The last section contains appendices that list the distribution and conservation status of the major plant communities and species of SA's southern agricultural districts. There is also a list of the distribution and status of weed species of SA's southern agricultural districts.

In summary, *Mangroves to Mallee* contains over 1000 full colour images, describes 56 plant communities, 386 native plant species and 112 common weed species that occur in the southern agricultural districts of SA.

Todd Berkinshaw comments that compromises in the accuracy of the information are inevitably made when compiling such a broad publication. He indicates that whilst every attempt was made to respect the original intent of the data sources, liberties could have been taken to present information in a format that is more easily understood by the reader and where possible such inaccuracies are acknowledged in the text.

The author explains that maps are intended only as a guide and that species lists are also intended as a statewide guide only and are not considered to be exhaustive or specific to any particular area of the state.

I can only think in retrospect how helpful this publication would have been when I first started examining plant communities in SA. However, having had to learn the 'hard way' has made me appreciate *Mangroves to Mallee* all the more, knowing how much effort and hard-earned knowledge is presented in the pages. The work of bringing together such a neat, targeted publication is to be applauded. If you have never thought about plants in the contexts of their communities before, *Mangroves to Mallee* serves as a good place to start thinking.

A history of PCR

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***The PCR Revolution: Basic Technologies and Applications*. By Stephen A. Bustin, editor. Cambridge University Press, 2010. xviii+307 pp. ISBN 978-0-521-88231-6 (hardback). AUD$150.**

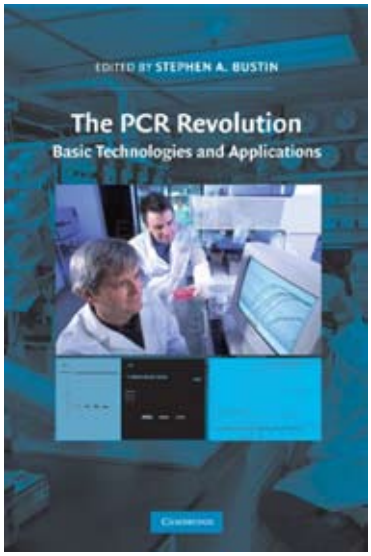
I'm usually not allowed into laboratories. I'm the sort of guy who never had buttons on his lab coat as an undergraduate, and so both the coat and my jeans often had large acid holes in them from leaning against the benchtop. My job in my lab group was to find out why we were doing the experiment and what result we were supposed to get, while the other members attempted to do the actual experimental work. By pooling our resources we all did pretty well. While I learned some worthwhile social skills (extracting information from the other lab groups), I failed to learn any of what you might call practical experimental skills—you see, most of my work was done in the coffee shop. I was not much better at fieldwork either, as I subsequently showed for 3 years of my PhD; and so I have spent a great deal of my later life sitting in front of a computer screen (or, nowadays, two).

I therefore have the required background for reviewing this new book, since it is aimed at people who have some idea what PCR (polymerase chain reaction) technology is about but who are not necessarily involved in it themselves. Still, it could easily be read by the latter group, because what it tries to do is "tell the story of the PCR and to shine the light on some of the scientific advances that would never have happened without it."

To those of you whose biochemical training predates 1990 (as does mine), I will say that the principle of PCR is quite simple. The objective is to increase the amount of selected DNA in a test-tube sample. This is done by getting a bacterial polymerase to do the job for you, since this macromolecule's usual job in a cell is to make copies of DNA. Heating the test tube causes the DNA's double strands to separate. If the DNA is immediately cooled, then any short strands of DNA (primers) that you might just happened to have put into the test tube will bind to the appropriate parts of the DNA. If you then heat the DNA a little bit, the polymerase will make a copy of the sequence between the primers. By repeating this 3-step process a number of times you will exponentially increase the amount of the selected

DNA. In practice, it is a bit more complicated than this, but the principle really is that simple.

PCR came into practical use in the mid 1980s (the patent applications were filed in 1985), although the boom did not start until the end of that decade. This boom is sometimes held up as an example of how rapidly some parts of science can change (Rabinow 1996), and the impact that these changes can have on entire disciplines. This was not a revolution in the Kuhnian sense, because there was no paradigm change. Instead, it was a practical revolution, opening up previously closed doors. Biology as a whole will never be the same as it was before the sequencing revolution, and systematics has been affected just as much as any other part of the biological sciences. Books such as *The PCR Revolution* can therefore be of interest, introducing the incredibly broad spectrum of PCR applications to those whose use of it is more limited.



