

know just where you are. The prose is faultless and a pleasure to read, even though the book is long and the amount of detail embodied in the text is vast. An admirable guiding principle can be discerned throughout — that the concerned reader should not be denied any detail, however small, if it might possibly affect their judgement on the contentious issues before them. This inevitably leads to some difficult passages, with which the reader with no knowledge of basic nuclear physics may struggle. Diehard opponents of nuclear power will no doubt say that, in proposing a safe path to its future use, Garwin and Charpak are partisan. No careful reader of this book could support that claim. The compilation is a full and fair contribution to understanding, and should be studied by everyone concerned with the problems of nuclear power.

Peter Hoffmann writes about the future for hydrogen and fuel cells in *Tomorrow's Energy*. As editor and publisher of *The Hydrogen & Fuel Cell Letter*, he has information on relevant development projects worldwide at his fingertips. In the eye of an enthusiast, hydrogen is the ideal fuel, for whether it is burnt in an engine for propulsion, or used in a fuel cell to generate electricity, the only emission is water. Yet the wider view reveals uncertainties, among them the question of effective generation of the gas. Hydrogen should perhaps be seen as a medium for transferring and storing energy, rather than a primary source.

Hoffmann's book is rich in references to small-scale developments, but poor in data presentation. In more than 250 pages of solid text there is not a single diagram, table or graph. Yet there are two dozen photographs, mainly of experimental vehicles, which add nothing to the technical understanding of the ventures they advertise. Science-based readers will feel deprived. ■

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Somewhere over the rainbow

The Rainbow Bridge: Rainbows in Art, Myth, and Science

by Raymond L. Lee Jr & Alistair B. Fraser
Pennsylvania State University Press: 2001.

408 pp. \$65

Philip Ball

Faced with John Keats complaining about all charms flying at the touch of cold philosophy, we might be inclined to respond, "Oh, not that again!" But this book by meteorologists Raymond Lee and Alistair Fraser shows just how crude, prosaic and clumsy the art/science debate is apt to become, because the book is so much the opposite. Stunningly well informed about the art, science, philosophy and history of all eras since the Periclean Golden Age, unerringly elegant, flatteringly intelligent and beautifully illustrated, it is a masterful piece of accessible scholarship.

The authors have, of course, the perfect subject for bringing together not only art and science but myth, nature and anthropology. And Lee and Fraser refuse to peddle the simplistic device that celebrates Newton's matter-of-fact 'unweaving' of the rainbow and then shows how artists persisted in getting the rainbow wrong. Rather, we see how both art and science are represented by a multitude of voices, making their interplay more rich and complex than is commonly portrayed. I would not have expected the poet Wordsworth to spring to Newton's defence, for example, but here he is: "The beauty in form of a plant or an animal is not made less but more apparent as a whole by more accurate insight into its constituent properties and powers." The physicist Richard Feynman was unable to put it better over a century later.

And it is not hard to sympathize with the

American painter Frederic Edwin Church in 1883: "I wish science would take a holiday for ten years so I could catch up." The book is a joy because of such things, whether you have ever marvelled at a rainbow or not.

But who has not? The wonderful insight that emerges from the book is that, although we all imagine we know just what a rainbow looks like, painters of realistic landscapes reveal an astonishing variety of ways in which the rainbow is perceived. Rubens' version in *Rainbow Landscape* (c.1636) is way off beam, the painter making the classic mistake of representing it as a solid object that can be seen obliquely. The rainbow always faces the viewer in the plane, and moves when we move.

John Constable studied atmospheric phenomena in pedantic detail, yet his rainbow arching over *Salisbury Cathedral from the Meadows* (c.1831) is impossible, because the sunbeams show that the Sun is too high in the sky for the rainbow to be visible at all. In his defence, Constable was not averse to artistic licence, and probably considered it more important here to place the symbol of optimism over the storm-threatened church.

Impossible sunbeams also undermine Eric Sloane's rainbow in *Earth Flight Environment* (1976), for the beams should always be radii to the arch of the rainbow. We needn't get too indignant about Caspar David Friedrich's bizarre achromatic eyebrow rainbow from c.1810, apparently gracing a nighttime sky, for naturalism was probably never of much significance for this supremely Romantic painter, and a devotee of Goethe was unlikely to honour Newton's spectrum.

Lee and Fraser miss no opportunity to explore the rainbow's many subtleties, giving us plenty of colour theory, wave optics and cloud microphysics. They also present a thoughtful survey of the rainbow as an advertising icon. By placing a lottery's 'pot of gold' at the end of a rainbow, the advertisers are inadvertently reminding us just how unattainable it is. Of the rainbows of popular culture, the one most sadly omitted here is the magical arch that symbolically conjures a Technicolor Oz from a monochrome Kansas.

Rainbows are genuine miracles because they reveal, for a fleeting moment and in a structure that seems a mile high, one of nature's best-kept secrets — what light contains, the origin of colour. And the rainbow is truly a bridge, not just between art and science but between myth and reality, heaven and earth. Classical commentators such as Cicero were torn between explaining the rainbow as a natural phenomenon and celebrating it as an emblem of the gods. The Bifrost bridge spanned Midgard and Asgard in Norse mythology, and its shattering was a suitably dreadful image to herald the Twilight of the Gods. Not all cultures revered the rainbow: some considered it an evil omen, and that is surely what it looks like in Dürer's *Melencolia I* (1514), framing a fateful comet. To point at



Rainbow tunnel: a colourful welcome to a tunnel in Marin County, California.

the rainbow was to break an awful taboo in cultures from Mexico to Hungary.

