

Both eminent and neglected

David Knight

William Whewell: A Composite Portrait. Edited by Menachem Fisch and Simon Schaffer. *Oxford University Press: 1991.* Pp.403. £47.50, \$45.

WILLIAM Whewell was one of the great pundits of nineteenth-century science. President of the British Association, twice president of the Geological Society, and then master of Trinity College, Cambridge, he was a meritocrat whose career shows the social mobility possible for the able scientist. He actually coined the word 'scientist', as well as 'anode', 'cathode' and 'ion', and the geological categories 'uniformitarian' and 'catastrophist'.



William Whewell (1794–1866) – 'science was his forte and omniscience his foible'.

With his treatises, he might almost be said to have invented history and philosophy of science as academic subjects. He also wrote on moral philosophy and theology: in a famous quip by Sydney Smith, science was said to be his forte and omniscience his foible.

Given his central position in the intellectual world of the mid nineteenth century, it is surprising how quickly he was forgotten: perhaps because he stood out like a Canute against the rising tide of specialization. It is very good that we should have in *William Whewell: A Composite Portrait* a series of essays about him, because they illuminate the theory and practice of the science of his day, and because some of his thoughts are still relevant to understanding scientific method.

His most famous books were the *History and Philosophy of the Inductive Sciences*

(1837, 1840); in which in opposition to John Herschel, John Stuart Mill and 'baconian' orthodoxy he proposed that good science consisted of authentic facts ordered by the active mind; which gave to each science its appropriate 'fundamental idea'. This determined its particular level in the hierarchy: chemistry required more than mechanical principles, and biology more than chemical ones. The unity of the sciences for Whewell would not be achieved by the reduction of them all to mechanics or some other basis; it was a matter of sharing a common inductive method.

The word 'science' in Whewell's time embraced any definite body of knowledge, and he hoped to see his sophisticated version of the inductive process making political economy and moral philosophy genuinely scientific. He believed that speculative and deductive thinkers, D. Ricardo in economics and utilitarians such as W. Paley and J. Bentham in ethics, had gone badly astray; as had P. S. Laplace in seeing no need of God in his deterministic cosmos. As a teacher, he distinguished 'permanent' subjects like geometry and classics as being the best discipline for young minds, who could come on to 'progressive' sciences like chemistry later; and he was thus a conservative in curriculum reform at Cambridge.

A composite portrait is an interesting idea, and on the whole it works extremely well: like a series of spotlights following an actor, the various authors illuminate him from different angles, and they have mostly got him in focus and written clearly. There is of course some overlap, and some disagreement: over whether Whewell can be described as a liberal Anglican, for example, and whether Darwin's *Origin of Species* is a good example of Whewell's 'Consilience of Inductions' or not.

There is still room for a biography, because there are gaps here; and there still seems to be a problem about Whewell's reputation and the reception of his ideas. Although he was so celebrated, his philosophy was not taken up until the twentieth century, when he was seen as a precursor of Popper, and when physics has very different fundamental ideas from those of 1850. It may be that he lived too long, surviving as a living fossil into the darwinian era; or conversely that his ideas were ahead of his time. But to be both eminent and neglected is indeed curious. □

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Coffee-table enzymology

Richard Perham

Discovering Enzymes. By David Dressler and Huntington Potter. *Freeman: 1991.* Pp.264. £16.95, \$32.95.

"WHAT we want is a story that starts with an earthquake and works its way up to a climax." David Dressler and Huntington Potter, authors of the beautifully produced *Discovering Enzymes*, approvingly quote Samuel Goldwyn and clearly set out to follow the injunction: no other book on enzymes that I know begins with the Big Bang and six pages and several billion years later, can be found rhapsodizing on the part played by enzymes in "[guiding] molecules across the threshold of life". Heady stuff, but accompanied by some exquisite colour photographs: a rock formation, a seashore, a developing embryo, a Jan Breughel, a collection of neurons (or is it nature imitating art – a Jackson Pollock? No, it is neurons), a blood clot, a silk moth emerging from a cocoon.

We then take a step back and are given an animated history of the discovery of enzymes. This too is richly illustrated (Jacques-Louis David's celebrated portrait of Antoine Lavoisier and his wife, for example – no enzymologist works like that today!) and is full of interesting personalization (von Baeyer's sour comment on Eduard Buchner, his former pupil, who crucially discovered cell-free fermentation, "This will bring him fame, even though he has no chemical talent". (Buchner was awarded the Nobel Prize for Chemistry in 1907.) The concepts of specificity, the lock-and-key hypothesis and the identification of enzymes as proteins (not forgetting ribozymes) are handled well. But I am not persuaded that it was wise to limit the discussion of enzyme structure and reaction mechanism almost entirely to chymotrypsin and related enzymes. The serine proteinases have an honourable place in past and present enzymology but it is strange to find no mention of lysozyme, of the haem proteins, of kinases or dehydrogenases, of folding domains or quaternary structure. Chymotrypsin is used to good effect in illustrating many features of enzymes, and the text conveys the excitement that unravelling the structure and function of a protein can bring, but we are denied a fuller picture of the extraordinary (and beautiful) range of structure-function relationships in enzymes. It also eliminates reference to coenzymes and cofactors, without which many enzymes cannot function and no metabolic pathway can exist.

