ance of a sun-centered model of the universe (formulated as early as the third century B.C.) for another 300 years. Lovell attributes the eventual adoption of Copernicus's model of the solar system, in the 16th century, to its compatibility with the ancient Greeks' belief in a harmonious, concentric universe (which made his idea appear less revolutionary), as well as to Galileo's persuasive demonstrations. The same classical emphasis on harmonious heavenly relationships led Johannes Kepler, in 1609, to discover elliptic orbits; his principles of planetary motion, in turn, laid the groundwork for Isaac Newton's laws of gravity and inertia (1687). Theory and observation were unified in Newton's cosmology. In our own century, Albert Einstein exploded the concepts of absolute time and motion and forced scientists to recognize the subjective, man-centered nature of their ordering principles. As a consequence, most scientists now believe there is no absolute order of the universe to be discovered— only more useful cosmic models to be devised.

A NEW SCIENCE OF LIFE: The Hypothesis of Formative Causation
by Rupert Sheldrake
Blond & Briggs, 1981
229 pp. $12.50

Heredity, we are told, depends on the arrangement of nucleic acids on the double helical strands of DNA. But this "mechanistic" explanation of the ultimate mystery of biology has serious limits. The differences between the DNA sequences of, say, humans and chimpanzees amount to only 1.17 percent. The genetic discrepancy between two species of mice is actually greater. And why does one cell become a kidney tubule while another with the identical DNA structure becomes a brain cell? Some "mechanistic" scientists claim that such cells are simply "programmed" differently. But programming implies a programmer, an implication from which these mechanists recoil. Sheldrake, a Cambridge biochemist, sees a need for a nonmechanistic, nonphysical theory of biology to account for such phenomena as the relative constancy (both structural and behavioral) within an animal species. Reviving the *vitalism* of philosophers such as Henri Bergson and Alfred North Whitehead, who

believed that life had a special character apart from its physical aspect, he postulates an influence "across space and time unlike any known type of physical action." Once established within a species, a characteristic is *somehow* transmitted to all members of the species. Sheldrake does not explain why or precisely how an organism takes the form it does. But, as more and more scientists have been pointing out, "traditional" biology has not provided a satisfactory theory either. Sheldrake's book challenges biologists to look at assumptions too long taken for granted.

THE MICROELECTRONICS REVOLUTION: The Complete Guide to the New Technology and Its Impact on Society
edited by Tom Forester
MIT, 1981, 589 pp.
$25 cloth, $12.50 paper

Behind the most recent industrial revolution is the tiny silicon-chip integrated circuit of the new miniaturized computers. Barely 20 years old, it far surpasses the transistor in complexity and speed of computation. Though the United States leads in the microelectronics field, Forester, a former correspondent for *New Society*, believes that most Americans are ignorant of what the industry has wrought and what its growth portends. Proceeding from this premise, 43 scientists, philosophers, and other contributors discuss the computer's pervasive influence in areas ranging from military weaponry to town planning. Designs or prototypes exist for fully automated factories, domestic robots, synthetic neural tissue—even robotic medical consultants and legal arbiters. Among the potential effects debated here are automation-induced unemployment and, with the increasing interconnection of data banks, invasion of privacy. Will the growing dependence on artificial intelligence subtly reduce the power and scope of human mental processes? Even such an optimist as Herbert Simon, professor of computer science at Carnegie-Mellon, views the future warily: The very "capability of the computer for solving problems and making decisions . . . poses the greatest difficulty in predicting its impact upon society."