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Newsletter

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AUSTRALIAN SYSTEMATIC BOTANY SOCIETY INCORPORATED

Office Bearers

President

Dr B.J. Conn
Royal Botanic Gardens Sydney
Mrs Macquaries Road
Sydney NSW 2000
tel: (02) 9231 8131
fax: (02) 9241 2797
email: barry@rbgsyd.gov.au

Secretary

Mrs R.M. Barker
Plant Biodiversity Centre
Dept for Environment, Heritage & Aboriginal Affairs
Hackney Road
Hackney SA 5069

tel: 08 82229348
fax: 08 82229353
email: rbarker@dehaa.sa.gov.au

Councillor

Bob Makinson
Centre for Plant Biodiversity Research,
CSIRO, GPO Box 1600, Canberra, ACT 2601

email: Bob.Makinson@ea.gov.au

Vice President

Bill Barker
Plant Biodiversity Centre
Dept for Environment, Heritage & Aboriginal Affairs
Hackney Road
Hackney SA 5069

tel: 08 82229303
fax: 08 82229353
email: bbarker@dehaa.sa.gov.au

Treasurer

Elizabeth Brown
Royal Botanic Gardens Sydney
Mrs Macquaries Road
Sydney NSW 2000
email: elizabeth_brown@rbgsyd.gov.au

Councillor

Kristina Lemson
Dept of Botany
University of Western Australia
Nedlands, WA 6907

email: lemson@networx.net.au

Affiliate Society

Papua New Guinea Botanical Society

Australian Botanical Liaison Officer

Dr R. Chinnock
Herbarium
Royal Botanic Gardens, Kew
Richmond, Surrey TW9 3AB
England
tel: 44-181-3325270
fax: 44-181-3325278
email: ablo@rbgkew.org.uk

Public Officer and Membership Officer

Mr A. Lyne
Australian National Herbarium
Centre for Plant Biodiversity Research
GPO Box 1600
Canberra, ACT 2601
tel: (02) 62465508
fax: (02) 62465249
email: al@anbg.gov.au

ASBS Web site: http://www.anbg.gov.au/asbs

ASBS INC BUSINESS

Annual General Meeting

The Annual General Meeting of the Australian Systematic Botany Society Incorporated will be held in association with the workshop on historical associations of genes, organisms and areas (see p. 2) in the National Herbarium of New South Wales, Sydney Botanic Gardens, on Thursday evening, 8th June 2000.

Council Elections

In accordance with the Society's Constitution, nominations are hereby called for all positions on the Council for the 2000-2001 term of office: President, Vice President, Secretary, Treasurer and two councillors. The current office-bearers are all eligible for re-election.

Each nomination must be proposed by two financial members, and the nominee's acceptance of the nomination must accompany the nomination form. Nominations must be made on the form included in this *Newsletter* or a facsimile of it. All nominations must be in the hands of the returning officer (Robyn Barker) by Friday 26th May, 2000.

NOMINATION FORM

Note: A separate nomination paper or facsimile of the same is required for each candidate.

We, the undersigned members of the Society, wish to nominate

---

for : President, Vice President, Secretary, Councillor.
(Please delete the offices that do not apply to your nomination)

First Nominator

Name: .....

Signature

Second Nominator

Name: .....

Signature:

I hereby consent to my nomination for the position of .....

Signature..... Date.....

Nominations must be in the hands of the Secretary by Friday, 26th May 2000.

Secretary: Mrs R.M.Barker
C/- Plant Biodiversity Centre
P.O. Box 2732
KENT TOWN S.A. 5071

Phone: (08) 8222 9348 Fax: (08) 8222 9353

ASBS Workshop

ASBS is sponsoring a workshop on historical associations of genes, organisms and areas, to be run by Dr Rod Page in June, 2000.

Many members will be familiar with the work of Dr Rod Page (University of Glasgow) on computerised methods for analysing historical associations between phylogenies. Methods that he has developed have been used to fit gene trees to species trees, parasite trees to host trees and area cladograms to general area cladograms. Rod has also written computer programs such as COMPONENT and GeneTree to implement these methods. He has agreed to run a two day workshop on his software for ASBS. The details are as follows:

Preferential registration given to ASBS members (until 8 May 2000).

Venue: Caley Seminar Room, Royal Botanic Gardens Sydney.
Dates: 8-9 June 2000.
Registration fee: full $150.00; student: $75.00.
Essential: BYO personal computer (preferably laptop or notebook computer; it must be either Intel-based PC running Windows 95/NT 4.0 or later, or Apple Powermac running Mac OS 7.5 or later).
Accomodation: ASBS is not organising accomodation for participants but the RBG can recommend both Balmain Lodge (415 Darling Street (cnr Birchgrove Rd), Balmain 2041; phone: 02 9810 3700) and the Macleay Astor Apartments (see http://www.astor-hotel.com.au/astor-hotel/index.htm).

Contact: Dr Peter Weston, Royal Botanic Gardens Sydney, Mrs Macquarie's Road, Sydney 2000; email: peter_weston@rbgsyd.gov.au

ABRS REPORT

Restructure of ABRS

As foreshadowed in the last newsletter, ABRS is now in the throes of a major restructure. An Interim Director, Dr Bill Phillips, has been appointed for 6 months from 1 March, to manage the change process. He will be looking at the full suite of ABRS activities, including the Grants process, the Publications process, and interactions between ABRS and its stakeholders. He will be consulting widely with individuals and organisations to gauge their needs and views. In this he will be assisted by Dr Geoff Dyne, who will also be with ABRS for 6 months, beginning on 3 April. I have reverted to my previous position of Executive Editor, Flora.

Publications

Flora of Australia vol. 17A, Grevillea, is expected to be published in the first or second week of April 2000. Despite the appearance in recent years of a number of books on this important genus, the *Flora of Australia* treatment will make a further major contribution to knowledge. It contains a substantial number of new taxa discovered in the last few years, and the author, Bob Makinson, has re-examined the work of his predecessors, making a number of changes to the taxonomy adopted by researchers such as Olde, Marriott and McGillivray. The book is obtainable from CSIRO Publishing, for $89.95 for the hard cover and $69.95 for the soft cover version. Orders can be placed through the CSIRO Publishing website (http://www.publish.csiro.au/), by email on sales@publish.csiro.au, or by writing to CSIRO Publishing, PO Box 1139, Collingwood Vic 3066.

Floodplain Flora of the Northern Territory. This book is to be published by ABRS by about the middle of 2000. Written by Ian Cowie and Philip Short, and lavishly illustrated by Monica Osterkamp Madsen, the book describes over 300 taxa found on the coastal floodplains of the 'Top End'. It includes 90 full page plates of line drawings, keys and descriptions, and 14 pages of colour plates. It will be a 'must have' guide for those visiting Kakadu and nearby areas, and will also have considerable application in adjacent areas of Western Australia and Queensland. Details on price and availability will be provided in the next report.

Marine Plants of Australia. ABRS has entered into a joint publishing agreement with University of Western Australia Press, to publish a major new work, *Marine Plants of Australia.* Written by Dr John Huisman, this book will provide descriptive information about many of the major genera of macroalgae and vascular plants of Australia's coasts. The descriptions are accompanied by excellent underwater photographs of representative species, and line drawings of anatomical detail. The book is expected to be published about August 2000.

Allan Cunningham's Collecting Localities During the King Coastal Surveys. By mid-year ABRS also hopes to publish a book detailing the collecting localities of Allan Cunningham during the King coastal surveys of 1817-1822. This should make the task of locating and documenting Cunningham collections from this key period of botanical exploration much easier. The book is written by Suzanne Curry and Bruce Maslin, with maps by John Maslin.

101 Forest Fungi. A LucID CD-ROM key and descriptive account of some of the more spectacular macrofungi of eastern Australian forests will be jointly published by ABRS and Knowledge Books in the next few months. The information package and identification guide has been written by Dr Tony Young, and is intended to be an introduction to these interesting organisms. It will be marketed by Knowledge Books, 40 Seaview St, Brighton Qld 4017.

Tony Orchard
Executive Editor, Flora

ABLO REPORT

It has been a pretty mild winter this year with relatively few heavy frosts although the short days and overcast weather has been a novelty. Like many Londoners I enjoyed the Christmas-New Year Period suffering from the flu. Spring has arrived very early. In February, London had its highest amount of sunshine since records began although I must have missed this event while on holiday in Ireland for two weeks!

Kew Gardens is now bursting into life with carpets of crocus covering the lawns and daffodills and snowdrops everywhere. Many *Pyrus* species are in full flower. Female ducks are being chased everywhere, in some cases with 5 or 6 suitors in pursuit.

