Chapter 2
Preamble to Life

The conditions that were necessary for life to begin on earth are reviewed; primarily these were the prerequisite chemicals and prerequisite processes for the origin of First Cell. Once arisen, it could grow, divide, and its descendants could evolve. Although the combination of events that actually started life is only dimly understood, it is evident that a simultaneous coalition of mechanisms had to function simultaneously and in the same place for life to be “kicked-started”. In an abiotic world these must have included the numerous and fruitless formation of “informational” macromolecules that could not carry out needed functional processes because of lack of support, but eventually there must have been a way to utilize these informational molecules to construct others. These would actually function as catalysts and probably were ribozymes, which are molecules that are almost enzymes. These could alter available small molecules and form macromolecules and do fruitful work. The third absolute requirement is the existence of a capability of transducing energy into a utilizable form that flexibly could enable (favor) the synthesis of small molecules and macromolecules and carry out other energy-requiring cellular processes. But useable energy alone would initially lead to nothing productive. The life-generating event had to do with the simultaneous existence of these three particular processes within a single lipid vesicle. Of course, it also required the availability of sufficient and appropriate chemicals from the environment. These essential processes and organic resources could spontaneously produce molecules that would catalyze the creation of more “cells” and then bigger and more sophisticated molecules. This continuing replication and continuing evolution eventually led to diversity and the massive world biomass on the assumption that new structures and mechanisms continued to evolve.

THE ABIOTIC WORLD

In the beginning there was a “big bang” resulting in an expanding and cooling universe. As the material became more spread out in the resulting cooler milieu, aggregates of various kinds formed. The spreading was not uniform, however, because of the effects of gravity. In many parts and regions of the
universe, concentrations of materials were higher. In these places high density developed as stars formed and went through their cycles. Nuclear reactions took place, and when the stars finally collapsed, some of the resultant materials were cool enough to become stable small atoms. Then the process repeated itself and the next star generation led to some still larger atoms. Finally, in the third generation of stars there was a sufficient quantity of large enough atoms so that the kind of life we currently experience on earth became possible. As a time line, our universe came into existence 13.7 billion years ago and our sun (Sol, a third generation star) appeared 4.5 billion years ago, as did everything in our solar system, including the earth. While the sun is too hot, the remainder of the solar system is cool enough to be able to coalesce into solids and molecules. The rest of the solar system includes interstellar space, planets, various comets, asteroids and planetoids. Organic molecules were made in various ways in various locations; they arose partly under the aegis of cosmic ray energy and ultraviolet light. These agents make and destroy organic molecules. However, some persisted, and some that fell to earth were probably important as resources for early life. These organic molecules were in addition to those produced on earth (see below).

Four and a half billion years ago, as the planet earth was formed, it was too hot for life. A barrage of meteorites bombarded it. If there had been any living thing to sterilize, these impacts would have killed them. There was no liquid water. It is thought that the intensity of meteorite bombardment decreased about 4.2 billion years ago. At this time surface water and oceans developed, and a variety of more stable organic chemical syntheses began to occur.

**RESOURCES AVAILABLE FOR LIFE**

The earth, as part of a third generation star, had adequate amounts of atoms of a reasonable size. Obviously, H, C, O, N were the key elements, but P, S are also vital. Then there are heavier elements such as Mg and especially Fe that also have a vital role. Getting all of them to form the appropriate compounds is not trivial and does require energy.

Light energy from the vacuum ultraviolet to the infrared would have been available in abundance, but other than for generating heat it would have been useless for a living creature with no ability for photosynthesis, and it would actually have been quite dangerous. When the earth cooled down sufficiently, there would have been liquid water, oceans, and rivers. There would have been organic compounds, vesicles, and reactants in the environment that had not yet reacted with each other, and there would have been atmospheric disturbances. The formation of vesicles would have depended on continual mixing by cosmic...