REVIEW

Life, biology and almost everything

Science as a Way of Knowing: The Foundations of Modern Biology
by John A. Moore, *Harvard University Press, pp 530, £23·95*

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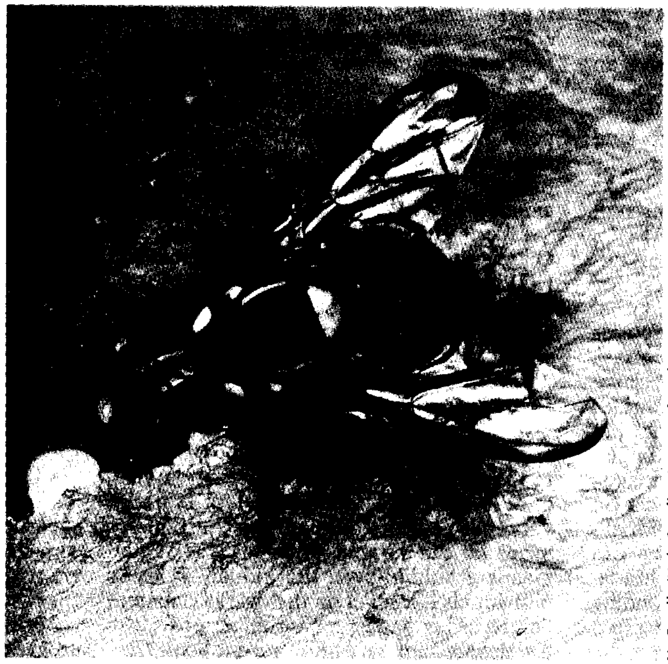
TO PEN a single volume embracing the entire history and present compass of ideas about life and its evolution, from the cave art of Lascaux to the molecular genetics of today, is a formidable undertaking. To tell the developing story of biological thought as an illustration of the principles and methods of scientific enquiry in a much broader sense compounds the task. John Moore, turning in retirement from his lifetime's researches on genetics and development, has fulfilled these aims amply in a work of enormous scope. He has informed his book with wit, a gentle humanism and considerable charm.

Science as a Way of Knowing may well become a classic. First there is the character of writing, reminding us that the colour, metaphor and felicity of prose can resemble that of poetry. Life, Moore tells us, "is a tension between the infinite and the finite". In the natural world, "both life and the environment are sustained because the environment is farmed, not mined". Homology is "similarity based on common descent". Again and again, elementary yet elegant phrases lead us into accessible descriptions of concepts and technicalities that are inherently difficult to explain.



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Geneticists' test-bed: fruit flies are cheaper than larger animals

Moore's rationalism is well-tempered too. In place of the counterproductive militancy some scientists show towards supernatural notions, we have simple personal testimony. "All belief systems tend to close the mind," he tells us by way of introduction to the Judaeo-Christian view. "A fundamental difference between religious and scientific thought is that the received beliefs in religion are ultimately based on revelations or pronouncements, usually by some long-dead prophet or priest . . . Dogma is interpreted by a caste of priests and is accepted by the multitude on faith or under duress." In contrast, "the statements of science are derived ultimately from the data of observation and experiment, and from the manipulation of these data according to logical and often mathematical procedures."

Moore's symphony of biology is in four discrete movements: "Understand nature", "The growth of evolutionary thought", "Classical genetics" and "The enigma of development". This arrangement has some drawbacks in terms of the temporal sequence of ideas (on page 403, we enter the 19th century for at least the second time). But overall the magisterial marshalling of the story works extremely well.

One is the differing contributions made by pioneers whose work is essentially descriptive, and that of individuals who initiate revolutions in thought. So Andreas Vesalius, William Harvey, Anton van Leeuwenhoek and Robert Hooke made historic advances in our understanding of living things, yet were not responsible for true paradigm shifts or concepts of major significance. "There emerged no theory of protozoans, theory of human anatomy and physiology, or theory of insect structure—nor could any theories emerge since no fundamental questions were being asked, no major hypotheses being tested."

Moore is instructive too on dead ends such as that which, at the close of the 19th century, confronted investigators who were trying to fathom the basis of inheritance by using the techniques of cytology alone. "How was one to establish a causal link between the behaviour of chromosomes and the data on inheritance derived from breeding experiments?. . . Both cytology and what we would now call genetics were awaiting the arrival of a new paradigm."

In discussing the drama of that new paradigm's arrival in 1900, Moore does not wholly follow tradition. Why was there a 35-year interval between Gregor Mendel's experiments on pea breeding and the realisation of their importance by Hugo de Vries and Carl Correns? Were the monk's findings really unknown for so long because he had published them in an obscure journal? Not at all. Moore points out that W. Q. Focke discussed Mendel's studies in his standard work on plant hybridisation in 1881, as did L. H. Bailey in a book published in 1895. Mendel had even corresponded with the foremost scholar in the field, Karl Wilhelm von Nageli, who was not impressed by those all-too-tidy ratios. Mendel's work was not unknown. It was unappreciated.

One figure whose standing is enhanced here is that of Walter Sutton. Though his name is curiously absent from most biographical dictionaries of scientists, it was two papers published by the then 25-year-old student at Columbia University in New York City in the early 1900s that demonstrated the close correlation between the behaviour of Mendel's hereditary units and that of the chromosomes in meiosis and fertilisation. This was the crucial insight which indicated that those units, genes, were indeed parts of chromosomes. As landmarks in the history of genetics, Moore suggests, Sutton's two papers stand alongside those of Mendel, and of James Watson and Francis Crick, in both fundamental importance and analytical brilliance. Yet little is written today of Sutton, who died at the early age of 39 after a brief but distinguished medical career.

A final reason for forecasting classic status for Moore's magnificent Baedeker of biological ideas is his skill in embedding pointed detail within the spacious texture of his work, with its continual sense of the sweep of history.

It's important to be reminded that Watson and Crick neither performed one experiment nor made a single observation on DNA; their genius was in analysing the few available facts. And it's arresting to learn that Thomas Hunt Morgan turned to the fruit fly, *Drosophila*, as a tool for genetics experiments not, as we are usually informed, because it bred quickly on cheap food, but because he had no funds with which to purchase larger animals. Such are the ingredients of science as a real, inherently unpredictable but gloriously successful human enterprise. □

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