Kew news

Thanks to the IT people at Systems Support Branch, no problems were experienced when the clocks turned over on January 1st.

The new security system that I mentioned in my last report is still not up and running but it is hoped that it will be functional soon. It is somewhat complicated as it involves restricting access to Wings C and D directly from the Foyer as well as access to the Library.

Award

On January 31st Ms Margaret Stones was honoured with the Kew Award for her outstanding service to the Royal Botanic Gardens.

Visitors

The winter period has been very quiet. Lucy Smith, botanical artist (James Cook Uni) is currently working at Kew with John Dransfield, curator of Palms, on the "Palms of New Guinea." This is a collaborative project between Kew and a number of other institutions including Lae, Bogor and James Cook University.

Printer

Although the ABLO had a bubble-jet printer, I found out on my arrival, that it was well past its use-by-date and non-functional, so I had to share the Central Management Units printer, as did Alex Chapman before me. This was unsatisfactory as the printer was located downstairs and was often used by CMU for specialist jobs so it was always necessary to check each time before use. It was also completely unavailable for most of December – early January during fumigation and renovation of the CMU room and consequently impeded correspondence. On the recommendation of Kew's IT section and after discussion with ABRS, funds were provided by ABRS for the purchase of a Hewlett Packard Laserjet 1100.

Phone numbers
Telephone area codes will change in London from the beginning of April. Central London 0171 will change to 020 7 followed by the phone number and outer London numbers starting with 0181 will change to 020 8 followed by the existing number. The Kew ABLO phone number is 020 8332 5270; Fax: 020 8332 5278. At the moment either area code can be used.

Lectures
Three lectures have been given this quarter:
15.i.2000: *Australasian Xerophytic Pteridophytes* to the British Pteridological Society at the British Museum.
21.i.2000:*Tmesipteris on the Pacific Rim*, at a fern day symposium held at the Royal Botanical Gardens, Kew.
24.ii.2000: *Mesemb Genera of the Southern Hemisphere*, Brighton Branch, British Cactus & Succulent Society.

Herbarium visits
I will be in Zurich March 18th –26th to attend the International Organisation for the Study of Succulent Plants Symposium and will be visiting **Z.** In early June I will be in Leiden and, if funds permit, I may revisit Paris LATE June or July if the Herbarium is re-opened. Currently the building is being electrically rewired. I intend to visit Cambridge (**CAM**) and Oxford (**OXF**) in the next few months.

British Museum of Natural History news

The BM is pushing ahead with ambitious plans to fund a new Darwin Centre, to house its Entomology and Botany collections. The new building will provide improved storage and working facilities, and increased public access to the collections.

At the end of November last year the Bernard Sunley Special Collections Room was completed. This now houses the Sloane Herbarium, and other pre-Linnean book-mounted collections, and will eventually also hold the Museum's Linnean specimens which, at present, remain in the General Herbarium.

The removal of the Sloane Herbarium from the General Herbarium will now allow compactors to be installed in the emptied area, and provide much needed expansion space for the collections.

Linnean Society of London news

The Committee has just agreed to set aside a fund to commence digitisation of all the Linnean and Smithian specimens.

The cases for the Smithian Herbarium are now waiting for new steel shelving, which will hold the boxes containing the collections once the conservation work has been completed. The conservation work includes removing centuries of accumulated grime from the sheets, securing the plant specimens where necessary and placing them in new folders. The data-basing of label information is now well underway and is also being done at Liverpool where the bulk of the collection has been transferred for both aspects of the work.

Bob Chinnock

ARTICLES

Eichler award recipient's report

Leaf blades or floral clades – A guide to spinifex phylogeny

The Australian tribe of grasses, Triodieae or 'spinifex', was well known to the early explorers of the continent's centre. The tough sharpened leaf blades of this 'porcupine grass' were a dreaded obstacle to the adventurers' vain pursuit of fertile lands and inland seas – a real Australian 'thorn in the side'. For most, the endless spinifex grasslands symbolised a harsh and monotonous, if not hostile Australian desert, a place to heroically endure rather than celebrate.

Yet, spinifex grasses are of great importance to what is a dynamic, biologically diverse and culturally rich arid zone. In many areas these grasses form the primary perennial biomass, providing habitat for the world's richest lizard fauna and several endangered mammals, playing a dominant role in the region's fire ecology and supporting a diverse ephemeral flora in inter-hummock areas (Griffin 1984). They form pure hummock grasslands or a dominant understorey on over two million km^2 of the continent – the single most extensive vegetation type in Australia (Griffin 1984).

William Dampier, in 1699, was the first European to collect a hummock grass (George 1999), although indigenous Australians have long used and traded the adhesive resin produced by some spinifex species. Dampier collected a specimen of what is now called *Triodia danthonioides*, from the southwest coast of Western Australia. For many years, the species was included in the genus *Plectrachne*, along with 15 others with remarkably similar spikelet characters of long linear glumes and three elongated awns on the lemma.

In contrast, *Triodia*, described by Robert Brown, has traditionally been distinguished from *Plectrachne* by its relatively short obtuse glumes and variously lobed or emarginate lemmas. In his recent comprehensive revision Mike Lazarides (1997) transferred *Plectrachne* into *Triodia*; the original glume and lemma criteria failed to account for the many species newly described in the post-war period. Instead, nine infrageneric groups were erected similarly based on features of the spikelet and inflorescence. A couple of smaller genera were retained; *Monodia* which is monotypic and *Symplectrodia* with two species from Arnhem Land.

The tribe now comprises 67 described species and includes considerable variation in the floral parts. However, there appear to be two quite different types of leaves that cut across these generic and infrageneric classification schemes. This leaf anatomical variation was first documented by Nancy Burbidge in the 1940's, but is significant enough to have attracted the common names, 'hard' versus 'soft' spinifex. 'Hard' taxa have stomata on both sides of the leaf, whereas 'soft' lack stomata and associated photosynthetic tissues from the outer leaf surface. 'Soft' spinifex species are, with one exception, restricted to the monsoonal region of the arid north. Species with the 'hard' type anatomy are found throughout Australia's north as well as the temperate south (Lazarides, 1997).

A survey of the 67 described species in the tribe identified 40 with the 'hard' type anatomy including *T. danthonioides*, whilst 27 species are 'soft' (Mant, unpublished). Both types occurred in the former *Plectrachne* and *Triodia*, and now six of the infrageneric groups are polymorphic for the leaf character. *Monodia* is 'soft', while *Symplectrodia* is 'hard'. Have these leaf forms arisen many times as the classification implies? Or are there, instead, discernible patterns of convergence in spikelet characters?

To resolve these competing claims for character importance, a morphological and molecular phylogeny of the tribe was attempted with some much needed financial assistance from the Hansjorg Eichler Research Fund. Molecular results from the ITS region of nrDNA support the recognition of two lineages corresponding to the hard – soft leaf

anatomy, as well as confirming the tribe's monophyly (see Mant et al. in press). *Symplectrodia* is nested within the 'hard' group, while the relationship of *Monodia* to the 'soft' clade remains uncertain. Instead of plasticity in leaf anatomical characters, these data point to strong convergence in key spikelet and inflorescence characters. It would seem that both *Plectrachne* and *Triodia* were not monophyletic as previously circumscribed.

Outgrouping supports a single derived origin of the 'soft' leaf, with the 'hard' type species forming a basal paraphyletic group in the tribe. Re-examination of the leaf anatomy indicates the two forms are likely to have markedly different physiologies relating to water use and photosynthetic activity (McWilliam and Mison 1974; Craig and Goodchild 1977). The 'soft'-type leaf anatomy may well be an adaptation to the more predictable rainfall of the monsoonal arid north.

In any case, Dampier's *T. danthonioides* and its other 'hard' allies from S-W Western Australia do not share recent ancestry with the northern monsoonal 'soft' species such as *T. schinzii* (the type of *Plectrachne*) and *T. pungens* (the type of *Triodia*). Overall, I would argue that features of the spikelet and inflorescence are unsuitable for generic classification in this tribe of grasses. Instead, it turns out that the key to the thorny issue of higher level spinifex relationships is to be found within those harsh spiky desert leaves.

References

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McWilliam, J. R. and Mison, K. (1974) Significance of the C_4 pathway in *Triodia irritans* (Spinifex), a grass adapted to arid environments. *Australian Journal of Plant Physiology* **1**: 171-175

Jim Mant

Jim Mant studied the systematics of Triodieae for his BSc Honours degree at The Australian National University and CSIRO Plant Industry. He is now doing a PhD on the comparative biology of *Chiloglottis* (Orchidaceae) and their sexually deceived thynnine wasp pollinators at ANU and Royal Botanic Gardens Sydney.

