

Sugars. Theoretically, it is not difficult to account for the synthesis of sugars under prebiotic (pre-biological life) conditions. The raw material (formaldehyde) is thought to have been present, and the chemical process is relatively simple. Balancing the national budget is also very simple in theory. The problem is achieving this balanced budget in the "real" world. The same holds true for the synthesis of sugar under prebiotic conditions. Sugars are very unstable and chemically reactive substances especially in an aqueous (watery) solution. To date, no sugars have been recovered in the laboratory under the requisite prebiotic conditions.

Organic Bases. Some of the organic bases have been produced under prebiotic (prelife) laboratory conditions. *Adenine* is the best-known example, and it is remarkably stable and resistant to destruction. Other bases have not, to my knowledge, been successfully synthesized in the laboratory. Well-known examples are the *pyrimidine* bases: *thymine*, *uracil*, and *cytosine*. Their chemical structure differs in that pyrimidine bases have a six-sided ring with nitrogen at the 1 and 3 positions.

Before completing the discussion of the formation of monomers (the molecular sub-units of life), it may be well to summarize what has been accomplished in the laboratory under prebiotic conditions. Some of the amino acids needed for proteins have been synthesized. Some of the organic bases needed for nucleic acid have been synthesized; others have not. Sugars have not been synthesized in the laboratory under what are thought to be prebiotic conditions.

This indicates that more than 30% and maybe up to 40% of the non-living sub-units for life have demonstrably been synthesized by "natural" processes in the laboratory. But there is no such thing as a potential 40% life. Matter is either 100% alive or it is not alive. And we are not yet talking about life; we are talking about non-living organic molecules that make up the building blocks of life. But let us assume for now that all the organic molecules have been brought into existence. Let us further assume that some presently unknown force is selecting only those relatively few organic molecules known to be useful in constructing living systems. Now the truly difficult part begins.

Stage 4. Polymers -- polypeptides and polynucleotides. The first problem with bringing about the formation of polypeptides (chains of amino acids) and polynucleotides (chains of organic bases and sugars) is in forging this linkage. A water molecule must be driven