reviews

Michael Berry

We are not aliens

Understanding the Present: Science and the Soul of Modern Man Bryan Appleyard 1992 Picador 283pp £14.99hb

WHEN he was a child, Appleyard tells us, he was astonished by the ability of his father (an engineer) to calculate the volume of water in a water tower, but "sensed something dangerous and ominous in this wisdom". During a later career as a journalist, in which he was often concerned with scientists and technological issues related to science, this unease matured and has now become the mainspring of an intricately connected, wide-ranging and passionate attack on science. I will try to summarise it.

Appleyard argues that science is astonishingly effective, but "effectiveness is not truth", and science is not 'true' because what it tells us changes with each revolution (mechanics changing from Newtonian to quantum, etc), and because its apparent triumphs are achieved only after grotesque oversimplifications which select "only those problems that can be solved by the known method"; moreover, its essentially mathematical content is inaccessible to ordinary people, which real truth ought not to be. Science has caused "appalling spiritual damage" and made us abandon "our true selves" by exposing us as always "destined to be the wrong size" to comprehend the scientists' cosmos of general relativity or the subatomic quantum world. This devaluation of the human is largely to blame for the indefensible relativism and fundamental instability of our liberal society. Then there is the atom bomb, which "suddenly revealed science itself as an uncontrollable extension of the human will to destruction", and our unpredicted effects on the environment, which show that "our arrogant simplicity has been humbled by . . . awesome . . . complexity". And now, with the theory of algorithms and the foundations of logic, applied to artifical intelligence, science is preparing "to cross the inner frontier of the self", a development that could yet be resisted in what would be "the humbling of science".

One of Appleyard's aims is to make scientists "as morally and philosophically answerable as the rest of us". Therefore it might please him to learn that I found his book painful to read. But the pain stems not from a guilty recognition of our shortcomings but rather from seeing our work so inadequately and ineptly dismissed. For a start, there is nothing essentially new here: Appleyard is putting a modern gloss on the eighteenth century romantic rejection of Newtonianism, well summarised by Hamann's "The Tree of Knowledge has robbed us of the Tree of Life".

Appleyard's dismissal of the truths of science as evanescent is doubly faulty. First, he underplays the role of experiment and observation, which not only generate simple facts (such as that matter is made of atoms) that change our view of the world and are not subsequently overturned, but repeatedly surprise us and challenge our simplifications. (Anyone who doubts this should reflect on the discoveries in the last decade of quasicrystals, high-temperature superconductivity and the quantum Hall effect – all fundamental and unexpected even in such a theory-driven area as condensed-matter physics.) And second, he forgets that a truth does not disappear when it is subsequently discovered to be a small part of a larger truth.

He might be less apprehensive if he realised the enormous incompleteness of science even in its own terms. While he rightly condemns glimpses of the end of physics as "crude historical arrogance", he seems not to appreciate that (for example) our understanding of the implications of quantum mechanics is still so rudimentary that, given the Schrödinger equation applied to a collection of nuclei and electrons, we would probably not yet have predicted even the existence of molecules. We are able to do quantum chemistry only because we know beforehand that molecules exist.

There is a contradiction in his treatment of the inaccessibility of the insights of science. He rejects the definition of our subject as "organised common sense", and finds it "absurd, almost sentimental, to claim, as would Bronowski, that a plough is like a CD-player". This is because the way the CD-player works is incomprehensible from the outside, unlike a plough. But there is a continuity between the two, and to the engineer the CD-player is a mechanism as transparent in its operation as a plough is to a peasant. To see Appleyard's contradiction, return to that water tower. I am sure he soon learned enough mathematics to demystify every step of his father's calculation. He graduated from the plough to the CD-player. Yet he still finds the mathematics sinister. This can only be because he wants to. I cannot think why.

Nor do I know anybody who feels diminished by learning that they occupy a mesoscale, between the quantum and the cosmos. On the contrary, most non-scientists I encounter feel exhilarated by being thus connected with realms that cannot be perceived by the unaided senses. Moreover, this connection provides a healthy antidote to the often-criticised reductionist disarticulation of the world into components, in a vision of the Universe as a unity (of course incompletely glimpsed – inevitably in my view). Appleyard dismisses this enlargement with contempt: "The stars . . . are no more wondrous than an . . . electric kettle . . . we are supposed to be impressed . . . to be *grateful*."

To 'blame' science for its evil misapplications such as nuclear weapons is like 'blaming' literature for the inflammatory evil of political propaganda (or, for that matter, the corrosive triviality of soap powder advertising). Among scientists and technologists there is roughly the same distribution of high-mindedness, confusion, cowardice, tolerance, greed, etc, as in any other subset of the population. It is naive to think otherwise.

And I find unconvincing his equation of science with the less appealing aspects of modern liberalism, where there are no certainties and "the possibility of choosing one point of view as more valuable than another" is denied. In my experience (especially in American universities) it is the physicists who see most clearly through the "perverse phenomenon of liberal authoritarianism" and the idiotic excesses of 'political correctness'. Why is this? It is because we

have in science (and apparently not recognised by Appleyard) a strong culture of consensuality, where a community works together to winkle out the truth in a sort of cumulative (and generally good-humoured) error-correcting which is, I suspect, unique among human activities; in many cases, the rights and wrongs of a scientific issue really do get settled, even if there is confusion along the way.

After all his raging against science, Appleyard has a responsibility to articulate an alternative vision of society. Instead of "the enforced neutrality of scientific liberalism", he wants us to move towards "realisation of specific excellence within a social context", or (quoting Updike), the recognition that "Existence itself . . . feels like an ecstasy, rather, which we only have to be still to experience". Not much for a scientist to disagree with here, but what about the need for "irreducible affections, values and convictions . . . these need not be defended further because they will express only our kinship with our culture and that kinship will be beyond appeal"? Well, which culture? Is it to be Judeo-Christian culture, English culture, North European culture, Western culture, Thatcherite mercantilism, Medieval Catholicism? Whichever he favours – he does not say – how does he seek to inculcate its myths? Would he eliminate science, for example, by making it illegal to continue to solve the Schrödinger equation, or publish the solutions? And what about those in our troubled but gloriously multicultural society who might have different visions?

Appleyard disappoints us. For him, the answer is beyond words; he provides a quotation from the philosopher Cavell, interpreting this as "saying that it is the philosophers who are wrong rather than the people who simply get on with their lives" – or, as Duke Ellington said: "Too much talk stinks up the place." Such anti-intellectual populism is not only pitifully inadequate, but also a bit rich, coming from one who has just spent 200 pages telling us how science has destroyed people's vision of their place in the world.

Nevertheless, I do recommend scientists to take a little time away from real work at the bench, or dreaming in the bath or at the computer, to learn one man's systematic misunderstandings and distortions of what we do. It might seem a waste of time, but we ought to be aware of a current of opposition that could be on the rise in these mean and shabby times.

Moreover, Appleyard is articulate and well informed; he knows the history of science, and has read his Bohm, his chaology, his Gödel. Unfortunately, though, the vision presented here, however intense and deeply felt, is no more than an elaborate rationalisation of that infantile revulsion at the water tower. As such it is, ultimately, deeply superficial.

Michael Berry is in the Department of Physics, University of Bristol, UK

Don Page

Not-so-brief history of Hawking

Stephen Hawking: Quest for a Theory of Everything Kitty Ferguson 1992 Bantam 192pp £5.99pb
Stephen Hawking: A Life in Science Michael White and John Gribbin 1992 Viking Penguin 304pp £16.99hb
Stephen Hawking's A Brief History of Time: A Reader's Companion ed Stephen Hawking, preparer Gene Stone 1992 Bantam 194pp £16.99hb

AFTER the publication of his best-seller, *A Brief History of Time*, Stephen Hawking has become the most famous physicist alive. With a film about him already released this year, it is an appropriate time for three books to be published on his life and work.

Kitty Ferguson's book is primarily aimed at young adults. It intersperses a basic outline of Hawking's life with a simple description of the key elements of his scientific work. The latter is a good companion to *A Brief History of Time*, often giving a more detailed explanation of points that Hawking covers rather tersely.

I was particularly impressed with chapter two, on the nature and limitations of a complete (physical) theory of the Universe. It elucidates very well the essence of scientific theories, the goal of a "Theory of Everything", the difficulties of calculating predictions from such a complete set of rules, and the uncertainty induced by quantum mechanics.

Ferguson also gives good descriptions of black holes, singularities, black hole explosions, the anthropic principle, spacetime diagrams, sums-over-histories, the Hartle–Hawking no-boundary proposal, wormholes, and baby universes. She defines imaginary numbers and even describes the concept of imaginary time, which Hawking uses extensively. A very short additional discussion could have helped motivate this idea better by showing how an imaginary time dimension is essentially the same as another spatial dimension.

"... the most famous physicist alive"

However, not all of the concepts can be well explained at the level of this book. One section that apparently led to great controversy between some of the experts that Ferguson consulted was the one on "Smearing out the speed of light?". The version Ferguson adopted, which she says was approved by Hawking, seems in my mind to confuse the uncertainty principle of the electromagnetic (photon) field with that for the gravitational (spacetime) field, but the distinction might have been difficult to explain.

Thus, except for making a few minor suggestions for improvements, I was quite pleased with Ferguson's book. Although it by no means attempts to give a complete biography of Hawking or a complete account of his work, it is a highly readable introduction to the man and his science for all laypersons, from young adults upwards.

The book by Michael White and John Gribbin is about twice as long and has many more details of Hawking's life, generally written in journalistic style. Many of the details were new to me, though many I had also seen before in other publications. Thus the account was not so fresh as one might have hoped. This criticism could also be levelled at the biographical account in Ferguson's book, which repeated some of the same stories from earlier sources. However, the criticism is less germane in that book, since the biographical element plays a much more minor role there.

One might argue that a biography of Hawking should include all of the interesting stories about him, whether or not they have been published before. But then one would expect a more scholarly investigation of which details are correct and which are wrong. Although they are generally minor, there are many factual errors in the White–Gribbin book.

For example, John McClenahan is attributed to remembering that in the sixth-form, Hawking immediately answered the question of whether hot tea gets to a drinkable temperature quicker if you put the milk in immediately or right before drinking: "Ah! Milk in first, of course." This made no sense to me and shouldn't have to former astrophysicist Gribbin. I later found the correct answer given by McClenahan himself in an interview in the