Email: jim.mant@anu.edu.au

Sharing Accession-based Herbarium Information

Introduction

This is a revised version of an article originally published in 1998 on the HISCOM Internet site (http://www.rgbsyd.gov.au/HISCOM). Since those who are not regularly using the Internet will not be aware of the principles presented in this paper, several herbarium curators have suggested that this article be circulated in the traditional print media.

Summary

Herbaria maintain large amounts of botanical information. Increasingly, this information is held in a computerised format. However, these data are rarely shared between similar botanical organisations, but rather, are often inadequately duplicated throughout the botanical community. This presentation discusses the costs of not sharing this information, both to the institutions involved and to the general community.

Interchange Agreement (1996)

The agreement by the *Council Heads of Australian Herbaria* (**CHAH**), at their general meeting in Darwin (1996), to freely interchange electronic herbarium label data between all major Australian herbaria, represents a significant transnational commitment to the sharing of botanical data. The 'Darwin 1996' commitment by **CHAH** requires a paradigm shift from the frequently politically State-defined philosophies and strategies of the past, to a more collective and cooperative national approach. This study reviews the first five months of the application of **HISPID3**[1], the standard format used for the interchange of electronic herbarium label data.

Rationale for Interchange of Electronic Herbarium Data

The rationale for sharing electronic herbarium data between Australian herbaria is that data entry consumes considerable personnel and financial resources, as well as time. The relevance of the need for sharing electronic data is based on the assumption that herbaria want a 'representative' collection of specimens for a region and/or taxa.

Aims Of Electronic Exchange Program

Overall Aims

The overall aims of the implementation of an electronic exchange program, using **HISPID3**, are:

- to reduce the time taken for data entry at each herbarium;
- to improve the quantity of information available to each institution;
- to improve the quality of information available (according to national standards).

Specific Aim

The specific challenge for all Australian herbaria is

- to ensure that every major Australian herbarium provides an electronic version of herbarium label information for all plant specimens exchanged, in **HISPID3** format, by the end of 1997.

Specifications

The specific details presented here, are based on statistics gathered from the *National Herbarium of New South Wales* (**NSW**), Royal Botanic Gardens, Sydney.

- In general, the herbarium's collection exchange policy aims to ensure that the number of donations from **NSW** should approximately equal the number of donations received.
- There are no formal specifications concerning the number of replicates that should be collected. This is largely left to the discretion of the collectors, within the requirements of the above specification.

Statistics

From 1992 until the end of 1996, the herbarium label information of more than 180,000 collections held at **NSW** were entered into the institution's database. Of these, 23% (c. 41,700 specimens) had been received from other institutions.

Even though **HISPID3** has been accepted as a standard format for the interchange of herbarium label data, between Australian herbaria, only the National Herbaria of Victoria (**MEL**) and **NSW** regularly exchange using this format by the end of 1996.

[1] Conn, B.J. (ed.)(1996). HISPID3 - Herbarium Information Standards and Protocols for Interchange of Data, Version 3, Royal Botanic Gardens, Sydney. [Internet URL - http://www.rbgsyd.gov.au/HISCOM].

Herbarium data have been received by **NSW** in non-**HISPID3**, albeit electronic, format from the Australian National Herbarium (**CANB**), the Northern Territory Herbarium (**DNA**), as well as from various New South Wales' State university herbaria and other State government agencies.

Almost all other herbarium label data, received as donations, are data processed again at **NSW**. This is still the *modus operandi* for most recipient institutions, both overseas and within Australia.

Analysis of Data

Approximately 55% of the collections made by NSW staff (from 1992 until the end of 1996) are unicates, 26% have one duplicate, with collections consisting of more than one replicate significantly less (Fig. 1).

If the total number of samples are compared with the number of replicates, in each collection, then much more material is represented by unicates (Fig. 2). Each collection by **NSW** staff has an average of 1.8 replicates (i.e. 3 samples).

Cost Of Data Entry

The average cost of data-processing a specimen is based on the considerable data entry projects funded through the *Environment Resources Inventory Network* (**ERIN**) during the 1980s.

- Although the financial cost of data entry of herbarium specimens slightly differs between herbaria, the average of cost is approximately $5.00 per specimen.
- This figure allows for the many daily activities, besides data-processing, that data entry staff have to deal with.

Therefore, the collection databased by **NSW** staff from 1992 until the end of 1996 (180,943 collections), represents a financial commitment of over $180,000 per year for this period. However, 41,705 of these collections had been received as donations, many of which had already been databased at the originating herbarium. Therefore, of the previous amount, **NSW** committed approximately $41,000 per year duplicating data held at the originating or other herbaria.

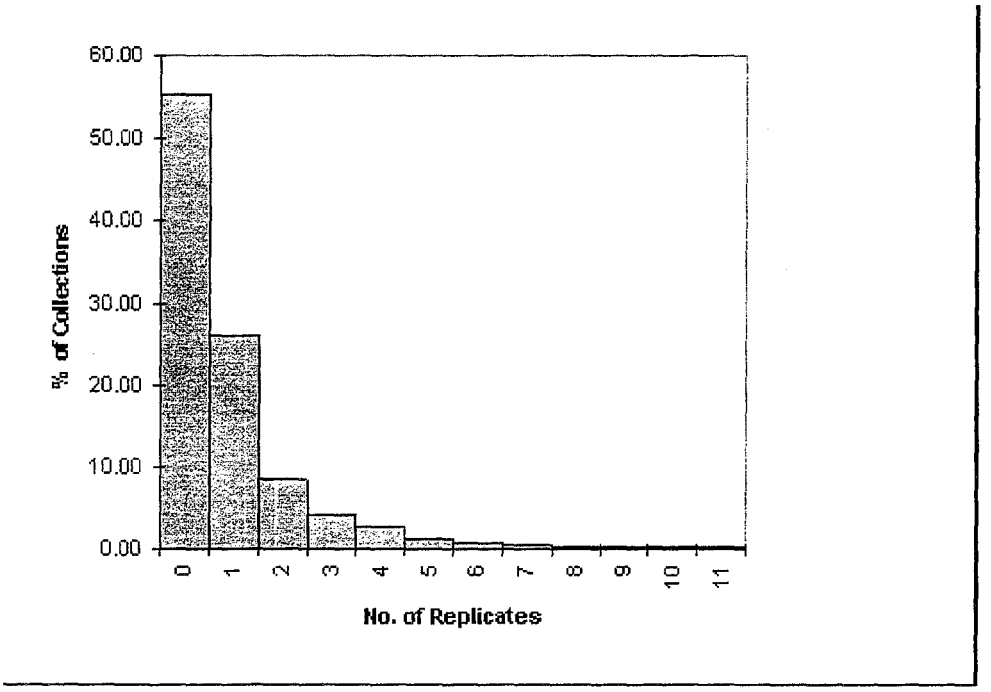

Figure 1. Average number of replicates collected by NSW staff as a percentage of the total number of collections.

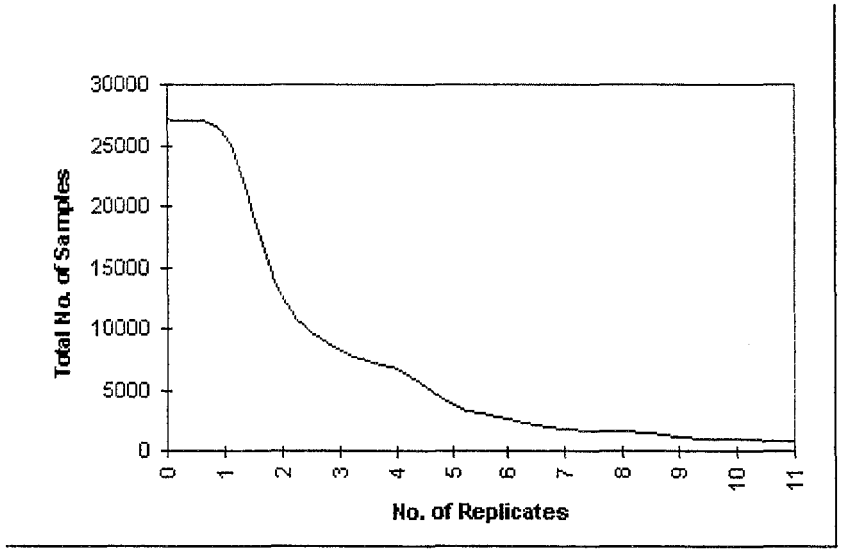

Figure 2. Total number of samples (collections plus replicates) per number of replicates in each collection.