There are 19 chapters arranged into two approximately equal groups: Basic Technologies, and Applications. Each chapter (average of 15 pages) is essentially a personal view from one or more of the people involved in developing the techniques or key uses. There is nothing particularly technical about the contents, although some basic biochemical knowledge is assumed, especially familiarity with the terminology. Indeed, the assumed level varies considerably between chapters, with some of the authors explaining everything in detail (which is often repeated in different chapters) and others assuming greater familiarity.

There is very little uniting the chapters other than the ubiquitous presence of PCR in one form or another, and the authors' obvious enthusiasm for it. Some chapters are quite anecdotal, reminiscing about a time two decades ago. Others are much more detailed, although still focusing on the development of the techniques and applications rather than on the mechanical aspects of the methods themselves (which are then relegated to literature citations). Breadth of scope is definitely here, as well as focus of attention, but there is no consistent target audience.

The chapters in the Basic Technologies section cover various aspects of the development of the techniques, from the original (qualitative) PCR to quantitative PCR and on to real-time quantitative PCR. Oddly enough, the best introduction to the development of PCR is in the final chapter of this section, by Nolan *et al*. (Chapter 9). If this chapter was placed first then the remaining chapters would follow more logically.

The obvious story missing from this section is that of Kary Mullis, the usually acknowledged instigator of the technique in 1983. A similar idea had previously been published by Kleppe *et al*. (1971), and the whole affair ended up with a court case between the DuPont and Cetus corporations. After all, this was big business: Cetus, one of the first biotech start-ups, got $US300 million when they sold the patents to Hoffmann-LaRoche. (At the same time, Cetus itself was merged with another biotech pioneer, the Chiron corporation.) Furthermore, PCR is reported to have earned approximately $US2 billion in royalties for the various rights holders, by the time the first of its core patents expired in 2005 (Fore *et al*. 2006).

Mullis has told his version of the story several times (1990; 1994; 1998), so its absence here will be noted only by the uninitiated. Mind you, his version is seriously disputed by the many other people involved (see the discussions by Rabinow 1996 and Fore *et al*. 2006). Indeed, the first publication concerning PCR was about an application of the process (Saiki *et al*. 1985), while Mullis' theory paper was rejected by both *Nature* and *Science* (Fore *et al*. 2006). Apparently, this paper was assessed as "merely technical and unoriginal" (Fore *et al*. 2006, p. 5), which may be the scientific equivalent of turning down the

Beatles. *Science* later tried to regain some lost ground by selecting PCR as the major scientific development of 1989.

Many of the techniques discussed in the Applications section of the book are unlikely to be of much immediate practical use to systematists, who have so far focused mainly on the simple determination of gene sequences. Most of the more lucrative applications were "unplanned" rather than being the result of explicit business strategies. Medical diagnosis and treatment play much the largest role in the Applications section, getting six of the ten chapters. This reflects the initial impact of PCR technology (in 1986), which was mainly in human diagnostics—PCR did not become a basic research tool until later on (1989). Perhaps the most directly relevant chapters for a systematist are those on ancient and archival DNA, the business of so-called 'molecular archaeology', although genetic variation is another obvious topic.

Sadly, the chapter on 'archival material' (Chapter 16) defines its subject matter as "'old' tissue samples stored in the deep freezer in the laboratory, air-dried by nature and stored at a dry place (e.g. a cave), or tissue frozen by nature and stored below 0°C by nature (e.g. in Alpine glaciers or the permafrost of Siberia or Alaska)." You will note that this definition seems to exclude herbarium and museum specimens, and indeed the author remains blissfully unaware of them. He makes a big song and dance about the "major breakthrough in medical research" of being able to combine modern biology with the "'dormant knowledge' collected over the last decades in the archives", without noting that systematists discovered and started exploiting this idea several centuries ago. It still amazes me just how ignorant of our discipline even well-educated people can be, and just how often the wheel can be re-invented by people who should know better.

Indeed, the biggest limitation of *The PCR Revolution* is its focus on diseases and medicine, as though the rest of biology does not exist. There are probably several stories missing from this section of the book, but to us the use of PCR in evolutionary biology is the most obvious of them. For example, the study of genetic variation is probably more abundant outside of medicine than inside it, but you would never know it from this book. Most of the discussion of it in Chapter 18 is actually quite general (and well written) but any time that a specific example is mentioned it is always medical in nature. Indeed, the only chapter in which biology gets at least equal time with medicine is in Chapter 19, on 'ancient DNA research'. Here, we get to hear about quaggas and moas, mammoths and bison, and even cave bears and cave hyenas. Sadly, the only way that a non-human can get into this book is to be extinct.

