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.*

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.**

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 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,

doctors accepted the opportunities for advancement that the removal of their Jewish colleagues afforded. Pledging the medical profession's support to Hitler in 1933, the head of the two main German medical associations also outlined the economic problems of German doctors. Within a year non-Jewish doctors' incomes had risen by 25%, and within six years, Jewish doctors had been decertified and 95% had fled or were dead.

This is a fascinating and profoundly disquieting book, neatly exposing the tension between medicine as an ethical profession and as a business, and showing how readily the trumpeted human, and humane, values of medicine can be subverted by those of 'science' with perverted ends. It vividly illustrates Abraham Lincoln's remark that all men can deal with hardship but that the real test is how they deploy authority. Required reading for medical undergraduates? I think so. ■

John Galloway is at the Eastman Dental Hospital, 256 Gray's Inn Road, London WC1X 8LD, UK.

Phylogeny branches out

Phylogenetic Trees Made Easy: A How-to Manual for Molecular Biologists
by Barry G. Hall
Sinauer: 2001. 192 pp. $24.95, £18.99 (pbk)

Yves Van de Peer

A little more than 10 years ago, when I was entering the field of phylogenetics myself, the construction of evolutionary trees was often a daunting task. In those, still early, days of personal computers, few programs for making trees were available, and it took about two or three days of fiddling with rulers, Chinese ink and typewriters to produce a publishable tree of less than 100 sequences. A lot has changed since then — currently, about 200 different software tools are available to construct and draw trees. Nevertheless, we had to wait a long time for a book like this. Whereas many other books or book chapters have focused on the theoretical aspects of certain methodologies or techniques, Barry Hall's is the first one, to my knowledge, that actually describes, step by step, how to build a tree.

Undoubtedly, there was a need for such a 'tutorial' book for non-expert users. Tree construction is a complicated business, and for those inexperienced in this matter the inference of phylogenies can be very frustrating, and the choice of programs and different options bewildering. Tree construction was, for a long time, mainly the business of biologists who studied the evolutionary relationship between organisms. In the era of comparative genomics, evolutionary analysis is becoming important in many new fields of research. Phylogenies are used to deduce the relationships — originated by both speciation and duplication — between genes in large gene families across different species. Phylogenomics refers to the discipline that tries to improve functional predictions for uncharacterized genes by overlaying known functions of genes onto an evolutionary tree containing all homologues. Functions of uncharacterized genes are then predicted by their phylogenetic position relative to characterized genes. More and more, phylogenetic principles are used to interpret, and date, gene and genome duplications.

Basically, there are three main methodologies for inferring phylogenetic trees: maximum parsimony, pairwise distance methods and maximum likelihood. Maximum parsimony reconstructs the ancestral character states (nucleotides or amino acids) at the branching points of the tree, and 'chooses' the topology requiring the fewest number of changes to explain the sequences at the tips of the tree. Distance methods compute, for all pairs of sequences, their genetic distance — the fraction of sites that differ between two sequences, corrected for multiple substitutions. A tree is then inferred by considering the relationships among these distance values. Maximum-likelihood methods are statistical methods that try to find the tree topology that maximizes the probability of observing the data, again being the sequences at the tips of the tree. As with distance methods, likelihood methods are based on an explicit model of evolution; now, however, this model is used to compute the probability, or likelihood, of having an ancestral character state at a branching point in a given phylogeny.

Recently, as a fourth approach, bayesian inference has been applied to phylogenetic tree construction; this differs from maximum likelihood in that it depends on the 'posterior probability'. Posterior probabilities of trees are based on the joint probabilities of the tree, branch lengths and the model of substitution, and are approximated by sampling from the entire posterior-probability distribution (the so-called 'tree space', or collection of all possible tree topologies). Bayesian phylogenetic inference is indeed rapidly gaining popularity — partly because of the possibility of including prior information, such as the single origin of a group of sequences — and is obviously Hall's preferred method.

Hall explains how to build a tree from an alignment of sequences using these four different methodologies. In a stepwise manner, a publishable tree is created by making use of the most popular software packages available, such as PAUP* and TREE-PUZZLE.

The book unmistakably derives its strength from the clear examples (for which the data sets are available on the Internet) using software, and this is probably also its major disadvantage. Whereas PAUP* is available for PCs, and the Windows version runs as a 'GUI' application, most options are, unlike the Macintosh version, command-line driven. For those who buy the book but have a PC, this will probably create some frustration, because the step-by-step procedures shown by displaying the menu options and different selections will be hard to execute in a command-line-driven environment. The book could have benefited from including the corresponding commands for the PC version. On the positive side, Hall discusses in detail aspects that may seem trivial, but often are not, such as the rooting and presentation of trees. Furthermore, a large part of the book is devoted to sequence alignment, and the author rightly emphasizes the importance of reliable alignment in tree building.

For many biologists, nothing is more exciting than seeing in a phylogenetic tree the sequences obtained after weeks or months of hard labour in the lab. This guidebook enables students and researchers anxious to start building trees to complete the job in a few minutes, and this will undoubtedly be highly appreciated. Unlike the pioneers, phylogenetic novices today have direct access to the appropriate computer hardware, software, and now even a tutorial manual that can initiate them into this important field of biology. ■

Yves Van de Peer is in the Department of Molecular and Plant Genetics, Flanders Interuniversity Institute of Biotechnology, Ghent University, B-9000 Ghent, Belgium.

Barking up the right tree

***Phaeographis inusta*, found on the bark of deciduous trees and shrubs — from *Lichens of North America* by Irwin M. Brodo, Sylvia Duran Sharnoff and Stephen Sharnoff (Yale University Press, $69.95, £50).**