argue that mutations such as sickle-cell anaemia are of benefit to the organism.[24] It is, however, generally agreed that most mutations are harmful to the organism while some are neutral in their effects.[25]

Specified complexity is a term used to differentiate between specified, complex and specified and complex structures. The following letter arrangements illustrate the distinction:

1. Orderly (periodic) and therefore specified

GIFT GIFT GIFT GIFT
example: crystal

2. Complex (aperiodic) and unspecified

TGELSIDHT TBWORMHQC PUQXHDMBT
example: random polymer

3. Complex (aperiodic) and specified

A message is riding on this sentence
example: protein[26]

The fundamental dogma of molecular biology states that information in living systems travels in the following manner:

DNA (Master blueprint)
transcription

RNA (photocopy)
translation

Proteins (Functional machines)[27]

The sequence of nucleotides in the messenger RNA (mRNA), which carries the information content of DNA to where the proteins are synthesized, is translated by the conventions of the genetic code into the amino acid sequence of a protein by a process similar to the encoding and decoding of messages in Morse code.[28]

Natural Selection is defined by the Concise Science Dictionary in the following way:

> The process that, according to Darwinism, brings about the evolution of new species of animals and plants . . . . (T)he size of any population tends to remain constant despite the fact that more offspring are produced than are needed to maintain it . . . . variations existed between individuals of the population and . . . . disease, competition, and other forces acting on the population eliminated those individuals less well adapted to their environment. The survivors would pass on inheritable advantageous characteristics (i.e. characteristics with survival value) to their offspring and in time the composition of the population would change in adaptation to a changing environment. Over a long period of time this process could give rise to organisms so different from the original population that new species are formed.[29]

These terms should not be viewed as exhaustive. However, I hope that they will prove instructive to the reader as a brief overview of the language used in discussing the nature of the primordial soup hypothesis.

CHAPTER 2

THE COMPLEXITY AND INFORMATION OF DNA

Organisms store and use hereditary information by encoding sequences of amino acids as nucleotide chains.[30] These nucleotides occur in the nucleic acids deoxyribonucleic acid (DNA), and various forms of ribonucleic acid (RNA). The formation of nucleotides enables nucleic acids to contain and transmit the hereditary information for an organism's cell structure, function, development, and reproduction.[31] Because DNA and RNA must carry genetic information from cell to cell and from generation to generation they must be capable of carrying a great deal of information within a microscopic structure.[32] A DNA molecule may be several million nucleotides long and could be arranged in a wide variety of possible sequences. Despite the incredible potential for variety, the genetic code is identical in all organisms, with very few exceptions concerning only the smallest details.[33] Therefore, any effective origin theory must necessarily explain the generation of the genetic code, the DNA molecule, proteins, and enzymes, and it must do so through a possible, probable explanation. The scientific community is definitely able to differentiate between a probable theory and an improbable theory, and is compelled by their discipline to affirm the more probable of two theories, absent a third and more probable theory.[34]

The primordial soup hypothesis has been the most popular origin theory of the twentieth century. This theory suggests that primitive nucleic acids and proteins were derived from simple organic compounds found in warm "puddles" on the earth's surface. The evolution of the protobiont from the primordial soup can be summarized by the following steps:

1. Raw Materials (H_2O, CH_4, NH_3, CO_2, H_2)
2. Energy source (Lightning/Ultra-violet radiation)
3. Monomers (amino acids)

4. Polymers (polypeptides)
5. Clumping (microspheres)
6. Completed parts (enzymes/proteins)
7. First living cell (protobiont)[35]

As illustrated above, the "evolutionary chain" is very important to the primordial soup hypothesis. The protobiont is made up of, and consequently dependent upon, the smaller proteins and amino acids. The importance of this dependence is carried over into the chain of proof sought by those who affirm the hypothesis. Their position is such that if the chance formation of the molecular precursors to the protobiont is proved, then the chance formation of the protobiont would thus be proved.[36]

INFORMATION CONTENT OF THE PROTOBIONT

As the genetic code has been recognized as containing information, many scientists have sought to calculate the amount of information contained therein. Mathematicians have estimated the information content of the protobiont, as the protobiont must have been sufficiently coded so as to give rise to all of the genetic diversity manifested on Earth. Michael Denton asserted that the protobiont must have contained sufficient DNA to code for about one hundred average sized proteins, an amount close to the observed coding potential of the smallest known bacterial cells. Denton's analysis of the question led him to assert that the complexity of the simplest known type of cells is so great it would be impossible to posit that the cells were the result of spontaneous generation via chance.[37]

Hubert Yockey also sought to determine the minimum information content in the instructions required to direct the actions and replication of the protobiont. Information theory states that the built-in set of instructions required for the operation of a robot or organism will degenerate because of noise and eventually become insufficient for its function.[38] Thus the protobiont must have a genome of sufficient complexity both to metabolize and to self-replicate, so that degeneration is avoided. Yockey looks to the genomes of the most primitive free-living organism living today, mycoplasmas and spiroplasmas to estimate this minimum information. From his analysis, although recognizing that his estimates are "highly speculative," he sets the minimum information content of the protobiont of in the range of hundreds of thousands to several million bits.[39] This number describes the amount of information that would have had to appear spontaneously in the primordial soup in order to form the first self-replicating organism. As shown, the primordial soup hypothesis asserts that chance gave rise to the specified complexity of the genetic code and to the first self-replicating organism. Having already discussed some of the tensions existing between the primordial soup hypothesis with respect to information content and information theory, I will now turn my attention to a mathematical analysis of the probability of spontaneous generation of life.

Origin scenarios tend to be divided on whether life began with proteins or with nucleic acids. In calculating the probability of spontaneous generation of life, Yockey calculates this in terms of proteins first. He determines that the probability of an amino acid arriving at a specific site in the protein sequence is not equal. For this reason, it would be incorrect to simply multiply the number of functionally equivalent amino acids at each site to get the total number of sequences. Yockey first chooses to examine a model protein for which the functionally equivalent amino acids are known, and thus chooses iso-1-cytochrome c. There are 9.737×10^{93} iso-1-cytochrome c sequences that differ in at least one amino acid, each carrying the same specificity.[40] He concludes that 1.5×10^{44} trials would have to be performed in order to have a probability of 0.95 of finding one molecule of iso-1-cytochrome c.[41] The probability that the molecule would be generated in one trial is 2.00×10^{-44}. This situation is then exacerbated once the issue of chirality is factored into the calculations.[42] We will examine chirality in the upcoming chapters.

All references on the primordial soup report that many non-proteinous amino acids and analogues are formed through chemical evolution, along with the proteinous amino acids.[43] Elongation of the protein chain is immobilized by the incorporation of one analogue or one wrong optical isomer, as this prevents the folding of the protein chain.[44] In addition, it is an established fact that all asymmetric molecules made by non-biological means are racemic, while only L-amino acids are present in naturally occurring proteins. When Yockey incorporates the fact that the amino acid glycine is symmetric into his calculations, he determines that the chance of selecting one iso-1-cytochrome c sequence, where all the amino acids are of one optical isomer, is $2.316 \times 10^{93}/1.01 \times 10^{168}$, which is equal to 2.3×10^{-75}. Yockey then supposes that all of the amino acids existing in the primeval soup are used at each trial, and then uses the calculated concentration of the amino acids as estimated by I.S. Shklovskii and Carl Sagan, which is 10^{44}.[45] In order to have a probability of 0.95 that one complete iso-1-cytochrome c molecule will be produced, then one amino acid from the pool of 10^{44} in the primordial soup must be selected once a second for 10^{23} years. As Yockey states, if that is the correct scenario, then evolution would only just be beginning, as the universe is estimated to be 1.5×10^{10} years old.[46]