Needless to say, this final chapter of the book is not only the most relevant to systematists (it is the only chapter containing the word 'phylogeny', and the only one acknowledging the existence and usefulness of museum specimens) it is also the most interesting. Using PCR it is possible to study specimens containing only a single DNA molecule, although this comes at the expense of almost certain contamination from modern DNA. Nevertheless, ancient DNA has been used to study everything from phylogeny to population genetics to vegetation communities. Due to the inevitable degradation of the DNA molecules, the current practical age limit is apparently about 500,000 years, and most studies are restricted to short sequence reads.

I quite enjoyed this book, despite the variable quality (and quantity) of the presentations and the blatant bias. However, I couldn't help thinking about the sadness of technological revolutions, in spite of (or perhaps because of) the enthusiasm of the authors. For instance, relatively simple sequencing techniques first came into practical use in the mid 1980s. I well remember the fate of one of my student office mates, who was working on bacterial DNA sequencing for his PhD in the early 80s. At the end of his time he repeated the entire previous 3 years' of laborious lab work in 3 weeks with the new technology. At least fieldwork is never like this.

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Botany on trial

Forensic Botany: cases from Queensland

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The solving of crimes from fragment and pollen identification is a little known aspect of botanical work associated with the service side of a herbarium, particularly those attached to State Government Departments. In Queensland, this work has included a number of interesting cases over the past 30 years, from all parts of the State. Botanists at the Queensland Herbarium have been called upon as expert witnesses to help solve major crime including drugs, robbery and murder.

Great train robbery

Gold was transported from north Queensland to Brisbane by train under high security. How then did it happen that the bags, when opened in Brisbane, contained only soil, leaf fragments and snail shells? The leaf fragments belonged to a species of rainforest tree only found north of Bowen and the snail shells were identified as a species only found north of Ayr. This information assisted the police in narrowing down the area in which the heist occurred.

Flower haired thief

In a sleepy small town, an orange-flowered shrub was growing under a Jacaranda, which provided good cover for the thief who climbed in through a window. The police had their man but had little to go on—just a few flowers and leaves from his hair. They were identified as *Streptosolen* flowers and Jacaranda leaves. A later inspection confirmed that the property in question was the only one in town that had these two species.

Stolen aircraft

An light aircraft mysteriously went missing and then turned up at the same airfield in a few days time. Just before the theft, the plane had been thoroughly cleaned, but the returned plane had mud with grass on the tyres. The grass turned out to be a species of *Poa* only found in a limited area of NSW, and assisted the police in directing their enquiries.

Angel trumpet party

A young teenager brewed tea from a nearby Angel's trumpet bush and adding it to the punch at a party. The death of a girl was the result. The pieces of leaf material from the punch was verified as *Brugmansia* x *candida*.

Scullcap skunk

We first encountered the odd looking "skunk" cannabis in a case involving "herbal" tea. The defendant apparently thought that he was taking the herb "skullcap". Skunk is a low-growing bushy cultivar that has palmately divided leaves rather than the usual digitately compound leaf. Under the microscope, however, the features were unmistakable.

Body in the creek

A body had been dumped in a black soil creek – unusual country with very distinctive vegetation. The police had their suspect, and his car, and were trying to link the car to the place where the body was dumped. Grass seeds were found to be embedded in the mud on the tyres. The seeds were identified as a species of grass only found in the unique habitat where the body was found. Under cross examination, the verification of herbarium information was questioned: were all the specimens/records collected and identified by qualified botanists?

Polymerase Chain Reaction â€¢ In vitro method for the amplification of short (up to ~5000 bp) pieces of DNA â€¢ Relies on a thermostable form of DNA polymerase â€“ Thermus aquaticus. Polymerase Chain Reaction â€¢ Required reagents: â€“ â€“ â€“ Template DNA Primers* DNA polymerase d. NTPs* Thermocycler.Â It is an indicator of the magnitude of the signal generated by the PCR * Rn is plotted against cycle numbers to produce the amplification curves and gives the CT value. What is Rn? +Rn Sample Rn Rn Threshold No Template Control CT 0 10 -Rn 20 cycle number 30 40.