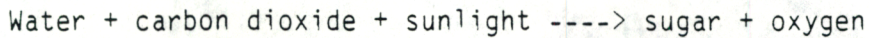


MAKING SUGAR FROM CARBON DIOXIDE:
THE BASIS FOR ALL FOOD CHAINS

by Louise Wootton

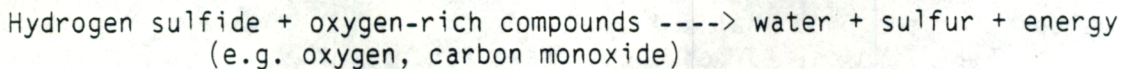
Most of us are familiar with the idea that plants are able to build sugars from carbon dioxide using energy collected from sunlight. This reaction is described by the equation:



The sugar produced is converted into the different compounds needed for growth, such as protein and fats. Animals, which are unable to collect the energy of the sun, must then eat the materials made by these plants in order to survive. For many years everybody, including scientists, believed that all life on earth was dependant upon plants and their ability to harvest the energy of the sun.

In the early 1970's an exciting discovery caused to rethink this evaluation. In 1977 geologists and biologists were exploring the area at the bottom of the sea in which new ocean crust is being made. Instead of the usual sparse animal populations found on most of the deep ocean floor, scientists found a very high number of animals at these "mid-ocean ridges" - many to many to be surviving on the meager amounts sinking to these depths from the surface. There must therefore be another source of food for these animals... one not dependant upon the presence of light. Quickly scientists realized that in these "vents", animals were utilizing the chemical energy available in these unusual environments in order to convert carbon dioxide to sugar.

At these "mid-ocean ridges" seawater is heated by close contact with the underlying molten rock. This water can reach temperatures above 300 degrees C. without boiling because the pressure of the overlying water is about 150 times that of our atmosphere. Water this hot is able to dissolve many chemicals from the rocks through which it passes. When this water reaches the surface of the rocks and exits into the cold water (4 degrees C.) of the sea bottom, it cools quickly. Many chemicals, such as the iron and manganese turn back into solids, building "chimney" like structures around the exiting water. However, some chemicals, such as hydrogen sulfide, stay in solution. Hydrogen sulfide is a substance that contains a great deal of chemical energy which can be liberated by reactions with compounds such as oxygen or carbon dioxide according to the pattern:



This reaction will take place automatically in seawater, in which case the energy will be "lost" as heat. However, some bacteria have evolved the ability to mediate this reaction by mixing hydrogen sulfide and carbon dioxide under controlled conditions within their cells and harvesting the energy that is given off. They use this energy to build sugar molecules from carbon dioxide. Hydrogen atoms from the hydrogen sulfide molecule and the energy harvested from this reaction take the place of water and sunlight in the conversion of carbon dioxide to sugar in plants so that the reaction inside the bacteria can be written:

