

The science of solar physics has two distinct aspects, one emphasizing the astronomical side of the subject (the 'solar–stellar connection') and the other the relationships between the Sun and the Earth. Both aspects are well covered in this book. On the astronomical side, the authors vividly describe the evolution of the Sun, drawing on current knowledge of star formation and evolution. The story runs from the Sun's birth in a collapsing interstellar cloud, through its youth and long middle age as a main-sequence star, its passage through the red-giant phase and the ejection of a planetary nebula, and finally to its slow death as a cooling white dwarf formed from the solar core.

The text provides remarkably clear explanations of some quite complicated things, such as the Sun's sharp edge, limb darkening, the formation of absorption and emission lines in the solar spectrum and the three-dimensional, dynamic nature of the solar chromosphere. There are also clear descriptions of the workings of several solar instruments, including the spectroheliograph and the birefringent filter. Interesting historical nuggets enliven the text throughout.

The authors are naturally at their best in discussing their own research specialities, solar eclipses (Pasachoff) and the solar corona (Golub). They give the reader a good feel for the careful planning, risks, tension, joys and frustrations of a solar-eclipse expedition or a space experiment. Several remarkable TRACE images of the solar corona, showing the beautiful, fine structure created by the Sun's magnetic field, enhance the volume, as do some important results from the Solar and Heliospheric Observatory (SOHO) and other recent space missions.

The book does have a few shortcomings. In their discussion of helioseismology, the authors fail to point out the basic fact that the waves causing the oscillations are sound waves. Subsurface magnetic fields are detectable not, as the authors state, because the magnetic field decreases the propagation speed by lowering the local temperature, but rather because it increases the propagation speed directly through magnetic restoring forces. There is little or no discussion of recent advances in high-resolution observations from ground-based telescopes, such as the use of image-restoration techniques or adaptive optics. But these are minor quibbles; overall, the coverage is broad and complete and the level of accuracy very high.

A timely feature of the book is its excellent chapter (entitled "Fire and Ice") on the Sun's influence on the Earth's climate. This chapter contains a thoughtful discussion of the climate system and global warming and shows why we need to have a better understanding of the effects of solar variability on our climate before we can sort out the man-made effects.

With the publication of this book,

Harvard University Press continues a tradition of excellent books on the Sun for general audiences. *Nearest Star* is an up-to-date, authoritative and entertaining introduction to the Sun for the general reader. It represents popular science writing at its best — expert authors writing in a clear and lively style, without oversimplification, engaging the reader's creative thinking and imagination. ■

*John H. Thomas is in the Departments of Mechanical Engineering and of Physics and Astronomy, University of Rochester, Rochester, New York 14627, USA.*

## Techy in fuzzy clothing

### **Operators and Promoters: The Story of Molecular Biology and Its Creators**

by Harrison Echols, edited by Carol A. Gross  
*University of California Press: 2001. 466 pp. \$65, £45*

#### **Horace Freeland Judson**

Textbooks in the sciences are typically ahistorical — hardly a word about how the science was created. Scientists and their textbook publishers are sceptical of a historical approach. It might do for undergraduate courses for non-scientists — in American terms, for fuzzies, non-science majors — but serious would-be scientists, the techies, haven't even got time for all the real stuff. In 1965, in his textbook for undergraduates *Molecular Biology of the Gene*, James Watson presented the science as though it were a mediaeval cathedral, the edifice inspiring, its artisans and architects anonymous (with exceptions including himself and Francis Crick). The book went through multiple editions.

Yet the alternative has occasionally been attempted. In 1971, Gunther Stent published *Molecular Genetics: An Introductory Narrative*. "The evolutionary origin and essentially pedagogic purpose of this book are reflected in the narrative presentation of the material in the historical sequence in which it actually came to be known (and in the occasional burdening of the reader with long-abandoned theories)," Stent wrote. "I happen to believe that an understanding of molecular genetics can best be taught in an organic (rather than logical) manner." Helped, to be sure, by muscular writing and Stent's immense acquaintanceship with the artisans and architects, the book stands as a vindication of the historical approach. It sold well enough to warrant a second edition before the subject grew too cumbersome.

Now we have Harrison Echols' *Operators*

and *Promoters*. Its subtitle claims that it's a history; its very format raises doubts. It weighs in at a kilogram, with heavy paper, margins fully as wide as the column of type, and a pricey illustration programme. Yet the book asserts that historical claim repeatedly, in a foreword by Arthur Kornberg, an afterword by Tom Cech and a long, laudatory preface by Carol Gross, Echols' widow and editor.

At the University of California, Berkeley, Echols was at one of the nodal points in the worldwide network of the research he has written about. In 1986, he learned he had cancer. For the next six years, Gross writes, his overriding aim was to complete "a personal account of the development of the biological paradigms that we now take for granted". But when he died, in 1992, he left a mass of materials, unfinished and unpolished. Echols' widow, herself a molecular biologist at the University of California, San Francisco, took it on. Echols wrote, Gross says, from his own scientific work, from his encounters and interviews with other biologists, and "with the eye of a physicist, the knowledge of a biologist, and the soul of an artist".

