New Scientific Understanding

Genetics and Molecular Biology

Ever since the Nobel Prize winning discovery in 1953 of the essence of life, embodied in the structure of a complex molecule known as DNA (deoxyribonucleic acid), there has been an explosion of scientific knowledge that is utterly transforming the study of life sciences and the practice of the healing arts.

Every form of life, including all plants and animals from human beings to the simplest bacteria, springs forth from DNA. A full strand of DNA, resident in each cell of its living host, contains the complete genetic code, or blueprint of life, that fully describes every biological aspect of an organism's existence. The precise sequence of the code determines its size and shape, strengths and weaknesses, functions and behavior. The living organism is, in essence, the ultimate physical manifestation of its underlying code.

Today, hundreds of scientists from plant biologists to cancer researchers are working both to determine the sequence of the code and to understand its meaning. Their hope is to identify the functions associated with its myriad arrangements and develop the tools needed to transform this knowledge into practical use.

Already, initial successes have brought enormous benefits. Rare forms of some human hormones, for example, can now be manufactured cheaply in the laboratory. Insulin used in the treatment of diabetes is perhaps one of the more dramatic cases. In other cases, with sufficient knowledge and capability, it may be possible for mankind to emerge triumphant in the future over some of its oldest and most dreaded scourges.

Although the promise for success is bright, the magnitude of the remaining task is staggering. The full strand of human DNA, called the human genome, consists of 3.5 billion elements of precisely sequenced genetic code. While the tools for analyzing such a complex molecule have improved dramatically in recent years, any hope of accomplishing the ambitious goal of complete understanding lies well beyond our current means. Smaller steps along the way must be taken first.

Hence, the focus of much of today's research is on smaller, more specialized and prioritized aspects of the larger problem. The object is to reveal in theory important lessons bearing on the whole, while addressing in practice a tractable set of research tasks.

Exemplifying this approach, Seed Money researchers in four separate projects funded in 1975, 1979, 1982, and 1985, played a fundamental role in developing basic knowledge in one particularly important, yet elusive area of investigation.

While it is well known that DNA provides both the code and the instructions for the manufacture of proteins, which are essential chemicals that stimulate and carry out an organism's vital functions, it is not known what causes the protein manufacturing process to start or stop. The focus of these four Seed Money projects, each being quite different from another, was on understanding the regulatory mechanisms that control the timing and duration of this manufacturing process.

To improve their chances for success, the Seed Money researchers chose for study a biological function associated with periodic and rapid growth of tissue, and selected an animal in which such behavior could be readily manipulated in the laboratory. The animal was a species of crab that normally lives out of water on land, and is fairly easy to maintain in captivity. Importantly, much of the DNA of this crab was known to break up under certain laboratory conditions into segments of interest that were of a manageable size (each of several thousand coded elements).

The biological function chosen was a process familiar to almost all fishermen, called molting.