Yockey uses probability as a measure of degree of belief, "It is clear that the belief that a molecule of iso-1-cytochrome c or any other protein could appear by chance is based on faith."[47] Yockey defines faith as a commitment to a religious system or a belief in an infallible doctrine or ideology. Yockey's opinion is such that one can only believe in a hypothesis having very small or zero probability through faith, not through science.[48] As shown, the probabilities are stacked against the spontaneous generation of proteins, and these probabilities are only for the generation of a single molecule. Many copies of different protein molecules must be generated in order to form a protobiont, which makes the spontaneous generation of a protobiont an even more remote possibility.[49] Yockey's rigorous examination of the probabilities of the spontaneous generation of life shows that even if one were to believe that the precursors to life were available in the primordial soup, that they do not spontaneously make proteins by chance.[50]

A common objection to Yockey's calculations is that chance might hit upon the correct amino acid at each locus on the first trial. Although theoretically possible, this objection is statistically impossible. The probability of arriving at an iso-1-cytochrome c molecule in one trial is 2.00×10^{-44}, an extremely minute probability. Furthermore, the protobiont would have had to have been made up of more than one protein molecule, which means that the above probability would have to be overcome for each molecule.[51]

Hoyle and Wickramasinghe also examine the question of spontaneous generation by calculating the probability of the evolution of a single protein, only they choose to examine a hypothetical protein that is ten amino acids in length.[52] As in all genes, the amino acids of the hypothetical gene had to be specific and in specific positions in order that the gene would prove functional. By hypothesis, the amino acids were not already in order, and thus it would take twenty to thirty million generations to change the amino acid at the first position, with only a small chance of the change being to the required amino acid. If the first position happened to change correctly, the other nine positions are likely to experience changes during these generations, and not necessarily to amino acids of the required identities. Hoyle and Wickramasinghe differ from Yockey in that they calculate the chance that when the first amino acid falls into the correct site the other nine will also be correct. This probability is calculated as 1 in 20^9, because there are twenty kinds of amino acids to choose from at each of the other nine positions. Hoyle likens this situation to what he terms a "plumber's nightmare," while one amino acid is being placed at the correct position, the other amino acids "jump away" and become wrongly situated again.[53]

The origin of enzymes is also a highly speculative issue. Hoyle and Wickramasinghe examine the chance that in a random ordering of the twenty different amino acids it happens that the different kinds fall into the order appropriate to a particular enzyme.[54]

Ten to twenty distinct amino acids determine the basic backbone of an enzyme. Active sites on the face of the enzyme promote biochemical reactions, and these sites must be correct in their atomic forms and locations. Hoyle and Wickramasinghe assert that in a random ordering of the twenty different amino acids which make up the enzymes the chance of obtaining a suitable backbone would be no greater than 1 in 10^{15}. They further assert that the chance of obtaining the appropriate active site could not be greater than 1 in 10^{5}. They then multiply the two probabilities to yield the probability of 1 in 10^{20} that one would obtain the required enzyme in a functioning form from the given random ordering of the amino acids.[55] However, there are about two thousand enzymes even in primitive cells, and the chance of obtaining them all in a random trial is only 1 in $10^{40\,000}$, a probability that Hoyle and Wickramasinghe assert could not be faced even if the whole universe consisted of organic soup.[56]

They also assert the following:

> Any theory with a probability of being correct that is larger than one part in $10^{40\,000}$ must be judged superior to random shuffling . . . . (T)he theory that life was assembled by an intelligence, has, we believe, a probability vastly higher than one part in $10^{40\,000}$ of being the correct explanation . . . .[57]

Hoyle and Wickramasinghe state that their position is based on the close examination of the data. In their opinion, the affirming of intelligence over chance with respect to the origin of enzymes is in keeping with the above-mentioned probabilities. I will now turn my attention to the question of specified complexity and its relationship to intelligence.

SPECIFIED COMPLEXITY AND LANGUAGE

In developing any origin theory, one must first be able to identify some distinguishing feature of life.[58] Systems must be able to process energy, store information, and replicate in order to be classified as "living."[59] Biologist Leslie Orgel states that the truly distinguishing feature between living and non-living systems is what is known as specified complexity. The specified and complex sequence information found in living cells distinguishes the organisms from random mixtures of organic polymers.[60]

As previously illustrated, specified complexity is manifested by proteins and by the genetic code. In fact, the similarity between the specified complexity of life's informational sequences and the specificity of letters in a written language is striking.[61] Each amino acid corresponds to a messenger RNA codon, which consists of a triplet combination of the four lettered nucleotide code.[62] The Central Dogma of molecular biology states that information may be transferred from DNA to DNA, DNA to mRNA and mRNA to protein.[63] The Central Dogma has also been shown to be a mathematical property of the genetic code, itself, and not a fundamental property of nucleic acids and amino acids themselves.[64] The primordial soup hypothesis, in explaining the origin of the genetic code, must not attribute the information content of the genetic code as deriving directly from its constituents, else it would contradict the Central Dogma.

Information theorist Lila Gatlin defines the DNA code as language in the following manner, ". . . . the base sequence of DNA (is) the encoded message at the source of the living channel and the amino acid sequence of proteins (is) the message which is finally received at the output."[65]

Orgel compares the protein molecule to ". . . a long word made up of a number of letters . . . some of which may be used many times."[66] Biologist Peter Calow describes the DNA code as the "message of life," a genetic programme for biological "machines."[67]

Michael Denton likens the genetic code to the language of computers, " . . . (The organism's) design is stored and specified in a linear sequence of symbols, analogous to coded information in a computer programme."[68] Physicist Ian Barbour refers to the language of DNA as consisting of a "four-letter 'alphabet' grouped in three-letter 'words' which are arranged in 'sentences.'"[69] Chemist Walter Bradley asserts that the biological function of the genetic code is analogous to the requirements of language and communication.[70]

Not only is the genetic code analogous to a language, in containing a specified and complex pattern which conveys meaning the genetic code, like Morse code, is considered to be a language. This fact is usually not disputed. However, the origin of the information communicated via the language is often disputed. If the primordial soup hypothesis is correct, then the genetic code is the result of spontaneous generation. The mathematical property of the genetic code arose out of chance. Although this assertion may be intellectually satisfying to some, others question its plausibility. Philosopher J.P. Moreland asserts that one's observation of the world reveals that intelligence is the only known cause of complexity and intricacy.[71] Moreland states that when one is confronted with language or with information, two things are true. First, if the language or information did not result from a rational agent then they are without meaning. Second, information exists outside of and prior to the arrangement of the sentence by the writer. Moreland summarizes in the following sentence: ". . . (T)he information in the genetic code existed prior to and outside of . . . that code and that information was imposed on those parts by a Mind."[72] According to Moreland, the genetic code, in that it contains meaningful information, must have been derived from a rational agent. Furthermore, as information exists prior to its arrangement, the information must have existed in the mind of a rational agent prior to the existence of the genetic code.

Royal Astronomer Sir Fred Hoyle and Chandra Wickramasinghe also assert that information proceeds from intelligence.[73] From their examination of simple living systems, Hoyle and Wickramasinghe concluded that the enormous information content could not be generated by "natural" processes, such as meteorological and chemical processes occurring at the surface of a lifeless planet. A large initial store of information, as well as a suitable physical and chemical environment were also deemed necessary for life. They asserted that intelligence not only has the ability to act on the information, it is the very origin of information.[74]

The genetic code operates under a transmitter-receiver-oriented system. Such a system requires a set-up based on initial meaning.[75] The primordial soup hypothesis cannot explain the origin of the initial meaning without regressing into the need for an explanation of the origin of the universe. In order to explain initial meaning, one would need to suggest that the information was intrinsic in the organic molecules,(which contradicts the Central Dogma), and then one would have to explain how the molecules originated, and then how their constituents originated, etc. into an infinite regress. A further criticism of the primordial soup hypothesis rests in the fundamental principle of information theory which states that the receiver never receives more information than already exists in the transmitter, and it usually receives less.[76] This is important if one argues that the amount of information in the genetic code accumulated over time. Such an assertion would be impossible based on the above law of information as the information level would degenerate until self-replication evolved.

In order for self-replication to take place, an intact set of instructions for replication, transcription and translation must exist. Self-replication also requires enzymes which are themselves products of transcription and translation. The primordial soup must plausibly explain the origin of enzymes and the genetic code before it can successfully explain the origin of self-replication. However, the hypothesis suggests that the genetic code is derived from organic compounds, which clearly contradicts the Central Dogma.

The primordial soup hypothesis is problematic with respect to the origin of the specified complexity and information content of the genetic code. However, the statement that chance cannot father specified complexity in a language is only one objection levied against the primordial soup hypothesis.[77]

CHAPTER 3

A BIOLOGICAL AND CHEMICAL ANALYSIS OF DNA STRUCTURE

An examination of the specified complexity of the genetic code and the probability of the spontaneous generation of protein molecules and of enzymes provides several serious objections to the primordial soup hypothesis. However, it is valuable to consider some of the finer points of the biological and biochemical nature of life systems and their workings to discover or to refute further objections to the primordial soup hypothesis.

Scientists who affirm the primordial soup hypothesis, such as Leslie Orgel, cite Natural Selection as a rebuttal to the statistical probability of the spontaneous generation of life.[78] They explain that Natural Selection is a process which progresses cumulatively.[79] For example, the chances of the eye being formed over one biological generation by a chance re-ordering of genes are acknowledged to be small, but the chances of a slight change occurring on the step towards an eye, such as a light-sensitive spot which gives a selective advantage to its owner, are less small.[80] Natural Selection proceeds because new forms which have an advantage over their contemporaries survive, while those without the new genetic make-up are gradually overtaken. Natural Selection is an unconscious process.[81]

However, Natural Selection as classically defined by Darwin, is inapplicable to the primordial soup hypothesis. Should one wish to re-define Natural Selection in order to "fit" the primordial soup hypothesis, one would only seek in destroying Darwin's original definition and one would further be guilty of modifying the definition ad hoc. Natural Selection in the primordial soup is an inapplicable term for the following reasons:

1. Natural Selection presupposes self-replicating living organisms.
2. Natural Selection does not explain the origin of specified complexity.

3. The system does not have an infinite amount of time in order to form a protobiont.

4. Mutation rates, in actuality, are very small and deleterious mutations are very common.

By definition, Natural Selection cannot be the cause of life. Natural Selection presupposes the existence of a self-replicating cell, and asserts that minute changes of the cell's existing genetic apparatus, (mutations), occur in order to evolve a more highly developed cell. The original self-replicating cell or protobiont could not have evolved via Natural Selection from lesser organized cells because there would have been no self-replication processes in existence prior to the first self-replicating cell. Orgel, himself, states that selection cannot occur without reproduction, but then states that the system of "living" organisms evolved from primitive replicating structures.[82] Yet, this assertion begs the fundamental question: what is the source of the primitive replicating structures? Did they arise from selection? Darwin's definition of Natural Selection presupposes not only a replicating system, but a large population of specific organisms, so that a good-sized pool of variation between the different members of the population might exist.[83] In the primordial soup there were chemicals and sugars, but (for millions of years) no living organisms. Natural Selection, as defined by Darwin, is inapplicable to the origin of the protobiont from lesser cells. Dickerson and Sidney Fox admit this point, stating that Natural Selection began when the first nucleic acid associated with a protein in order to form the first replicating mechanism.[84] However, Dickerson further admits that he and his colleagues are only able to speculate as to how the nucleic acid and the protein came into being in the first place and then how they came to associate with one another.[85]

INFORMATION THEORY AND THE GENETIC CODE

The DNA molecule reproduces itself via replication. That is, it makes an exact copy of its genetic material in order to pass the material on to its offspring. The primordial soup hypothesis asserts that self-replicating DNA evolved from proteins and enzymes through a selective process. However, this assertion is problematic with respect to the hypothesized prior existing proteins, and also to the pattern of the genetic code.

Proteins are required for the self-replication of the DNA molecule. However, proteins are also dependent upon DNA sequences for their formation and structure, as they are made via DNA transcription and subsequent RNA translation. The primordial soup hypothesis is faced with a "which came first" scenario when it discusses the origin of proteins and nucleic acids. Proteins are dependent upon DNA, and DNA replication is dependent upon proteins. The primordial soup hypothesis needs to adequately explain how this co-dependence was overcome.

In order to solve this dilemma, the primordial soup hypothesis asserts that polymers resembling proteins and nucleic acids were distilled out of the concentrated primordial soup.[86] Although scientists, like Orgel, admit that no polymerization reactions of this kind have been successfully carried out in a laboratory, they persist in asserting that proteins and nucleic acids were spontaneously generated together in the primordial soup.[87] As shown in chapter two, the probability of spontaneously generating a protein from a collection of amino acids is one in 2.3 x 10^{-75}, if the amino acids are of one optical isomer.[88] It is highly improbable that nucleic acids and proteins were both spontaneously formed from the primordial soup, and within close proximity of one another that they might mix to facilitate DNA replication. Furthermore, DNA replication requires six different types of proteins in order to function, each in specific structures and in specific amounts. DNA polymerase III, DNA polymerase I, helicase, topoisomerase, DNA ligase, and SSB proteins are all required. It is not enough for Orgel and his colleagues to suggest that proteins and nucleic acids co-evolved from the primordial soup. He needs to demonstrate that the proteins generated were of the kinds and amounts required for DNA replication, and that the nucleic acid evolved was DNA and not some other sort of nucleic acid. The current explanation of the co-dependency of proteins and DNA is co-evolution. However, as demonstrated, this explanation does not have empirical data on which it is based, nor does it account for the variety and amounts of proteins that are required by the DNA molecule for self-replication.

The primordial soup hypothesis is also problematic with respect to the nature of the genetic code. Prior to the use of self-replication in the primordial soup, the pattern of the genetic code would have been dependent on previously existing patterns which themselves would have been dependent on previously existing patterns. Information theory declares that if a given pattern is made from a pattern that is different from itself then the process of replication degenerates into an infinite regress.[89] Self-replication must be used to instruct the formation of a pattern, otherwise the manufacture of a given pattern would require another, different pattern for its own reproduction, and this pattern would require another, different pattern and so on.[90] The pattern of the genetic code could only have resulted from a self-replicating pattern, otherwise the code would have been derived from a different pattern, which results in the infinite regress argued against by information theory. The primordial soup hypothesis asserts that the pattern of the genetic code arose via the amalgamation of organic molecules, and undergoing thousands of years of Natural Selection. However, as argued, without an intact, self-replicating pattern such evolution is impossible. Furthermore, as argued above the hypothesis is inconsistent with the Central Dogma of molecular biology.

The primordial soup hypothesis asserts that the intact, self-replicating pattern is the result of an amalgamation of organic molecules, and undergoing thousands of years of Natural Selection. On this point, the primordial soup hypothesis not only violates the classical definition of Natural Selection, it also violates the laws of logic. The genetic code must have been derived from an intact, self-replicating pattern, which could not have been derived through different patterns. In the face of these statements, the hypothesis continually asserts that Natural Selection is the author of the genetic code, even though information theory declares that without an intact, self-replicating pattern there would be an infinite regress. The primordial soup hypothesis cannot satisfy these objections without abandoning Natural Selection as the author of the genetic code, and without affirming, along with information theory, that an intact, self-replicating pattern gave rise to the genetic code. However, in asserting this, the primordial soup hypothesis has now created another problem for itself: How did the intact, self-replicating pattern come into existence? We have shown above that Natural Selection cannot give rise to a self-replicating organism without existing replicating structures. Now, the primordial soup hypothesis must find another explanation for the origin of the self-replicating cell. Through these objections it is evident that the primordial soup hypothesis with respect to the origin of the pattern of the genetic code and to the existence of the protobiont lacks internal clarity.