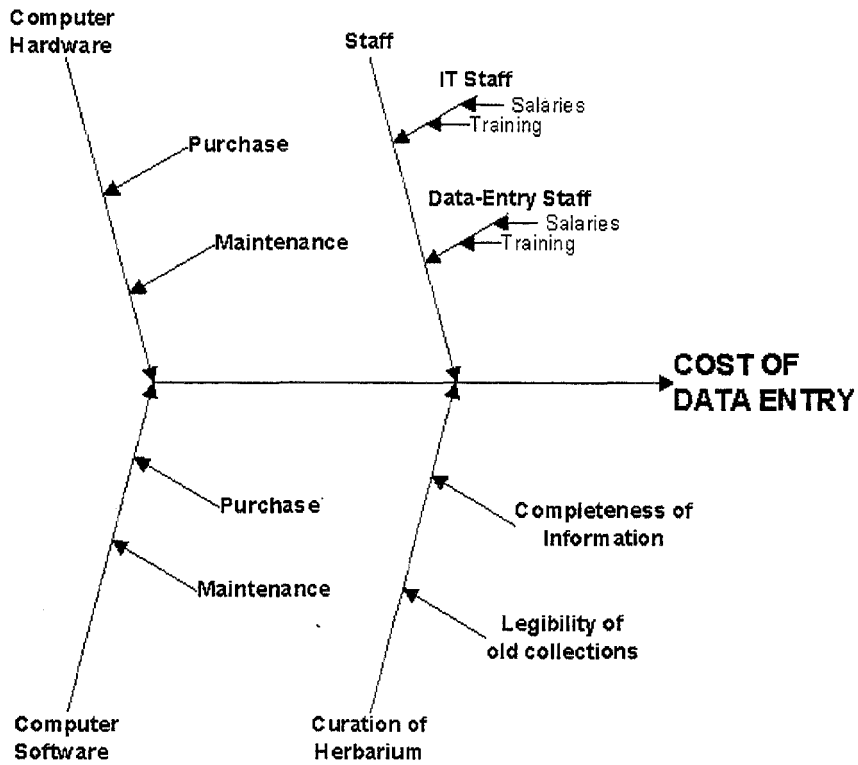

Figure 3. The factors contributing to the costs of Data processing the Herbarium label information.

Factors Contributing to Data Entry Costs

There are several factors that contribute to the final cost of data-processing herbarium label information (Fig. 3). A significant investment of resources is required to establish an appropriate computer system and database. Associated with these expenses, Information Technology personnel, either as staff or consultants, are required to develop and maintain the computer system. Resources are directly required for IT staff training or indirectly in the form of equivalent consultant expertise. Likewise, resources are required to ensure data-entry staff have adequate skills. The completeness, and hence, standard of the curation of herbarium specimens also effects the amount of time spent completing or adding herbarium label information (e.g. adding latitude and longitude geocodes for spatial data, or deciphering handwriting or abbreviations on the label).

However, on a national or global scale, the 'Cost of Data Entry' is only one of the contributing factors of the 'Overall Costs of Herbarium Label Data Capture' for any institution. The herbarium label information can either be directly entered by institutional data-processes (as assumed in Fig. 3) or this information can be electronically provided by donating institutions.

How To Reduce Data-Entry Costs Nationally

The specific aim of this proposal is:

- to reduce the cost of data entry by donating electronic herbarium label data between all major Australian herbaria, as part of the normal herbarium exchange program, with implementation of the methodology by the end of 1997.

Assessment of Current Practice

Approximately 300,000 collections have been databased at **NSW**, representing a cost of about $1.5 million just for data entry. That is, approximately $150,000 per annum over 10 years. Although many of these collections are replicates received from other institutions, a significant amount of this material is not held in an electronic form elsewhere. However, modern Australian material exchanged between herbaria, is almost always held in an electronic form by the donating institution. Therefore, this form of the data represents an important opportunity for Australian herbaria to reduce the national costs of electronic data capture.

Cost of Incorporating Electronic Data into an Herbarium Database

Initial Costs

Apart from hardware and software expenses specific to the database, there is an initial expense in developing software to manipulate the information held in a database so that it is compatible with the **HISPID3** interchange standard. Likewise, software is required to transfer incoming **HISPID3**-formatted data 'back' into a form that can be incorporated into the institution's accession database. For **NSW** to be in a position to exchange electronic data, more or less according to **HISPID3** format, has cost approximately $4,500, representing approximately one month of development time by institutional IT staff.

Interchange Costs

In recent years, Australian herbaria receive approximately 3,500 replicate collections and donate a similar number, as part of the herbarium exchange program. Although the cost of direct data entry was known, the actual cost of incorporating similar, but electronic data, transferred from one institution to another, had not been calculated. Herbarium data transferred from the National Herbarium of Victoria (**MEL**)(in **HISPID3** format), from the Australian National Herbarium (**CANB**) and the Northern Territory Herbarium (**DNA**)(both converted by **NSW** to **HISPID3** format) established an average cost of $0.60 per specimen.

This figure is based on capturing an average of 50 specimens per hour of electronically interchanged records, compared to an average of six specimens databased per hour when directly data entered.

Reducing the National Cost of Data-Capturing Herbarium Label Data

The costs of directly data-processing the original collection plus each of the replicates (in different institutions) is significantly more costly than data-entering the information once and then electronically interchanging this information with the replicate material (Fig. 4). For example, the average cost of data-processing a unicate collection is $5.00; whereas a collection with one replicate is

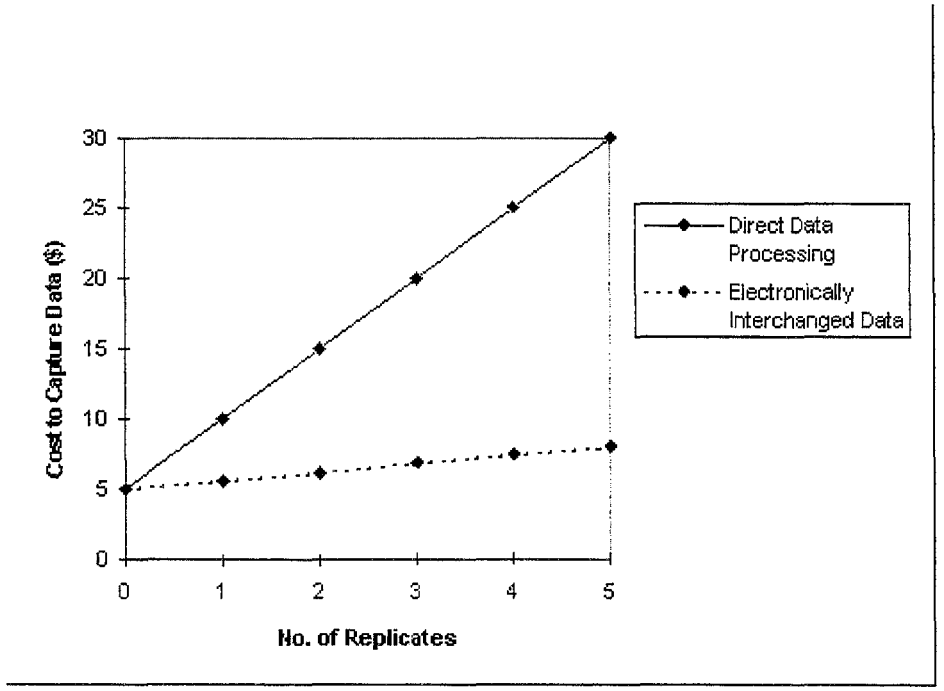

Figure 4. The average cost of directly data-processing the herbarium label data of one collection with none, 1, 2, 3, 4 or 5 replicates, compared to the cost of capturing that data by electronically sharing this data.

$10.00 (compared to $5.60 ($5.00 + $0.60) for sharing the electronic data with the recipient herbarium); one collection with two replicates is $15.00 (compared to $6.20); and so on.

Cost-Benefit Analysis

- **COSTS:**

If it is assumed that an organisation is committed to electronically storing the herbarium label data of their botanical accessions, then it is relatively easy to estimate the more significant financial costs of developing and maintaining an electronic interchange system. As part of this analysis, it is assumed that the computer hardware, software and IT staff are such that the potential capability of interchanging data is possible. Therefore, these costs are excluded.

