

## Beyond the Double Helix

I have never seen Francis Crick in a modest mood." James Watson's mischievous opening line of *The Double Helix* raised many eyebrows at the time, but even Crick wouldn't quarrel with it now. Still brash and outspoken at 86, even without the booming laugh that once echoed through Cambridge's Cavendish lab, Crick has no reason for modesty. In the years since their discovery of the double helix, Crick, unlike Watson, has continued to do significant research, mostly by pondering big--and often controversial--theoretical questions rather than by toiling in the lab. Says his longtime colleague and fellow Nobel laureate Sydney Brenner: "He's the only molecular biologist I know who has managed to make a living as a theoretician."

Ranging widely over the biological landscape, Crick helped explain how genes build proteins. With a colleague, Leslie Orgel, he speculated on the origins of life, concluding that it began not on Earth but elsewhere in the universe. And for the past two decades, Crick has been pursuing that most baffling of topics, consciousness, an interest he jokingly says some regard "as a sign of approaching senility."

The scientifically inclined son of middle-class parents from Britain's Midlands--his father was a shoe manufacturer--Crick started out studying physics and during World War II worked on radar and magnetic mines. But like Watson, he switched fields after reading Erwin Schrodinger's *What Is Life?* After their triumph in 1953, Crick went on to study the larger issue of how the millions of base pairs along DNA's twisted strands convey the message of the genes.

Together with Brenner and others, Crick provided an initial solution: DNA's sequence of four bases, taken three at a time, direct the formation of 20 amino acids; then, guided by DNA's single-chain cousins, messenger and transfer RNA (whose existence Crick predicted), these molecules link up to form more complex proteins. In the process, Crick asserted, genetic information always flows one way, from DNA to RNA to protein, an idea he called molecular biology's "central dogma."

In 1966 Crick, always restless, decided there were greater opportunities in embryology, the study of how a single fertilized egg develops into an adult organism. A decade later, he made another major change by moving to the Salk Institution in La Jolla, Calif., to explore the brain. He began by looking at dreams and soon shocked Freudians by concluding that dreams were simply the brain's nightly housecleaning to make room for

new memories.

Crick's ideas on the origins of life are no less provocative. Concluding that conditions on the young Earth were far from favorable for the spontaneous generation of lifelike organisms, and trying to explain why the genetic code is the same in all earthly creatures, he and Orgel revived a theory known as panspermia ("seeds everywhere"). In their version, called directed panspermia, a distant civilization arising long ago on a planet where conditions were benign, sent unmanned rocket ships to seed the primitive earth's oceans with sporelike organisms that multiplied and evolved.