MUTATIONS AND THE PROTOBIONT

The mechanism of mutations is favoured among those who affirm the primordial soup hypothesis. However, those who use mutations to affirm the hypothesis ignore what geneticists have discovered about mutations and what is observable in natural populations. Optimistic descriptions of evolving populations due to mutation are cited with regard to the primordial soup in the papers of Dickerson, Fox, Orgel and many others. Lawrence Dillon hypothesizes that organisms with deleterious mutations were removed by selection and replaced by those with greater fitness.[91] He further hypothesizes that the primitive replicating structures were very imprecise, making mutations more common.[92] However, the strength of the general mutation argument is widely disputed. C.P. Martin, Michael

Denton, Andrew Blackmore, Vernon Page, and Henry Morris are only a few of the many individuals in the scientific community who criticize the primordial soup hypothesis with respect to mutations. Morris asserts the following:

1. Mutations are random, not directed.
2. Mutations are rare and not common, at least in modern protein-based repair mechanisms.
3. Good mutations are very, very rare.
4. Mutations affect and are affected by many genes.[93]

The randomness of mutations demands that Natural Selection takes what comes. There can be no direction. Furthermore, some scientists, such as C.P. Martin, deny the existence of <u>any</u> beneficial mutations:

> Accordingly, mutations are more than just sudden changes in heredity; they also affect viability, and, to the best of our knowledge, invariably affect it adversely. Does not this fact show that mutations are really assaults on the organism's central being, its basic capacity to be a living thing?[94]

Geneticists agree that mutations are, for the most part, hazardous to the health and life-expectancy of an organism. Some geneticists, such as Kai, assert that "beneficial" mutations do exist.[95] The mutation that is universally cited in this case is that of sickle-cell anaemia. Sickle-cell anaemia is beneficial in countries where malaria is a threat, because those that carry one sickle-cell gene and one normal gene are resistant to malaria and do not manifest sickle-cell anaemia. Those that have two sickle-cell genes die. If two carriers of the sickle-cell gene have children, twenty-five percent of their offspring will be susceptible to malaria, fifty-percent will be resistant to malaria, and twenty-five percent will die of sickle-cell anaemia.[96] It would seem to most that this "beneficial" mutation has only limited benefits. True, those heterozygous for the sickle-cell gene will be resistant to the gene, but one-quarter of their offspring are still susceptible to malaria and another quarter will die. How could mutations such as these lead to the development of more advanced, fitter organisms? Already, the "fitness" of the carrier is decreased by one-quarter because one-quarter of their offspring will die.

As Morris states, "If any one mutation is highly likely to be deleterious, then since a changed characteristic requires the combined effects of many genes, and therefore many concurrent mutations, the probability of harmful effects is multiplied manyfold."[97] The mutations that would have to occur in an organism in order for its characteristics to noticeably change would have to be a large number. With a large number of mutations, comes a large probability that the organism will die and therefore, not live to reproduce. Many mutations kill the carrier outright. Many mutations result in deformation or aesthetic changes (i.e. albinism), which might eliminate or decrease the chance that the carrier will have the opportunity to reproduce and/or to produce viable offspring.

In global society, individuals seek to avoid behaviour which would increase the risk of mutation. Substances and chemicals which result in mutations are legislated against or are subject to government restrictions, primarily because of their harmful effects on those who come in contact with them. For example, those who have been subjected to fall-out from nuclear testing and children of mothers who had ingested the drug thalidomide while pregnant have had their genetic make-up mutated, and some have been forced to live with the harmful effects of deformity, while others have died. If mutation is as beneficial as those promoting the primordial soup would have us to believe, then why are the effects so harmful? Why is mutation something world societies seek to avoid? The answer is clear, there are no beneficial effects to mutations.

The majority of, if not all, mutations are either lethal or detrimental to the cells in which they occur.[98] Although mutation is acknowledged to be the only way that new genes are made in a given population, it is not the principal means by which variability is maintained within a population.[99] Every individual contains only a certain part of the total genetic information in a population, and when two individuals reproduce, the offspring contains a new mixture of the genetic material belonging to their parents.[100]

Naturally occurring mutations are rare in the modern world, because of the efficiency of the protein-based repair mechanisms existing in self-replicating cells. The primordial soup hypothesis suggests that mutations in primitive replicating structures were much more common. This is a fair assertion as primitive cells would probably have existed for a long period of time before the repair mechanisms evolved. However, mutations occurring in a small, inbreeding population, such as would have existed in the primordial soup, would most likely have destroyed the population long before any beneficial mutations could occur.[101] The primitive replicating structures, if prone to mutation, would soon modify the existing genetic code to the point where replication was no longer possible. If we re-examine Hoyle's example of the enzyme, we note that the primitive system is most likely to destroy itself just as it is building up to a correct sequence. For each site on the enzyme, there is a one in twenty chance that the correct amino acid will be chosen from the pool. When multiplied together, the chance that the enzyme in question will be completed is one in 9.77×10^{-14}, while there is 9.77×10^{14} chances for destruction. This is the "plumber's nightmare" of which Hoyle spoke, for as one amino acid is correctly placed, the other amino acids will become wrongly situated again.[102]

As shown, primitive replicating systems are prone to mutation. When replication is hampered, a given population will become extinct. As argued above, most if not all mutations are harmful for the organism. Any mutation that kills its organism would obviously be detrimental to the population. Any mutation that decreases the chance of reproducing for the organism will also be detrimental to the population as this would reduce the number of viable offspring. Due to the nature of mutations and the threat they have for organisms, the replicating cells in the primordial soup would have had to fight against the probability of destruction after they had already battled the probability of coming into existence and surviving long enough to reproduce.

Regarding the nature of mutations, Denton draws an analogy between computer programmes and living systems:

> If complex computer programmes cannot be changed by random mechanisms, then surely the same must apply to the genetic programmes of living organisms. The fact that systems in every way analogous to living organisms cannot undergo evolution by pure trial and error and that their functional distribution invariably conforms to an improbable discontinuum comes, in my opinion, very close to a formal disproof of the whole Darwinian paradigm of nature.[103]

Hoyle and Wickramasinghe also argue that mutation and Natural Selection cannot produce complex biomolecules from a random association of atoms because the probabilities are against it.[104] They use a comparison between the alpha-hemoglobin chains of humans and of gorillas to estimate the chance of a DNA copying error. The alpha-hemoglobin chain of the human differs from that of the gorilla by one amino acid, glutamic acid in man, aspartic acid in gorillas.[105] According to evolutionary theory, man diverged from gorillas seven million years ago. During this time, only a single neutral mutation has appeared to differentiate the alpha-hemoglobin chain of the human from that of the gorilla.[106] If there had been one million generations of humans and gorillas since the divergence, then the probability is 1 in 1 000 000 per generation that an error would cause a change of any particular amino acid in the alpha-hemoglobin chain.[107] However, Hoyle and Wickramasinghe then state that in the case of the alpha-chain there are twenty to thirty possible neutral mutations. This would make the chance of a DNA copying error twenty to thirty times smaller than that calculated above, thus making the chance twenty to thirty million per generation.[108] This mutation rate is very slow. According to their calculations, an incorrect amino acid will be substituted on the DNA molecule in every twenty to thirty million generations. Gorillas and humans differ from one another far more than by one amino acid. As stated, even this difference is a neutral one, a mutation that is neither beneficial nor detrimental to the organism. If it takes twenty to thirty million generations for an amino acid substitution, then it would take many more million generations for the massive mutations required to produce man from a gorilla. Even if the primordial soup hypothesis were able to overcome the above objections concerning self-replicating patterns and Natural Selection, it must demonstrate that the mutation rate of the evolving organisms was high and that the population of organisms was able to survive under this high degree of mutation. Hoyle and Wickramasinghe's calculations are designed to show that the rate of mutation for the past seven million years is actually quite slow.