This is a substantial book in all senses: at 400 or so large-format pages on dense paper, it is not something to tuck in your briefcase. Nor does its attention to detail make for light reading. But those things do nothing to alter the fact that we need more books like this, unafraid to assume a degree of commitment and cultural understanding in the reader without ever losing clarity and accessibility. It will bring some colour into your life. ■

Philip Ball is a consultant editor for Nature. His latest book, Bright Earth: The Invention of Colour, is published by Penguin.

A severed thread

Medicine and the German Jews:

A History

by John M. Efron

Yale University Press: 2001. 343 pp. £35, £27.50

John Galloway

John Efron tells us that in today's Germany, out of 200,000 doctors only about 300 are Jews, the same number as when the Second World War began in 1939. Yet in 1933 there had been 5,500. Although it could be difficult to be neutral about such facts, Efron states them objectively, and says why this situation occurred and what it meant — and means. We learn hard lessons about the historical (and the present-day) practice of medicine in Germany — as elsewhere.

The destruction of the Jewish doctors was both an integral part of, and a sub-plot in, the Nazi regime's policy of exterminating entire national and international cultures. In Britain and elsewhere, we tend to think of the Holocaust as part of the Nazi war effort during the Second World War. Efron shows that, on the contrary, the policy of extermination was independent of the war, except that conquest brought more people within its reach. Indeed, it can be regarded as the final act of religious and secular conflict dating back to the Middle Ages.

Efron describes a wonderful ambiguity in the attitudes of the religious and secular authorities to Jewish doctors from the thirteenth to the fifteenth centuries. Royalty, the aristocracy and the clergy used the services of Jewish doctors widely and publicly. Yet at the same time, both church and state forbade Christians to be treated by Jews. That they repeated the ban at intervals suggests that the population ignored it. Indeed, in the thirteenth century, although Jews accounted for no more than 1% of the population of Europe, in many areas half the doctors were Jewish, clear witness to their popularity.

Jewish doctors were highly regarded, but



Lily pads of Wisconsin

A *Sand County Almanac* by Aldo Leopold, one of America's pioneering conservationists, was first published in 1949. It has now been republished (Oxford University Press, \$35) with photographs

by Michael Sewell. The book celebrates the changing seasons on Leopold's Wisconsin farm, and is said to be one of the most influential works on humans and the environment.

for different reasons at different times. Unlike the Greeks, there does not seem to have been an identifiable Jewish medical tradition, but their ability to translate medical books gave them access not only to the Greek tradition but also to Arabic and Indian knowledge. The very fact that they were Jewish also seems to have implied a familiarity with ancient knowledge and practices not available to others. This assumption cut both ways — it could be trotted out as secret and sinister when the need arose, and there was a tradition of accusing Jewish doctors of malfeasance when it seemed convenient. In 1348, foreshadowing the Holocaust, all Jewish doctors in Germany were burned alive, having been found guilty of 'causing' the Black Death.

The book also traces a complementary theme of Jews not as doctors, but as patients. Gradually, the idea grew that the Jews were not as healthy as the rest of us, despite evidence to the contrary. Some early modern Jewish doctors made a special study of Jewish diseases, which may have heightened the sense of a 'racial' difference. The Nazis used this 'genetic science' to justify their policy of racial purification to attain their goal of strengthening the nation.

Jews were early enthusiasts of a scientific approach to medicine — apparently not something that endeared them to their non-Jewish colleagues. In the nineteenth century they were accused of a mechanistic and reductionist approach to the human body and its ills, rather than the more holistic approach generally favoured by doctors. In time, this led to the rise of medical specialisms, with the specialists being predominantly Jewish. This had an unfortunate

consequence. In the First World War, when most of the German medical workforce was drafted, Jewish specialist doctors were not seen to be useful to the war effort — too effete and esoteric to treat the victims of high explosives and machine-guns. They became tarred with the brush that blamed Germany's defeat on the Jews.

In the nineteenth century there had been another issue — too many doctors. The medical profession expected status and a good income. In the period from 1889 to 1898, when the German population grew by about 11%, the number of doctors rose by nearly 60%. Jewish doctors and dentists in German and Austrian cities were in the majority, and increased competition for patients resulted in a loss of income and then status. The medical profession looked for a remedy and turned to, and then on, the Jews, particularly immigrants from Eastern Europe whom they claimed were unfit to be doctors. Some 'assimilated' Jews (including Sigmund Freud) supported this claim at first. Anti-Semitism exploded at every level in the medical schools.

When the Nazis came to power the different historical strands finally came together in a lethal intertwining. German non-Jewish doctors saw the idea of 'national hygiene' — the purging of the national 'body' of the genetic traits that weakened it — as an opportunity for advancement and power. They readily made the first fatal step of rallying to the siren call to leadership. How easily leaders lose their humanity. They slipped from a concern for people's health to the abstract and dangerous idea of racial health — and its lack. Like many others in German public life,