Where the extended discussion of serine proteinases does take us is into the biochemistry of blood clotting and fibrinolysis. This allows an introduction to enzyme cascades and signal amplification and the potential for enzyme therapy. To conclude,

the authors take up the enzymology of signal transduction in the nervous system. The failure to deal earlier with ATP-linked reactions is mitigated here in the description of the sodium-potassium ion pump. Alzheimer's disease, nerve gases, the McNaghten Rules, are all brought into a rousing climax.

Discovering Enzymes can safely be recommended to anyone, undergraduate upwards, who wishes to become acquainted with the current excitement in the field of molecular enzymology, though it lacks the breadth of coverage to fit that bill on its own. One or two small quibbles: the strength of an

ionic bond is not the same as the force between two point charges; the velocity-substrate concentration plots, as drawn, are not rectangular hyperbolae; and it will sow confusion if amino-acid residues in proteins are referred to as subunits. Perhaps it is best summed up as that miracle of rare device, a coffee-table book on enzymes; it should fulfil a useful purpose in presenting a major area of the life sciences in a colourful and attractive way to a wider public. □

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Modern shamans

Alison Jolly

Walking with the Great Apes. By Sy Montgomery. Houghton: 1991. Pp.280. \$19.95.

JANE Goodall, Dian Fossey and Biruté Galdikas have transformed our knowledge of chimpanzees, orangutans and gorillas — and with it our view of women's place in nature. In her joint biography, *Walking with the*

Great Apes, Sy Montgomery traces three extraordinary lives. But she does more than tell their story; she tries to show that these three women are not scientists but modern shamans who reach out with an emotional current to the wild. She reveals the empathy, even the love, one must feel to spend decades with wild creatures, but is she right that science and love exclude each other?

The book has lively, lucid writing, and is constructed as a three-part fugue. Montgomery balances tact and openness, and respect without adulation. To me she too often knows what her subjects were thinking 20 years ago, or just what emotion is mirrored in an ape's eyes, but mostly this is a fine read.

She brings out well the differences between the three.

Jane Goodall's "westernness stands out like a porcelain tea-cup on a rough-hewn tree-stump". To judge from her story, though, Goodall's true mettle must be more like high-strength titanium, especially now in her crusade for the humane treatment of chimpanzees that have fallen into human hands. Galdikas makes her home in the swampy Bornean rainforest she compares to "the original Garden of Eden". She lives with her Dayak Indonesian husband, two of her children, a dozen or more ex-captive orangutans, Dayak guides, American Earthwatch volunteers and Indonesian graduate stu-

dents. As for Dian Fossey, Louis Leakey said years before her murder, "Her life was a tragedy, and will always be a tragedy". She was tragic in the Greek sense, not as a person to pity, but as a hero whose own power entailed her downfall.

Is Montgomery right that these three are not scientists, but shamans? In a revealing preface, Montgomery describes her own study of three young emus, Australian birds tall enough to look a woman in the eye. With minds so alien, she could not delude herself into even the partial empathy we feel for apes. Yet Montgomery realized that what



Communion with nature — Hollywood's version of Dian Fossey's tragic life.

she felt for the birds was love — a special kind of love that has no basis in dependency, no expectation of return. It is this love, this communion she attributes to Goodall, Fossey and Galdikas.

Right. But then she spoils it by undervaluing their scientific contribution. She repeats disparaging (and unjustified) remarks about Goodall's Cambridge thesis. She only once mentions the 25-year monumental monograph *The Chimpanzees of Gombe* (Harvard University Press, 1986). She cites Galdikas as having only 40 publications, and that her one book so far is in Indonesian. This

might be thought a respectable sum for a male scientist teaching on two continents, running a major research camp five hours' boat-ride into the rainforest, and incidentally mothering small children. Even Fossey, with her tortured warfare in defence of her gorillas, published a book and journal articles which will stand for years to come.

In her latest book, *Through a Window* (for review see *Nature* 348, 371; 1990), Goodall tells how she went to Gombe to recover from her second husband's death. In that time she came "intuitively . . . closer to the chimpanzees than ever before. For I was with them not to observe, to learn, but simply because I needed their company, undemanding and free of pity." That makes Montgomery's point: communion with nature goes far deeper and broader than the scientific attitude. It makes mine as well, that for 20 years before, and ten since, Goodall has gone notebook in hand, observing, thinking as well as feeling.

A different interpretation is that these three have led a paradigm shift in the study of animal behaviour. Goodall's insistence on the importance of the individual has now been accepted in primate studies, and resonates out into further and further fields. Kuhn showed us that such a paradigm shift is al-

ways resisted — but that it is an integral part of science, not a renunciation of science. Montgomery also quotes praise, concluding, "Jane's work has ushered in the glimmerings of a new way of doing science, a scientific outlook that draws upon the feminine emphasis upon individuality, relationships, and empathy".

Much is now written about women's science as different from men's. This may be so. But I suspect that an accurately attuned feeling for the organism will turn out to be not just female science, but good science. The important thing is not to lose either thought or feeling in an artificial dichotomy. In this present world, we humans threaten the survival of wild ecosystems and wild creatures including the great apes, our nearest relatives. We are

only just realizing how dependent even our own species is upon a fragile biosphere. We desperately need modern shamans: wise women and wise men. Our modern shamans, to be most effective, must also be scientists. If we insist on a dichotomy and champion either blind emotion or sterilized intellect, we risk deliberately letting go of our lifeline to survival — for the apes, or even for ourselves. □

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