Morris asserts that the mathematical problem inherent in mutations has to do with related mutations. He calculates the odds of getting two mutations that are related to one another as 10^{14}, or the product of their separate probabilities.[109] As Morris asserts, two mutations might result in a fly with a wavy edge on its bent wing, a far cry from a new structure or reproducing organism! The odds of getting three mutations in a row is 10^{21}, which makes the event almost impossible, regardless of the fact that it would probably only result in a fly with a strange wing.[110] It would take many more mutations to result in a different structure, and even more mutations to result in a new species. If we accept Hoyle and Wickramasinghe's calculations, then DNA copying errors only occur at a rate of 1 in 20 000 000 generations.[111] So it would take twenty million generations of housefly for one mutation to occur, without even considering Morris' calculations that the chance of getting two related mutations to occur after one another is 1 in 10^{14}. The assertion that mutations are the explanation for the divergence of organisms is highly improbable even if life had an infinite amount of time to evolve further.

As mentioned, the question of time is a major inhibitory factor to the primordial soup hypothesis. Those who would assert the hypothesis cannot assume that time is infinite and that they have an eternity in which to perform all of the trials needed to spontaneously generate life via chance. The age of the earth is estimated by modern science at 1.5 x

10^{10} years.[112*] If Yockey's calculations concerning the spontaneous generation of a protein are correct, then evolution would only just be beginning.[113]

The fact that the primordial soup hypothesis, despite its problems, is accepted and presumed by the scientific community leads me to believe that the probabilities have been deemed to be unimportant. Perhaps the scientific community believes that the mere fact that a single possibility exists whereby life might have originated by chance is enough to warrant affirming the hypothesis. As Yockey wrote, for those with faith in the hypothesis, the small probabilities are not discouraging.[114] Yet it is within this assertion of faith over data that I find an inconsistency. If I am to call myself a "scientist" and by that mean that I appeal to empirical, reproducible data over all other kinds of data, then I must behave in accordance with this affirmation. By this I mean that I cannot call myself an empiricist, and then abandon empiricism when the empirical data (which is in this case probability), does not support my presupposition. The true believers in the primordial soup hypothesis must recognize that they are affirming the hypothesis through faith because the empirical data shows that the spontaneous generation of life by chance is statistically impossible. Having recognized this, the true believer must then not make inconsistent assertions such that his view is scientific because the true empiricist would follow the data, and conclude that the evidence for the primordial soup with respect to probability is insufficient. Science should prove that the spontaneous generation of life is not only possible (by extremely remote odds), but that it is probable as well. Those like Dickerson, Fox, and Orgel who assert that the primordial soup hypothesis must be affirmed because there are no other alternative origin theories are manifesting the logical fallacy of the false alternative, which is sometimes referred to as the fallacy of false dichotomy.[115] An inadequate hypothesis should not be endorsed simply because no alternate hypothesis exists. Scientists must pursue knowledge in the face of ignorance. In failing to do this, scientists fail to be true scientists.

A further argument against the affirmation of the primordial soup hypothesis in the face of statistical impossibility is my previous argument regarding language and information theory. The primordial soup hypothesis cannot satisfactorily explain the origin of the specified complexity of the genetic code. The hypothesis appeals to the evolution of a code through different patterns. This assertion contradicts one of the basic principles of information theory which states that a pattern cannot be dependent upon a previous pattern without resulting in an infinite regress of patterns. Not only is the primordial soup hypothesis statistically impossible, it is insufficient and unsatisfactory in that it cannot explain the origin of the specified complexity of the genetic code.

It has been estimated that the protobiont would have to have contained sufficient DNA to code for about one hundred average sized proteins.[116] As part of the primordial soup hypothesis, it is postulated that a series of simple cells led gradually from the organic compounds of the soup to the more complex protobiont, the protobiont then gave rise to other living cells. Accordingly, Denton asserts the following: "The only possible precursor to the existing cell system with its wonderfully efficient translational apparatus would be one that was less perfect."[117] Denton's objection is that the protobiont would be very primitive in its structure and that its apparatus for replication would also be very primitive and consequently very inaccurate. As suggested above, the mutation rate of the primitive systems would be extremely high until Natural Selection removed the deleterious mutations from the population, and succeeded in evolving a protein-based repair mechanism in the replicating structure. Although this admission "opens the door" to the possibility of an abnormally high initial rate of mutation, it is an inadequate starting point for replication and genetic variability. A proto-cell system, which would in essence be evolution's "first try" at replication, would necessarily be far more prone to making translational errors when synthesizing proteins than our modern apparatus.[118] This means that the chances of a primitive error-prone translational system manufacturing "statistical proteins" and successfully producing functional enzymes would be next to nil.[119] Even if the system could somehow manufacture a "statistical protein," it could not maintain it for any length of time before the same "errors" which produced it eventually destroyed it. Similar to our argument concerning mutation rates in an inbreeding population, Denton argues, "That an error-prone translational system would lead inevitably to self-destruction is not only a theoretical prediction but also a well-established empirical observation."[120]

SELF-REPLICATING PROTEINS AND NUCLEIC ACID-PROTEINS

The primordial soup hypothesis has difficulty citing experiments that show how the transition from self-replicating proteins to a nucleic acid-protein system was made.[121] The question of how a system of proteins developed toward life without the presence of nucleic acids was examined by Leslie Orgel in 1968. Orgel discovered that the difficulty encountered by the proteins was in the process of replication, which requires new enzymes.[122] Each enzyme in itself would represent a further series of enzymes. Orgel discovered that it was highly questionable that a self-replicating unit could lack such elements and exist and then evolve. Orgel further examined the possibility of unit-by-unit replication of polypeptides, or complementary replication, and considered this unfeasible. Orgel then suggested a primitive system such that the polynucleotides would affect the chemicals in their environment toward the development of metabolism. However, as shown by Kai, this suggestion does not have any demonstrable evidence to lend credence to it.[123] If further research in this area were to yield evidence that would substantiate Orgel's suggestion, then of course that evidence would have to be studied and discussed. At this point in time, however, there is no evidence, and Orgel's suggestion remains simply a suggestion.

MILLER'S EXPERIMENT AND AMINO ACID YIELDS

Stanley Miller's experiments have been cited for decades as substantiating the primordial soup hypothesis. However, Richard Dickerson's discussion of Miller-type experiments includes the assertion that although the experiments yield many of the amino acids found in the proteins of living organisms, they also yield as many related molecules which are not present.[124] As cited by Dickerson, three isomeric forms of the amino acid $C_3H_7NO_2$ are synthesized, yet only one form, alanine, is incorporated in the proteins of living organisms. Seven isomers with the formula $C_4H_9NO_2$ are synthesized by Miller-type experiments, none of which are protein constituents.[125] From these results, Dickerson concludes that the twenty amino acids chosen to exist in the genetic code were not "foreordained by the availability of a particular set of molecules on the primitive earth."[126] However, Dickerson is unable to explain how the amino acids of the genetic code were foreordained and by what or by whom.[127]

Although Dickerson admits that the reactions do not produce the desired conformation, he still affirms the primordial soup hypothesis. He is in good company with his affirmation, as the primordial soup hypothesis remains the most popular origin theory to date. I would argue that although the hypothesis is a popular one, its popularity does not necessitate its validity. History has shown us that popular hypotheses have often been disproved, despite their popularity. For some time geneticists believed that AIDS was a rare form of cancer, found only in homosexual males. Since the discovery of HIV, scientists now know that AIDS is caused by the HIV virus and that it may be contracted by men, women and children regardless of their sexual orientation. Further research showed that the popular hypothesis concerning the "rare, homosexual cancer" was in actuality completely false. Thus, I assert that the popularity of the primordial soup hypothesis in no way necessitates its validity.