The Estimated Costs are as follows:
Initial (One-Off) Costs -
Development of software to manipulate the exchange data into **HISPID3** format and to translate it from **HISPID3** format for storage in the database $4,500.00

Recurring Costs -
Based on the following four assumptions:

1. Cost of selecting replicate electronic records from database ... $ 5.00

   [Note: this assumption is based on the selection of records consisting of 3 replicates, at an hourly rate of $20.00. Since it is assumed that it takes approximately 1 hour to select a standard-size exchange set of records, it is effectively cheaper to select records with more replicates than those with fewer ones.]

2. Cost of semi-automatic conversion of data (from database) into **HISPID3** format (including verification of standard of resulting **HISPID3** files) ... $ 10.00

   [Note: it is here assumed that is takes half an hour to convert each exchange file, including random checks of each to ensure it satisfies the **HISPID3** standard. It also assumes that each file is interchanged using email.]

3. Cost of semi-automatic conversion of data (from exchange **HISPID3** file) into format for inclusion into **NSW** database ... $ 10.00

   [Note: the assumptions of point 2 are also relevant here.]

4. Each exchange file consists of an average of 50 specimens. [Based on costs of assumptions 1 and 2 (or 3) per 50 specimens.]

   Therefore:
   Costs per Electronically transferred Record (by email) ... $ 0.30

- **BENEFITS:**

Cost of each electronically received record (by email) ... $ 0.90

[Note: this is based on the assumption that it costs approximately $0.60 to capture electronically transferred data into a database, by the data-processor plus $0.30 to convert the **HISPID3** file, for each record, into a suitable format for inclusion in the institutional database.]

Optimum Number of Replicates

Although it is clear that it requires less resources to share electronic herbarium label data of replicates, is there an optimum number of replicates (per collection) that minimises the costs without placing undue demands on other aspects of the exchange program? The difference between the cost of data-processing unicate collections and those with replicates, where the latter information is transferred electronically, is illustrated above (Fig. 4). However, a large number of replicates add to the costs of processing (including pressing, drying, pest-control and dispatch). In Figure 5, the % cost of capturing the information of replicates by electronic transfer is compared with the cost of directly data-processing each replicate. It can be seen that one replicate reduces the cost of capturing the data of both the original (primary) specimen and its replicate by almost half (actually 56%). If two replicates are collected (three samples in total), then the cost is reduced by about 40%. Whereas three replicates reduces the overall cost to 34%. To make further significant savings, it is necessary to collect many more replicates. For example, to reduce the costs to a quarter, it is necessary to collected 6 replicates (25.1%).

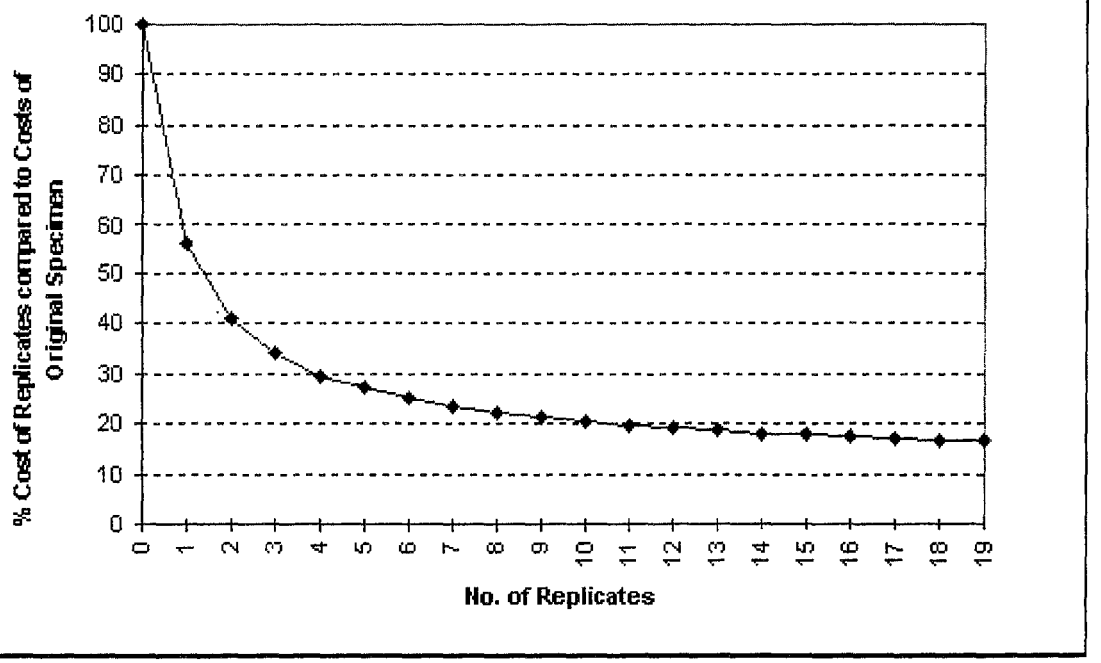

Figure 5. The % cost of capturing the information of replicates by electronic interchange, compare to the costs of directly data-processing each replicate.

Therefore:

- logistically and financially, it is recommended that collecting procedures be changed so that the 'Mean Number of Replicates' equal 3, rather than 1.8.

Although the mean number of replicates can be increased by each plant collector including more replicates in each collection, an excessive increase in the amount of additional material would significantly add to herbarium processing costs. Collectors already collect a range of replicates. Therefore, a significant increase in this number would be required before a noticeable change in the mean occurred. A more effective method of increasing the overall mean number of replicates is to *collect fewer unicates* rather than by just collecting more replicates.

Conclusion

There are several challenges remaining before continuous improvement of quality in the current herbarium specimen exchange program will be realised.

On average, 3,500 specimens are exchanged between each Australian herbarium per annum. Therefore, the electronic sharing of herbarium label data represents a saving of approximately $15,000 per institution, when compared with current practices.

A National Reduction in the 'Overall Cost of Herbarium Label Data Capture' can be achieved by:

- an increase in the amount of Herbarium Label information shared electronically, as part of the herbarium exchange program;
- a reduction, by about a third, of the comparative costs of each collection by collecting an average of 3 replicates (4 samples in total).

Post-script

What has happened since 1996?

- **AD, MEL** and **NSW** exchange electronic herbarium label information as a regular part of their specimen exchange program
- **CANB** has made their accession data available (in **HISPID3** format) to other Australian herbaria through the Internet

Barry J. Conn
Royal Botanic Gardens, Mrs Macquaries Road,
Sydney NSW 2000, Australia
(barry@rbgsyd.gov.au)

Rediscovering *Grevillea rosmarinifolia*

One of the few plant species actually described by Allan Cunningham was *Grevillea rosmarinifolia*, which appeared, along with several others, in Barron Field's Geographical Memoirs of New South Wales (Pp.326-329). Although Cunningham was a capable botanist himself and collected hundreds of species unknown to science during his time in Australia and New Zealand, most of his specimens and descriptive work was sent to Robert Brown who used his manuscripts and often even his manuscript names in his *Supplementum Primum Prodromi Florae Novae Hollandiae* published in London in 1830.

Cunningham's Latin description of *Grevillea rosmarinifolia* was accompanied by the words ..." A shrub of robust growth, and with reddish showy flowers. Banks of the Cox's River." The rediscovery of this plant at the Type locality has been one of the holy grails of New South Wales botany, especially those associated with the genus *Grevillea*.

Grevillea rosmarinifolia is not a rare species, as circumscribed by McGillivray (1993). This circumscription is very broad and encompasses several population-based distinctive taxa. The species *sens. lat.* will soon the subject of a detailed revision. It is distributed on a wide range of soils ranging from basalt to granite and desert sands over a large area of both New South Wales and Victoria. Yet the form from the Cox's River differs from all the others in having longer and broader, linear to narrowly lanceolate leaves. There are few recorded collections of this taxon. The only specimens are those of Cunningham, collected in 1822. However, in a Catalogue of Plants cultivated at the Botanic Gardens, Sydney, New South Wales, January 1828, Charles Fraser indicates that *G. rosmarinifolia* was

introduced there by himself in 1825. Indeed Fraser died while returning from Bathurst with a cartful of living plants in 1831.

The particular form of this species next appears between 1827-1828 in Robert Sweet's *Flora Australasica* as an illustration of a plant growing at Mackay's Clapton Nursery. Sweet also informs us that it was first introduced at the Royal Botanic Garden at Kew, without explicitly stating by whom and how the plant was communicated. In 1829, there appears another illustration from a 'weak and starved' specimen at the Hackney Nursery, London. This can be found in Conrad Loddiges' *Botanical Cabinet*: 15 where we are informed that the species had been in cultivation in England 'since c. 1820'. Subsequent sources give variable dates of introduction. Sweet (1827) says 1821 while Loudon (1830) says 1824, the latter date being the most likely since Cunningham did not collect it until 1822 as far as I can make out.

In Europe, *Grevillea rosmarinifolia* flourished in horticulture. There is evidence of its cultivation in Dusseldorf 1834, Florence 1854-55, Amsterdam 1857 and even Russia at Aksakov, 1860. However, things on the ground at home were not too good. In a letter to Richard Cunningham accompanying the Type Sheet at K, Allan Cunningham recommends a visit to the grassy flat of the military depot (now known as Glenroy) where Governor Macquarie rested in 1815. *Grevillea rosmarinifolia* was to be found 'on the flat at Cox's River just below the Military depot on the immediate bank of that ?stream where also are to be observed *G. sulphurea* and *G. canescens*....if not destroyed by cattle'. The place must once have been a haven for grevilleas. In a diary entry dated Friday 11th April 1817, Cunningham writes "At this river we first observed granite, of which its bed is composed. *Grevillea acanthifolia* and *Grevillea asplenifolia* (sic!), ..., grow on the banks of this river in the greatest luxuriance."

Several searches of the Type locality in the late 1960's and early 1970's failed to locate any plants of *G. rosmarinifolia*. Certainly no new collections have appeared in the specimen base at NSW, although specimens that differ in minor ways have been collected at Hampton and on the Kowmung River at Tuglow.

Then in a brief note that set interest soaring, D.J. (Don) McGillivray (1975) stated that 'in August 1969, [he] observed a specimen of the type form of *G. rosmarinifolia* growing outdoors, beside a building in the Edinburgh Botanic Garden. Cuttings from the plant were sent to the Royal Botanic Gardens, Sydney, and specimens have been established in a number of gardens and some nurseries in New South Wales and Victoria. It is distinguished from other forms of the species by its longer, broader leaves, c. 2.5-4 cm long and 2-3 mm wide.'

The very thought of a presumed-extinct Australian plant form being re-discovered at Edinburgh nearly half a world away and 1.5 centuries after it had presumably disappeared from its natural habitat was scarcely believable; but to have material returned from there to be re-introduced perhaps into the Australian wild was inspiring and exciting to say the least. Not only that but the re-discovery was such a fluke in itself. The interpretive label on the living plant at Edinburgh Botanic Garden was *Grevillea lanigera* , and perhaps the only person in the world capable of recognising the taxon and its correct name and significance at that time happened upon it there by chance.

The origin of the plant at Edinburgh is unclear. It may have been cloned from the original material at Kew which was communicated probably by Cunningham. However, it may have been sent independently by Fraser, who was also a Scotsman and sent large amounts of material to Scotland during his tenure at the Sydney Botanic Gardens. Indeed, this was part of his job description. From 1823, he was officially known as 'Superintendent Sydney Botanic Gardens' where he worked to collect and grow indigenous plants for the garden and to stabilise them for long voyages in a 'plant cabbin' to grace the gardens of the King and also as a clearing house for exotics and fruit vines being introduced to the colony.

In 1826, William Jackson Hooker published a description of *Grevillea pubescens* (syn. *G. baueri* subsp. *baueri*) from a specimen grown from seed sent to him at Glasgow by Charles Fraser in 1822, flowering there in 1825. Seed was also sent by Fraser to Dr Graham at Edinburgh Botanic Gardens. The truth is that we do not really know how or from what clone the Edinburgh material arose but we can surely be grateful that it had been maintained so successfully in cultivation for so long and that plants continued to survive outdoors in such a climate.

In Australia, meanwhile, the search for topotypical material continued. Between 1990 and 1999, individual members of the *Grevillea* Study Group (a part of the Association for Growing Australian Plants) had conducted no less than four private and unofficial searches in the Hartley area. As most of

the area is now degraded, private farm land, these searches consisted of fence-peering and traipsing through road verges (no trespassing, of course!). In November 1999, a *Grevillea* crawl was conducted in the area. On Saturday morning, November 6, while a number of the party travelled to Lithgow to vote for the republic that was not to be, Anders Bofeldt, Wollongong Botanic Gardens, decided to take a walk in the area where we had encamped the night before. On returning to camp, he asked innocently what this particular pink-flowered plant was that he had just collected. The specimen was from a single plant that appeared to be about 30 years old, judging from the main stem which was the thickness of a man's arm. *Grevillea rosmarinifolia* - rediscovered!

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P. Olde
petero@gco.apana.org.au

New staff and some new research directions at the Royal Botanic Gardens Melbourne

1999 has seen several changes in staff and research focus at the National Herbarium of Victoria (MEL), Royal Botanic Gardens Melbourne (RBGM).

Firstly, in March, Dr Teresa Lebel commenced as our second Mycologist. Teresa completed her PhD in 1998 at Oregon State University, Corvallis USA where she worked on the truffle-like Russulales of Australia and New Zealand. She plans to continue taxonomic research on southern hemisphere truffle-like fungi and their macrofungal relatives. Her other research interests include (1) the effects of disturbance on ectomycorrhizal fungal communities (i.e. logging, agriculture, and fire), (2) the effects of different management practices on food resources of mycophagous mammals such as the rare Long-footed Potoroo (fungi form up to 90% of the diet year round), (3) insects associated with fungal fruiting bodies, and (4) biogeography of truffle-like fungi. This appointment coincides and complements recent funding by the Hermon Slade Foundation to database the entire fungal collection at MEL.

The second Pacific Dunlop Fellow, Dr Niels Klazenga, commenced on the 30th of August. Niels has recently completed his PhD at the Rijksherbarium, Leiden, the Netherlands. For his PhD he revised the moss genus *Dicranoloma* in Malesia and completed a cladistic analysis of the genus. At MEL he plans to expand this project to include Australasia and Pacific members of the genus. Our third Pacific Dunlop Fellow, Christine Cargill, also a Bryologist (specialising in hepatics, in particular *Fossombronia*), is expected to commence working at MEL in July 2000 overlapping for a time with Niels.

Dr Frank Udovicic was appointed to the newly created Molecular Systematist position at MEL and commenced in October. Previously Frank had undertaken postdoctoral fellowships for two years at the School of Botany, The University of Melbourne, and for two years at the Australian National Herbarium, CSIRO Division of Plant Industry, Canberra. Frank plans to continue research on the phylogenetic relationships of *Eucalyptus* and its allies, as well as that of

Melaleuca and *Callistemon*. The new molecular laboratory is located in the basement of the National Herbarium. Despite some minor flooding over the Christmas break the laboratory is expected to be fully functional soon.

With the completion of the *Flora of Victoria* (Foreman & Walsh 1993; Walsh & Entwisle 1994, 1996, 1999) Neville Walsh will concentrate on his new position of Conservation Botanist and focus his continuing taxonomic work on threatened groups. In this position Neville will set priorities for and coordinate the RBGM *in situ* and *ex situ* plant conservation program. He will collect propagating material (seed, cuttings etc.) of target species for conservation efforts, and make assessments from field observations and herbarium/literature records of species considered at risk or potentially at risk in Victoria.

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Marco Duretto
Plant Sciences Manager
Royal Botanic Gardens Melbourne

Forthcoming anniversaries

Birth of George Bentham

Having celebrated the centenary of Bentham's death on 10 September 1984 we now look forward to the bicentenary of his birth which occurred on 23 September 1800.

A one-day symposium is to be held in London, organised by the Linnean Society of London, the Royal Botanic Gardens, Kew.

Visit of Diels and Pritzel

On 30 October this year it will be just 100 years since the arrival in Fremantle of Ludwig Diels and Ernst Pritzel, German botanists who stayed in Western Australia for over a year. They made extensive collections and observations on the flora, vegetation and biogeography, published in two major works.

Alex George
'Four Gables', 18 Barclay Road,
Kardinya, W.A. 6163
Phone (08) 9337 1655; *fax: (08) 9337 9404;*
email alextris@iinet.net.au

"Game over"?: Palaeopalynology in the new millenium

Summary

The global de-emphasis on palynostratigraphy in the earth sciences, including the resources industry, means that if palaeopalynology is to survive in the new millenium, it will need institutional support from other end-users, notably in the biological and palaeontological sciences.

Preamble

Palaeopalynology is palynology (the study of plant miospores) applied to pre-Late Quaternary contexts. This position paper is concerned only with terrestrial floras (and faunas) from the time when the angiosperms first reached Australia in the late Early Cretaceous up to the mid Quaternary (~100 to 1 million years ago).

Like Late Quaternary palynology, palaeopalynology 'falls' between three stools – the earth sciences, the biological sciences and the climatic sciences. Not surprisingly, palynology *sensu lato* tends to play a service role, providing answers to questions that range from the wholly pragmatic (mineral resource industries) to the theoretical (evolutionary biology).