With respect, the history of science demands more than the careful ascription of results to individuals, leavened with the

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"The style of writing is hard to place ... although Gross's humour and enthusiasm are considerable compensation ... This book provides captivating snapshots, but sometimes lacks the narrative of a good movie, or book for that matter." Philip Ball, *Nature* **402**, 119–120 (1999)

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by Charles Seife  
*Souvenir Press, £9.99, \$13*

occasional personal anecdote or quotation. It requires detachment, selectivity and an explicit understanding not just of the building of the science and its subsets, stone by stone, but of the styles of the different institutions where the science was done, and of the evolution of the structure of the field, both intellectually and as that network of interactions.

The history of molecular biology is marked above all by a radical shift in the nature of the central problems and by a concomitant transformation of the research networks. By 1970, the founding fathers had erected an elegant, overarching outline of the nature of the genetic material and the relationships between genes and their products, between DNA, RNA and proteins, with prototypical forms of genetic regulation. So the chief task became, in Crick's phrase at the time, to do molecular biology all over again for eukaryotes. This has meant turning at last to what has for centuries been biology's great intractable, the working out of what used to be called embryology — development and differentiation.

The other aspect of the transformation has been, of course, the splintering of the research into multiple lines and the high-exponential proliferation of the numbers of workers and research centres. Yet all those lines and most of those workers must be concerned primarily with the control of the expression of genes — not just in elegant outline but in full and stupefyingly complex detail. Stent published his narrative textbook on the cusp of the transformation. His future was Echols' and Gross's past. The bulk of their book treats a selection of these mechanisms of control. This treatment is right in principle, yet the selection is skewed by its tight dependence on Echols' own research background. The result, if it qualifies as history at all, is internalist to an extreme, presenting the science narrowly and technically — just what textbooks do.

We are indeed told who did what. But operators and promoters? That could be piquant. Science at its creative best is as dependent as, say, sculpture or theatre or pop music on the styles of individuals and groups. The double meaning of the title was deliberate, yet Echols and Gross reveal little of the individuality of scientists. They tell us virtually nothing about where they worked, or how they interacted with colleagues and competitors. Nor do they address its societal context, how the science described in the book has affected and been affected by its rise to its present dominance of the headlines and of public policy. Instead, those wide margins are decorated by pencil portraits of molecular biologists — 76 of them, including three women. I know 43 of them: only about six are recognizable. But they're smiling. ■

*Horace Freeland Judson is at the Center for History of Recent Science, George Washington University, Washington DC 20052, USA.*

## Science in culture

### Bee string theories

*Humble Boy*, a play by Charlotte Jones.

Sara Abdulla

"I have been doubly unlucky in life: to marry a biologist and give birth to a physicist." So says Flora Humble, the linchpin of Charlotte Jones's gentle new comedy. Flora's astronomer son — the 'Humble Boy' of the title — is home for her entomologist husband's funeral. For one long, hot summer, mother and son grope through grief towards an understanding of their own and the dead man's life, motivations and legacy.

*Humble Boy* is an entertaining celebration-cum-send-up of the personal and professional quest for immortality through science, love and children. More a laid-back buffet in the manner of Yasmina Reza's recent *Lifex3* than an earnest essay à la Michael Frayn's *Copenhagen*, it is a likeable domestic drama. It contrasts the personal satisfactions of amateur research (unbeknownst to his family, the late James Humble discovered a new strain of bee) with the gallery-playing antics of the academic life (Felix Humble's febrile pursuit of Cambridge kudos). The play pits the palpable beauty of the natural sciences (the garden setting is lovingly Latin-labelled by James's ghost) against the poetry of mathematical astrophysics (Felix transcends his stutter to enthuse on the equations describing the Universe's coiled dimensions).

Magpie-like, Jones picks shiny bits of grade-school science in a shameless but irresistible attempt to graft on gravitas. Her characters inter-

relate like the insects in James Humble's centre-stage hive. The indomitable Flora is the queen bee — life-giving and languid. Her husband, lover and even her son are drones bent to her bidding. Her childless female friend — her worker.

Similarly, the play's emotional journey skims off superstring theory's easy-to-digest cream. Professionally, Felix Humble is searching for a 'Theory of Everything' that will reconcile general relativity with quantum mechanics. This is echoed by his personal struggle to understand how the big events in life — births, deaths, marriages — are informed by the seemingly inconsequential stuff. It may sound trite but, thanks to Jones's facility with dialogue, it works.

Less successful is her recourse to tired tropes, such as the socially inept researcher evading his emotional shortcomings through a life of the mind. That her women find creative fulfilment and make their mark solely by having babies also jars. Jones redeems herself by painting parenthood as "full of Eureka moments", thanks to the insatiable — scientist-like — curiosity of children. Profound? Not really. Pleasurable? Definitely. ■

*Sara Abdulla is editor of the Nature News Service.*

*Humble Boy is at London's Cottesloe Theatre.*

Visualizations: *The Nature Book of Art and Science, a collection of essays edited by Martin Kemp, is published by Oxford University Press (£20) and the University of California Press (\$35).*

Simon Russell Beale as Charlotte Jones's Felix Humble.