THE CHIRALITY OF SYNTHESIZED AMINO ACIDS

The primordial soup hypothesis cannot account for the chirality of the amino acids occurring in the genetic code, or for the chirality of the sugars which compose the DNA molecule. It is universally acknowledged that laboratory simulations of pre-biological reactions give rise to equal numbers of both D- and L-isomers of amino acids.[128] However, all living organisms consist of only L-amino acids. Similarly, the sugars which compose the DNA molecule are all D-isomers, while laboratory reactions only produce sugars composed of fifty percent D-isomers and fifty percent L-isomers. There appears to be no process in nature for the production of one-hundred percent D-isomers.[129] Many attempts have been made to explain the chirality of the amino acids in synthesized reactions. The most popular solution to the question of chirality is the primordial soup hypothesis which asserts that the DNA molecule favoured D-isomers via chance.[130] This assertion contradicts the basic assumptions of Natural Selection, which state that only systems and organisms with beneficial modifications are selected. If there is no benefit to choosing D-isomers over L-isomers then Natural Selection cannot be credited with this decision. Furthermore, the fact that naturally occurring amino acids are of one isomer, and synthesized amino acids are chiral suggests that there is some process involved in nature of which science knows nothing at the present time. Further research might uncover that natural process, but to date, the process is unknown and it is inadequate to label chance as the author of the decision between isomers. Orgel, himself, suggests that "there could be no structural reason for selecting living organisms of one type of 'handedness' rather than those of the other."[131] Orgel also affirms that there is no convincing argument as to why all amino acids in proteins have the same configuration, or why living organisms favour L-isomers while laboratory experiments give rise to equal number of both D- and L-isomers.[132]

Sidney Fox asserts that optical activity evolved at a later stage of molecular evolution.[133] However, he cannot explain how or why this evolution was accomplished. At the present time, no one has been able to adequately explain the evolution of optical activity.[134] Kai asserts that the use of one specific configuration rather than a racemic mixture "confers a greater advantage for the production of more and highly specific genetic information."[135] As evidence, he cites experiments showing that the D- or L-isomers generally propagate faster and become more stable than a mixture of D- and L-isomers.[136] Consequently, he asserts that the chirality of the isomers is simply a product of Natural Selection.[137] However, Kai is unable to explain how all of the D-isomers in existence since the primordial soup were destroyed, since there is no deleterious consequence to having a D-isomer in a compound's structure. It is admitted that it has been shown that there is a benefit to having a single isomer in the amino acid, but he needs to go further in his suggestion and show how genetically such a decision was made, and why genetically the D-isomer was selected. To assert Natural Selection as the solution to the question of the monomeric nature of amino acids is insufficient. Kai needs to show how this selection was accomplished.

POLYMERIZATION IN THE PRIMORDIAL SOUP

The primordial soup hypothesis asserts that amino acids formed proteins in the warm "puddles" on the earth's surface. Thaxton, Bradley, and Olsen, in their work The Mystery of Life's Origin: Reassessing Current Theories, flatly deny the possibility of such a formation under equilibrium conditions.[138] In other words, amino acids existing in the primordial soup or any other location cannot polymerize to form proteins without the input of energy from an external source. Should amino acids have arisen in the primordial soup from the existing chemicals (whose source has still not been satisfactorily explained by the hypothesis[139]), they would be unable to form proteins without the input of energy.

In affirming the primordial soup hypothesis, one must posit that at the origin of life there existed a prebiotic aqueous environment in which chemicals capable of forming amino acids resided. A spontaneous burst of energy from an external source was suddenly added, and the amino acids began to form proteins. (It must here be remembered that proteins are still not living, functioning cells.)

Dickerson also cites a problem with these reactions under pre-biotic conditions. He admits the difficulty in explaining how polymers were formed through reactions which are known to require both the input of energy and the removal of water, and how such reactions could have occurred within the primordial soup.[140] A further problem with the reaction occurs if the reactants and products are present in similar concentrations, as the reverse reaction occurs spontaneously, while the desired reaction requires the input of free energy.[141] As investigated by Dickerson, there are two different ways that the desired reaction could be fuelled. One way would be to concentrate the reactants and remove water from the products, or to couple the process to an energy-releasing reaction which will provide free energy. In today's organisms, enzymes assist in reactions by releasing energy. However, in the primordial soup enzymes would not have existed yet. Thus, "coupling agents" would have had to be used. These coupling agents are organic compounds such as cyanogen (NC_2N), cyanamide ($NCNH_2$), and cyanoacetylene (NC_3H). Yet, these coupling agents, under prebiotic conditions, would have to have been prevented from combining directly with the surrounding water molecules and thus "short-circuiting" the desired reaction. Coupling agents have brought about the desired reaction in laboratory conditions, while dissolved in non-aqueous solvents.[142] This is an important point. Clearly the definition of the primordial soup rules out coupling agents as providing energy for the polymerization reactions as they require solution in a non-aqueous solvent, and "short-circuit" in an aqueous environment. If coupling agents would not have worked, and enzymes would not have existed in the primordial soup at that time, there would have been no adequate energy source available.

THE PREBIOTIC ATMOSPHERE

A further problem with the primordial soup hypothesis is the fact that the early earth's atmosphere was hypothesized by Harold Urey and others to have contained a lot of hydrogen, approximately 10^{-3} atmosphere.[143] Modern assessments indicate that the atmosphere contained more oxygen than hydrogen.[144] Theses assessments have been derived from both geological and astronomical research. Analyses of ancient rocks show that they contain iron oxide, which is evidence that oxygen was present in the prebiotic atmosphere.[145] Further evidence for oxygen in the prebiotic earth's atmosphere is the process of photolysis. By this process, the light of the sun reacts with water in the atmosphere to produce hydrogen and oxygen.[146] Since it is reasonable to assume that since the first ray of sunlight hit the water on the earth photolysis has been occurring, the amount of oxygen in the atmosphere would be incredible.

The content of the primordial atmosphere is important because of the fact that organic compounds are difficult to synthesize in the presence of oxygen. Oxygen will oxidize fragile compounds such as sugars and proteins and break them down into their constituents.[147] Fox discusses experiments performed by Heyns, Walter and Meyer in which amino acids could were produced from a mixture of ammonia, water vapour, and oxygen only after the oxygen had been exhausted. No amino acids are produced if the surrounding atmosphere contains free oxygen or if the atmosphere contains CO_2, N_2, and H_2O.[148] Thus, the formation of amino acids out of the primordial soup would have been severely limited by the presence of oxygen in the atmosphere. Oxygen was not viewed as a limiting factor by Miller, as he hypothesized that the prebiotic atmosphere contained a lot of hydrogen.[149] This is a further example of how science has progressed since Miller first performed his now-famous experiments..

If the prebiotic earth's atmosphere had had low or no levels of oxygen, there would be further limiting factors to the polymerization reactions of the primordial soup. Without oxygen, there can be no ozone. The ozone layer above the earth protects life forms from ultraviolet radiation.[150] If the ozone layer had not been in place, then the ultraviolet rays reaching the earth would have been more than sufficient to break down organic compounds just as quickly as they were produced.[151] Ultraviolet radiation not only causes organic compounds to break down, it causes thymine dimers within the genetic code, which result in mutations. The ravages of skin cancer are the effect of ultraviolet radiation. Primordial organisms would have been extremely susceptible to mutation in their evolutionary state by virtue of their primitiveness. Ultraviolet radiation would increase the rate of mutation, as well as destroying the organic compounds that composed them. An example of ultraviolet radiation is seen on Mars. The absence of organic compounds in the Martian soil has been widely attributed to the strong ultraviolet radiation that is continuously bombarding the situation.[152] The Martian atmosphere has been found to be an oxidizing atmosphere, yet Mars is entirely void of life.[153] This fact alone shows that it is highly unlikely that the primitive earth could have had an oxidizing atmosphere and yet spontaneously produced life.