The major non-industry driver at present is the reconstruction of past climates, often as analogues of global (greenhouse) climatic change in the future. This role is a contracting one as isotopic techniques and increasingly sophisticated global climate models diminish the need for palaeoecological data as proxy evidence of past temperatures and precipitation. Otherwise demand for pollen and spore-based data continues to arise on an *ad hoc* basis only, especially as regards the analysis of onshore (continental) sequences.

Historical developments

The macrofossil remains of plants (colloquially equated with palaeobotany) and animals have been studied for well over a century in Australia (Archer *et al.*, 1994; Hill, 1994). The study of fossil pollen and spores, however, is wholly a mid-late twentieth century phenomenon arising from research undertaken by Dr Isobel Cookson in the 1940s on plant microfossils and the floras of sub-Antarctic Islands. One consequence is that palynological studies have never attracted the institutional support given to invertebrate and vertebrate palaeontology or, in some universities, palaeobotany. For example there are no curatorships or other specialist positions dedicated to the study of microfloras in Australian museums or herbaria.

Along with plant macrofossils, palaeopalynology may be said to have come of age in Australia with the 1994 publication by R.S. Hill (editor) of *The History of the Australian Vegetation: Cretaceous to Recent* (C.U.P.). The reason is a simple one – plant fossils regained their pre-war status as a primary form of evidence for Tertiary floras and vegetation.

This publication included the first comprehensive overview of Australian Tertiary floras based on fossil pollen and spores (Macphail *et al.*, 1994). With few exceptions the data come from *geological* institutions and were collected *as a by-product* of hydrocarbon- and groundwater exploration between 1968-1993. However, without massive retrenchment within the oil exploration industry during the 1980s-1990s, the existence (and sheer size) of the industry databases would have remained unknown and the expertise to cull and expand them simply would not have been available.

Continuation of this trend through the 1990s now threatens the existence of Cenozoic palaeopalynology in the next millenium.

Present state of play

Information on past floras in Australia and the currently used biozonal schemes for dating and correlating Late Cretaceous and Cenozoic faunal and plant macro- and microfossil remains in Australia are living 'on overdraft' from palynostratigraphic work completed in the 1970s–1980s chiefly from the well-sampled Gippsland Basin in eastern Bass Strait (cf Stover & Partridge, 1973, 1982; A.D. Partridge & M.K. Macphail unpubl. data).

This 'overdraft' encompasses both the taxonomic base of fossil and living species, and systematic recording of fossil species' distributions around the continent and in geological time.

Such information is essential for understanding the evolution/migration of plants regarded as quintessentially Australian. For example Volume 1 (Introduction) of the *Flora of Australia* and introductions to other volumes treating the gymnosperms, the Poaceae and the Proteaceae include reviews of the (largely unpublished) macro- and microfossil evidence. In rare instances marsupial remains are preserved along with

microfossil evidence of the habitats in which the animals once lived, e.g. Macphail (1996a, 1996b).

Present entrenched weaknesses include:

1. Basic taxonomic research is limited to species perceived to be of biostratigraphic value or pertinent to neobotanical projects in Australian herbaria. Less prominent taxa have attracted little attention and living equivalents mostly are identified on an *ad hoc* basis. The only comprehensive modern *pollen* herbarium in Australia (at the Australian National University) is under-valued by the host institution and under-utilised by the wider biological research community.

2. Experienced palynostratigraphers are becoming fewer each year due to natural attrition and diminishing employment opportunities. The mid 1999 shedding of the remaining 'palaeo' staff at the Australian Geological Survey (AGSO) is the most recent example.

3. There is an irreversible shift in offshore hydrocarbon exploration from Cenozoic basins in the south, to much older basins in the north-west margin of the continent where the fossil record is of limited significance to understanding the evolution of the living Australian fauna and flora.

4. Geological investigation of the Cenozoic continental deposits mostly is limited to sediments which host gold or groundwater reserves needed for agriculture. Deep weathering of the regolith since Late Jurassic time has meant that organic remains are seldom preserved at depths less than 30-50 m below ground surface. Such fossiliferous sediments are accessible only by drilling.

5. There is a shift away from fossil pollen and spores, perceived by industry to be of low biostratigraphic resolution, to marine microfossils such as dinoflagellates, nanoplankton and foraminifera which are more easily linked to the International Time Scale. With few exceptions, these marine taxa do not range inland and, unlike fossil pollen and spores, cannot be used for dating terrestrial deposits.

6. Exposure of the resource industries to global market forces has restricted geological sampling to negligible levels compared with the 1960s–early 1980s. For example the focus on Palaeozoic or older rocks means that the overlying Cenozoic alluvial strata are seldom sampled by industry.

7. Linked to this (Point 6) is the widespread attitude amongst geological resource managers that biostratigraphic service work can be out-sourced in the short-term and any lost expertise 'reinvented' in the longer-term.

A not surprising consequence is that widely used biozonation criteria remain undocumented and/or unavailable for use by the wider palaeobotanical and palaeontological communities interested in the evolution of the terrestrial fauna and flora.

For example the only published biozonation schema developed for inland regions are based on the epicontinental Murray Basin in south-east (Martin, 1984; Macphail & Kellett, 1993; Macphail & Truswell, 1989, 1993; Macphail, 1999) and small basins in central (Macphail, 1996c, 1997a) Australia. Elsewhere, continental deposits which preserve plant macrofossil and faunal remains are mostly dated by reference to the Gippsland Basin in eastern Bass Strait, often using the now outdated criteria published by Stover & Partridge (1973), e.g. northern South Australia (Sluiter, 1991).

Similarly a great deal of the microfossil information that is pertinent to palaeontological and neobotanical research (cf Archer *et al.*, 1994; Hill & Brodribb, 1999) has been gained at considerable personal disadvantage and exists only in privately maintained records.

Cenozoic resources

Fossiliferous drill core and related (side wall core, cuttings) samples preserved in geological institutions is a diminishing resource that is unlikely to be replenished in the shorter-term except in districts hosting groundwater or alluvial minerals. Accelerating the attrition is a widespread attitude that geological material not looked at in the past one to two decades does not warrant the expense of long-term storage, let alone their formal curation.

Nevertheless a surprising amount has survived, albeit through neglect.

For example, drill core housed in a tin shed in Alice Springs recently was found to preserve a quasi-continuous record of species and plant communities occupying central Australia over the past ca. 70 million years (Macphail, 1996c, 1997a). In Tasmania, drill core abandoned by the Hydroelectric Commission preserved evidence not only of the earliest recorded Cenozoic glaciation outside of Antarctica (Macphail *et al.* 1993) but

also the oldest known pollen of the Stylidiaceae, now confined to the South West Pacific and South America, and Asteraceae tribe Mutisieae, now confined to South America (Macphail & Hill, 1994). The same material preserves a detailed macrofossil record for the earliest Oligocene (R.S. Hill, in prep.).

A comprehensive review of published and unpublished palaeobotanical evidence of Late Cretaceous-Tertiary climates across Australia (Macphail, 1997b, in prep.) has revealed the existence of a large number of processed and unprocessed samples in varying states of preservation at the various State geological surveys.

Palynological expertise

Australian palynologists fall into two camps – those with backgrounds in Botany or Physical Geography who work on Quaternary sequences, and those with geological backgrounds who mostly work on pre-Tertiary sequences. The overwhelming bulk of pre-Quaternary palynofloras have been analysed by geologically trained palynologists with little or no experience (or interest) in modern pollen floras or vegetation.

At present there are three only palynologists (two retired) in Australia (M.K. Macphail, H. Martin, E.M. Truswell) and one in New Zealand (D. Mildenhall) who have geo-botanical backgrounds and are familiar with both modern and Late Cretaceous-Cenozoic microfloras preserved in Australasia.

The two former biostratigraphers employed by Esso Australia Ltd. in the 1970s-1980s, A. D. Partridge (Biostrata Ltd.) and M.K. Macphail are the last palynologists to have had extensive experience on the only well-sampled basin in Australia which preserves relatively continuous pollen and spore sequences for Late Cretaceous and Tertiary time.

Implications for palaeopalynology post 2000 AD.

- Recent reviews have confirmed that palaeopalynology is an important but underutilized tool in taxonomic and palaeoecological research in Australia.

- Over the past decade, palaeopalynology in general and taxonomy in particular have become both unfashionable and unsupported except in narrowly focused contexts such as reservoir correlation (North West Shelf) or the Geological Time Scale project (AGSO).

