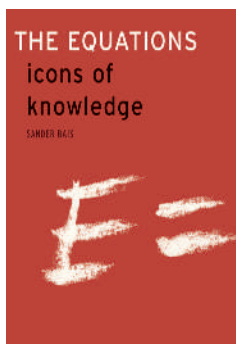


Only skin deep



THE EQUATIONS: ICONS OF KNOWLEDGE BY SANDER BAIS

Harvard University Press: 2005. 96pp. £11.95

Every physicist will be sympathetic to the aim of this book, which is to present the fundamental equations of our subject in a non-technical way. The author deserves praise for unashamedly disregarding the cultural prohibition against equations in popular science writing. His good reason for doing so is that “equations are compact statements of the way nature works, expressed in the language of mathematics”.

Each short chapter is centred on a single equation or group of equations, in a roughly historical arrangement starting with newtonian gravity and mechanics, and incorporating successive branches of classical physics: electromagnetism, thermodynamics, kinetic theory and hydrodynamics. Then twentieth-century physics begins, with special and general relativity, continuing with quantum mechanics through to string theory by way of the standard model and the electroweak theories.

All the explanations of the equations seem correct, and they are generally written in the most aesthetically pleasing form (although Maxwell's equations could have been written more compactly in terms of differential forms, rather than — or perhaps in addition to — their vector form). An attempt is made to explain most of the symbols in the equations (although not the thermodynamic differential d). There is one blunder: the assertion that the northern lights consist of radiation from charges spiralling in the Earth's magnetic field (in fact they result from collisions of the charges with atoms in the atmosphere). And I am surprised at the claim that “...the Dirac equation also led to an explanation of Pauli's exclusion principle”.

Although its aim is laudable, I find the book disappointing in some respects. The explanations are unexciting, and resemble an old-fashioned lecture course in theoretical physics with most of the technical details removed. The book is narrowly conceived. I would have liked to learn the author's opinion

on the old philosophical question of ‘the unreasonable effectiveness of mathematics’, rather than simply the assertion that mathematics works. There could even have been a discussion of whether equations will survive as the backbone of theoretical physics, rather than being replaced by algorithms, as argued by Stephen Wolfram. And there is almost no mention of the ways in which the equations underpin our technology. Readers would surely be interested to learn that Maxwell's equations are central to electric power generation and all modern communications, that Schrödinger's equation is the basis of semiconductor technology and therefore of computers, that the antiparticles suggested by the Dirac equation led to positron emission tomography scans in modern medicine, that relativity is essential for the operation of Global Positioning System navigation...

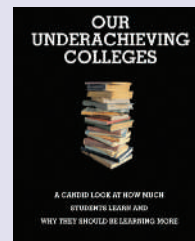
I am left wondering which readers the author is aiming at. Not professional scientists, surely, because the lack of detail will leave them unsatisfied. On the other hand, non-scientists will find too many technicalities; for example, they will be bewildered by the idiosyncratic choice of ‘tautological toolkit’ as the title of the first chapter. There is some attempt to separate the more technical material into brown boxes (that also include some historical material), but the division between these and the main text is confusing, as are some of the figures.

Perhaps the book might inspire physics or mathematics undergraduates at the start of their studies, by enabling them to see theoretical physics as a whole. I hope so; it would be a pity for the author's effort in writing this attractively produced book to be wasted.

Michael Berry

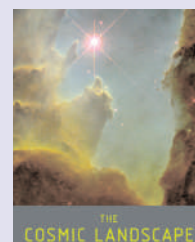
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On our bookshelf



Our underachieving colleges
by Derek Bok
Princeton Univ. Press:
2006. 424 pp. \$29.95

American college students are not learning significantly more than they did fifty years ago, according to former Harvard University President Derek Bok. Universities should focus on how, not which, courses are taught.



The cosmic landscape:
String theory and the illusion of intelligent design
by Leonard Susskind
Little, Brown and Company: 2005.
416 pp. \$24.95

String theory presents us with multiple solutions, so how did it happen that conditions in our Universe are ripe for intelligent life? Could our Universe be a ‘pocket universe’ in a vast ‘megaverse’?