In summary then, if the atmosphere contained a lot of oxygen then the polymerization reactions of the primordial soup would be impossible. Yet, if the atmosphere was devoid of oxygen or contained low levels of oxygen then the organic compounds of the primitive organisms would be destroyed, and the mutation rate would be increased. The primordial soup hypothesis, in suggesting that the prebiotic atmosphere contained large amounts of oxygen, neglects the fact that polymerization reactions are severely limited by the presence of oxygen. Furthermore, the primordial soup hypothesis cannot affirm that the prebiotic atmosphere contained little or no oxygen because such an affirmation would conflict with what we now know about ultraviolet radiation and its harmful effects on living systems. For the primordial soup hypothesis to circumvent these objections, it would have to undergo many ad hoc modifications to accommodate the evidence concerning the oxygen levels of the prebiotic atmosphere.

CHAPTER 4

CONCLUSION

The primordial soup hypothesis is inadequate because it cannot adequately explain the origin of the specified complexity and information content of the genetic code. The primordial soup hypothesis suggests that Natural Selection and chance authored the chemical and physical changes that occurred in the proto-cell in order that it might replicate through some primitive sort of replication. However, the hypothesis is unable to directly explain the origin of the code's specified complexity. The hypothesis suggests that Natural Selection authored the genetic code, and I have already shown this assertion to be self-contradictory as Natural Selection presupposes self-replicating systems. This assertion also begs the question: what is the source of the specified complexity of the genetic code? The hypothesis cannot explain the origin of the self-replicating systems without further appeal to Natural Selection and to chance. Again, Natural Selection could not have caused a self-replicating system because it presupposes self-replicating systems by definition. At present, the only known author of a self-replicating system is a self-replicating system. Further, the genetic code exhibits specified complexity which ensures its definition as a language. Information theory asserts that a new pattern of information cannot be made from another, different pattern because this results in an infinite regress of patterns. The origin of a pattern is from a self-replicating system. As shown above, the primordial soup hypothesis cannot explain the existence of self-replicating systems.

Universal experience shows us that specified complexity is always the result of a mind. Information theorists have concluded that intelligence is a necessity in the origin of any informational code (which must manifest specified complexity by definition).[154] All examples of specified complexity on earth, barring that of the genetic code, are the result of a mind. Informational codes are constructed of vocabulary and grammar, both of which are necessarily produced by intelligence.[155] The genetic code is an informational code. It consists of structural genes which function as words and regulatory mechanisms which function as rules of grammar.[156] The primordial soup hypothesis, as a scientific examination of the question of the origin of specified complexity is utterly inadequate. An alternative hypothesis to the primordial soup would then be one that adequately explains the origin of the specified complexity of the genetic code in keeping with information theory and universal experience. This alternative hypothesis is essentially that the specified complexity of the genetic code is the result of a mind.[157]

The primordial soup hypothesis has many different flaws, including its inadequacy in explaining the origin of the specified complexity of the genetic code. The hypothesis is also inadequate as it asserts that chance gave rise to the information content of the protobiont. The work of Hubert Yockey has shown this assertion to be statistically impossible. Sir Fred Hoyle and Chandra Wickramasinghe calculated the probability of a hypothetical single gene of ten amino acids in length appearing by chance to be 1 in 20^9 trials, which is also statistically impossible.[158]

The primordial soup cannot explain the generation of a single enzyme, except through positing chance. Again, Hoyle and Wickramasinghe show that it is statistically impossible to obtain a required enzyme in functioning form, and that it is even more impossible to obtain all of the two thousand existing enzymes by chance.[159]

Mutations have been cited by evolutionists for decades as the source of genetic variation in the living system. However, a self-replicating system must first exist in order for the mutation to take effect. The primordial soup is unable to adequately account for the origin of self-replicating systems, thus the affirmation of mutations is further discredited.

The protobiont could not have arisen from the primordial soup. Michael Denton, a medical doctor, reminded his colleagues in the scientific community that a proto-cell system would undoubtedly be prone to make translational errors when synthesizing proteins. These proteins would undoubtedly die before they could reproduce.[160] Denton calculated that at least one hundred functional proteins would be required in one place in order to get a cell by chance. The probability of that occurring would be 1 in 10^{-2000}.[161] Not only is this event highly improbable, it presupposes the existence of one hundred functional proteins, each of which would have had to have been spontaneously generated prior to collection at the prescribed location. Yockey's calculation of the spontaneous generation of an iso-1-cytochrome c protein is 1 in 1.5×10^{44} trials.[162] One can see that the chance of getting a protein is astronomical enough to reject the primordial soup hypothesis, without taking into account the incredible probability of the proteins aggregating in order to form a primitive cell.

Experiments analogous to those performed by Stanley Miller in the 1950's show that only certain amino acid isomers are formed from organic compounds. Some of these isomers are found in the protein constituents of the universal genetic code, and some of them are not.[163] Thus, the primordial soup hypothesis cannot clearly explain how the current isomers in the genetic code were formed, as the experiments used in order to determine the hypothesis show the hypothesis to be invalid.

A further criticism of the hypothesis involves the chirality of the amino acids found in living organisms. Only L-isomers are found in living organisms, while laboratory experiments always give rise to an equal number of both D- and L-isomers. The primordial soup hypothesis cannot explain how the reactions occurred under prebiotic conditions such that only L-isomers were formed. The hypothesis suggests that there is a benefit in having only one optical isomer of amino acid found in living organisms, which would be an increase in the speed of assembly rates of proteins. Such an advantage would be important in the primordial soup as it is hypothesized that the primitive replicating cells replicated at a very slow rate. However, the primordial soup hypothesis cannot explain the mechanism of selecting one optical isomer over the other, and how such was done.

Furthermore, it cannot explain the qualitative difference between L-isomers and D-isomers which would cause the mechanism to choose one over the other. In this respect, Natural Selection cannot be cited as having made the choice between the two because the specific evolutionary benefit of the L-isomer over the D-isomer has yet to be explained.

Several further chemical and biological objections have been made against the primordial soup hypothesis, in addition to the ones discussed above. As described by Dickerson, the reactions hypothesized to have formed polymers in the primordial soup require both the input of energy and the removal of water. It is difficult to understand how such reactions could have occurred in an aqueous environment.[164] Sidney Fox has suggested that the polymerization reactions occurred while an aqueous solution of amino acids and hydroxy acids fell upon hot rock.[165] However, Fox can only experimentally demonstrate that the amino acids polymerized to large molecules, he cannot account for any self-replicating structures. Fox, himself, admits that his hypothesis does not have enough data to warrant a conclusive discussion.[166]

It has also been shown that the polymerization reaction requires energy to occur, whilst the reverse reaction occurs spontaneously.[167] The primordial soup hypothesis must suggest a source for this energy other than enzymes, which would not have existed at this point in the evolutionary change. If the scientist suggests ultraviolet light as the energy source, then he must suggest how it is that the long-wavelength (i.e., >2 000 Angstrom)[168] ultraviolet light did not destroy the organic compounds. Long-wavelength ultraviolet light is destructive to both organic compounds, and to amino acids.[169] Long-wavelength ultraviolet light is more intense than the short-wavelength (i.e., <2 000 Angstrom) ultraviolet light which is used in synthesis.[170] The scientist must explain how this destruction was circumvented. If the scientist suggests coupling agents such as cyanogen as the source of energy, then he must explain how cyanogen could be prevented from combining directly with the water molecules, thus "short-circuiting" the reaction.[171]

A further chemical objection to the primordial soup hypothesis is related to the atmosphere. If the atmosphere surrounding the warm, aqueous pre-biotic environment was primarily made of hydrogen, as Miller hypothesized, then the organic molecules might have combined to form organic compounds, though in themselves a far cry from self-replicating structures.[172] However, the atmosphere of the early earth has been shown to have contained large amounts of oxygen, which would seriously inhibit the primary stages of the origin of organic compounds.[173]

In contrast to the primordial soup hypothesis, the positing of an intelligent cause can adequately explain the origin of the specified complexity and information content of the genetic code. As explained above, an adequate origin theory must address the origin of the specified complexity of the genetic code, as well as the origin of self-replicating structures. Norman Geisler, in his work Origin Science, describes the alternative scenario to that of the primordial soup. Geisler states that the positing of a primary intelligent cause accounts for the generation of the information stored in the cells of all living organisms.[174] Geisler agrees with Moreland that the source of the information found in genes and proteins must be an intelligent source. This intelligence would obviously preclude mindless Natural Selection or evolution from being the source of complex information.

Geisler also cites the existence of specified complexity as necessitating a primary intelligent cause.[175] In corroboration, Geisler cites William Paley: ". . . wherever we see marks of contrivance, we are led for its cause to an intelligent author. And this transition of the understanding is founded upon uniform experience."[176]

In light of information theory and molecular biology, Geisler and Winfried Corduan sought to restate Paley's argument in the following manner:

1. Living cells are characterized by their specified complexity.
   a. Crystals are specified but not complex.
   b. Random polymers are complex but not specified.
   c. Living cells are both specified and complex.

2. A written language has specified complexity.
   a. A single word repeated over and over is specified.
   b. A long series of random letters has complexity.
   c. A sentence has specified complexity.

3. Uniform experience informs us that only intelligence is capable of regularly producing specified complexity.

4. Therefore, it is reasonable to assume that living organisms were produced by intelligence.[177]

Geisler and Corduan's form of the teleological argument summarizes the aspects of information theory that we have examined with respect to the primordial soup hypothesis. It is the writer's opinion that his articulation is the most cogent statement of the argument with respect to DNA information theory. Geisler and Corduan's position is essentially that as a primary cause of specified complexity must also have existed in the past. In order to refute his argument, one would need to show an alternate hypothesis as to the origin of specified complexity and the DNA molecule to be valid. The hypothesis usually cited by evolutionary biologists as accomplishing this end is the primordial soup hypothesis, which has been shown by the writer to be statistically impossible and seriously flawed. The primordial soup hypothesis cannot explain the origin of the specified complexity of the genetic code or the origin of self-replicating structures. Geisler's primary-cause creation scenario addresses both of these questions, without begging the question or spiralling into vicious circular reasoning.

Naturalists would object to Geisler and Corduan's argument by posing the "god-of-the-gaps" objection. This objection argues that theists seek to make sense out of anomalies and/or the failings of naturalistic theories by citing God as the source of the anomaly. However they phrase their argument, the "god-of-the-gaps" objection fails when levied against Geisler and Corduan's position as delineated above. Geisler and Corduan are not arguing for the existence of the God of theism. They are not even arguing for a god.

They are arguing for a possible, probable origin theory that is able to explain the existence of the specified complexity of the genetic code. The closest they come to the idea of God in their conclusion is intelligence, nothing further. The gaps objection also fails in that it does not attack the validity of the premises of the argument, it simply questions the conclusion. In logic it is immaterial if a group of individuals do not like the conclusion of an argument because of its personal repercussions, the argument must be disproved via the falsity of its claims. The gaps objection does not even attempt to do this.

Furthermore, God is not simply being postulated as "filling a gap." The presence of specified complexity in an informational code denotes that intelligence "put it there." There is no leap from specified complexity to God. Intelligence is required by the available data of information theory.

Geisler and Corduan's formulation of the teleological argument as it relates to information theory is in keeping with their aspiration to outline a strong case for the plausibility of intelligent creation. The positing of a first-cause explains the origin of the specified complexity of the genetic code and the origin of self-replicating structures. It overcomes the statistical improbability which renders inadequate the primordial soup hypothesis. The input of reaction energies, and the chirality of amino acids can both be explained by the positing of a first-cause. The primordial soup hypothesis in no way accounts for the intelligence suggested by the biological information encoded in DNA. While Geisler and Corduan point to the God of theism as the author of specified complexity, the evolutionist points to the god called "Chance."

The scientific implications of the positing of a first-cause would most likely be a strong conflict with the ingrained empirical and anti-metaphysical nature of the discipline. Decisions must be based on observed data. If the best empirical hypothesis concerning the origin of life is the primordial soup hypothesis, then those who affirm it are violating their own empirical commitment. The primordial soup hypothesis has been shown to be statistically impossible. To ignore the statistics of probability and to affirm the hypothesis in the face of these statistics and further observed data is clearly anti-empirical. The very nature and structure of the genetic code in the DNA molecule and its marvellous design certainly provide the starting point for the development of an origin hypothesis. The positing of an intelligent cause can adequately explain the design of DNA while not falling prey to the improbable nature of chance. Although scientists cannot hope to reproduce a first-cause in a laboratory, they cannot reproduce all of the steps entailed by the primordial soup hypothesis, either. They must then examine the probabilities and the data in order to determine which hypothesis is more probable. The observed data requires intelligence. Scientists may not conclude that this intelligence is God, but they can recognize the synonym for intelligence. The positing of a first-cause adequately addresses the observed data with respect to the question of origins while the primordial soup hypothesis inadequately addresses that self-same data. The data of information theory <u>requires</u> intelligence, therefore I cannot be accused of committing the logical fallacy of the false alternative. I am not affirming the first cause hypothesis because there are no viable alternative hypotheses, I am affirming the hypothesis because it is in keeping with the data available. Therefore, I conclude that the positing of a first-cause <u>must</u> be affirmed over the primordial soup hypothesis.

The philosophical implications of the positing of a first-cause extend to the question of life's meaning (if any), and the repercussions any such meaning would have on life's value. If life was created by a first-cause, then it is much more precious than life that arose by chance. Life that arose by chance cannot claim any ultimate plan or goal save that of survival and higher evolution. Man is the highest of all organisms, but there is nothing truly remarkable about his existence. Natural Selection eliminates the weak and the deformed. In the evolutionary paradigm, the physically and mentally handicapped must be viewed as liabilities to the genetic community. In order to escape this distasteful and intolerant assertion, the evolutionist must argue that Man has evolved either compassion for the physically and mentally handicapped or a role for the handicapped to play in our modern societies. However, such a reason can only be traced back to chance, and purpose cannot result from chance, as order cannot result from chaos.

If the genetic code is resultant from intelligence, then life is the product of a mind, of a cosmic designer. In the creation paradigm, the Mind provides life and the ultimate plan and goal of that life. The relationship between the Mind and man (if such is possible), will of necessity be of great importance. Man will wish to know more of the Mind which created him, and the Mind will undoubtedly have reasons for creating man.

In conclusion, the primordial soup hypothesis, as an origin scenario, has not been adequately demonstrated as more than barely possible. Many different portions of the hypothesis have been shown to be problematic, and those who would affirm the hypothesis have yet to adequately answer the objections or to modify the hypothesis in order to satisfy said objections. In light of the data, the primordial soup hypothesis must be rejected as it cannot offer a plausible, probable solution to the question of the origin of life. The positing of a first-cause as an alternative to the primordial soup hypothesis has been suggested, and it has been shown to satisfy the objections levied against the primordial soup hypothesis.

The writer would therefore conclude that information theory in relation to the teleological argument provides a compelling piece in the puzzle to determine the origin of life. This teleological scenario cannot be comprehensively addressed in this limited thesis but the topic is pursued elsewhere and by other researchers. When coupled with the objections to the primordial soup hypothesis, Geisler's teleological argument shows that the positing of an intelligent cause is a far more probable origin scenario than the primordial soup hypothesis, which is its desired objective.

Endnotes

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[60]Orgel, 189, 191.

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[105]Ibid.

[106]Ibid.

[107]Ibid.

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[110]Ibid.

[111]Hoyle and Wickramasinghe, 18.

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*Recent evidence gathered from space exploration suggests that the earth is only one-half this age. If this new evidence is conclusive, it will only serve to strengthen my argument, as the time for the probabilities to occur will be diminished by one-half.

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