- As a consequence, the ability of the broader scientific community to use plant microfossils to resolve outstanding questions concerning the evolution of the Australian terrestrial fauna and flora during the Cenozoic is greatly diminished.

- Known problems include the imprecise, if not actually flawed, chronology against which terrestrial evolutionary events are measured, and the lack of systematic research into the point of origin (evolution/migration) and subsequent adaptive radiation and changing distribution of many taxa that are of neobotanical or phytosociological significance in modern Australia.

- If the above trends (and attitudes) persist, the outcome will be little short of disastrous for those charged with understanding the basic and evolving relationships amongst the Australia biota and their often surprising relationships to the biota of other landmasses in this hemisphere.

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Mike Macphail
Visiting Fellow, Dept. of Archaeology & Natural History, Research School of Pacific and Asian Studies, Australian National University
[macphail@coombs.anu.edu.au]

Sequestration of the northern Australian flora during the Late Cretaceous and Tertiary

Introduction

Australasia has been the interface between two geo-botanical 'mega-realms', southern Laurasia (Eurasia) and Gondwana for the past 200 Ma ago (see Metcalfe, 1996). The distribution of plants within the region is usually seen as reflecting allochthonous (geological, climatic) as well as autochthonous (biological) forces. The former include shifts in the distance between the various fragments of Gondwana and Laurasia that make up Australasia.

For example, Burrett *et al.* (1991) suggest that the migration of terranes and associated island arcs is sufficient to account for e.g. the existence of Australian-type floras on Fiji in the SW Pacific and the mixing of Australian and Eurasian biota on Sulawesi in the Indonesian archipelago. Michaux (1991) has concluded that plant distributions in Indonesia are the result of transportation of ancestral taxa on continental fragments derived from both Gondwana and Indo-China during the Mesozoic, and collision with Australia/New Guinea during the mid Miocene.

Many of the species inhabiting the extensive monsoon (wet-dry) tropics regions of northern Australia extend overseas, e.g. into Indo-Malaya and some as far as Africa and America (Crisp, 1996) and the same 'floating ark' model is applied to Australia with one significant difference. Australia's position at high latitudes in the evolving Southern Ocean is seen as pre-empting floristic interchange with the evolving Southeast Asia archipelago until the Neogene collision. Evidence for this is centred on the observed low vagility (dispersal ability) of many subtropical-tropical angiosperms over even relatively narrow ocean gaps (see Barlow, 1981; Crisp, 1996). For example, the present-day boundary between the Australia and Asian floras lies not in the Indonesian archipelago, but at Torres Strait (Wace, 1975) despite the periodic exposure of this seaway as dry land during the Quaternary.

Macphail *et al.* (1994) have challenged this model for two reasons. (1) Continental fragments (terranes), some derived from Australia, formed island 'stepping stones' in the closing ocean that separated this continent from Southeast Asia during Eocene-Oligocene time (see Metcalfe, 1990, 1996; Daly *et al.*, 1991; Abbott, 1995). (2) There is unequivocal palaeobotanical evidence for the long distance dispersal of angiosperms, gymnosperms and cryptogams over wide ocean gaps in the south-west Pacific and Indian Oceans during this period. Pole (1994) has extended the concept to claim that the bulk of the modern New Zealand flora has arrived by long distance dispersal during the Late Cenozoic.

Plant microfossils provide the most direct evidence for determining how the changing positions of the landmasses which making up Australasia, have functioned as biogeographical 'filters', shaping the migration of plants within Australasia during the Late Cretaceous and Tertiary.

This study uses fossil pollen and spore records from northern and central Australia to explore the apparent failure of the Eurasian flora to invade northern Australia despite apparent ample time and opportunities for colonisation during the Cenozoic - why Tertiary *Terra Australis* became Australia, not an outlier of Asia in the Southern Ocean.

South-east Asia and New Guinea

Rapid uplift in New Guinea and other tectonically active regions of Southeast Asia has resulted in high rates of sedimentation into equally rapidly subsiding offshore basins, resulting in massive reworking and mixing of different aged palynofloras. Detailed palynostratigraphic data are mostly proprietary and unavailable for comparison purposes.

A equally important *caveat* is that many unrelated angiosperm and some cryptogam genera produce very similar/nondescript miospores and it is possible that phytosociologically important Eurasian taxa will have gone unrecognised as such in Australian Late Cretaceous and Tertiary palynofloras (and *vice versa*). One Australian Late Cretaceous pollen complex found in northern and central Australia that warrants further study is echinate tricolporate grains whose closest known equivalent are grains produced by *Neoscortechinia* (Euphorbiaceae), found in swamps from Burma as far east as the Solomon Islands.

Published data for Southeast Asia mostly focus on the biostratigraphic value of tropical mangroves and other riparian species that are widely distributed throughout Australasia (Morley, 1977, 1990, 1996; Watanask 1990). Nevertheless, the data confirm that a number of important genera and families that now are restricted to the Indo-Malaysian region were part of the Australian flora during the Late Cretaceous and/or Tertiary (cf. Truswell *et al.* 1987). First appearances of shared taxa usually are earlier in Australia than in Southeast Asia although this in part reflects regional geological differences as well as sampling strategies (cf Germeraad *et al.*, 1968; Muller, 1968; Anderson & Muller, 1975; Khan, 1976; Playford, 1982; Morley, 1990; Macphail *et al.*, 1994). Conversely, distinctive/well-dispersed Eurasian pollen taxa such as pine (*Pinus*), fir (*Abies*), alder (*Alnus*) and walnut (*Juglans*) which may dominate mid-late Tertiary palynofloras in Asia (see Morley, 1990, 1996) do not occur in correlative assemblages anywhere in Australia.

North-west Australia

Late Cretaceous clastic sediments have been sampled by numerous exploration wells drilled offshore in north-west Australia. Not a few preserve diverse pollen and spore assemblages although these have received relatively little attention because of their limited biostratigraphic value relative to marine phytoplankton and foraminifera. Owing to sediment starvation, facies accumulating offshore during the Tertiary are dominated by bioclastic lithologies (cf Apthorpe, 1988; Bradshaw *et al.*, 1988). None are known to host hydrocarbon reserves and, as a consequence, are seldom sampled for palynological study.

On present indications, Paleocene (65-56.5 Ma) and (diverse) Oligo-Miocene (35.5-5 Ma) palynofloras are seldom preserved in offshore basins in northern Australia. Pollen records for the period are even more limited onshore in northern Australia due to the subdued relief and limited tectonic activity. What little data exist come from small basins in the Alice Springs region of central Australia (Macphail, 1996, 1997a) and 'spot samples' preserved by 'geological accident', e.g. in the Goats Paddock meteor crater (E.M. Truswell, pers. comm.).

Core samples from petroleum exploration wells drilled in the Bonaparte Basin, Northern Territory and in the Carnarvon Basin, Western Australia, and stratigraphic and hydrogeological boreholes from central Australia indicate:

1. Most Late Cretaceous palynofloras are dominated by Gondwanan taxa. Prominent angiosperms are the Proteaceae (cf Dettmann & Jarzen, 1998) and simple tricolpate and tricolporate types, presumed to represent primitive angiosperms. Many of the latter resemble species found in mid Cretaceous sediments elsewhere e.g. North America (references in Brenner, 1967; Norvick, & Burger, 1975; Burger, 1993; Doyle & Hickey, 1976).

2. Tertiary palynofloras in north-west Australia are dominated by Casuarinaceae, Proteaceae, and/or Myrtaceae (including eucalyptoid types) (Truswell, 1987; Martin & McMinn, 1993, 1994; M.K. Macphail unpubl. data). Warm temperate rainforest angiosperms such as *Nothofagus* (*Brassospora*) extended from the south into central Australia during the Middle Eocene, and along with podocarps, may have dominated the flora during the Late Oligocene to ?Early Miocene (references in Macphail, 1997a).

There is no evidence that *Nothofagus* reached north-west Australia during the Tertiary and migration of *Nothofagus* (*Brassospora*) into New Caledonia and New Guinea almost certainly was via the humid eastern margin (references in Macphail, 1997b; Macphail *et al.*, 1994)

3. The few unequivocal Eurasian taxa entering via northern Australia (cf Muller, 1966) appear to have come from farther afield than SE Asia.

Examples are *Anacolosidites* (Olacaceae: *Anacolosa*) a genus now confined to the Old World tropics, *Longapertites* (Arecaceae, a fossil palm which occurs as far north as Somalia during the Late Cretaceous (Shrank, 1994). Undescribed species of *Triangulorites*, found in Maastrichtian sediments (central Australia), and *Striacolporites*, found in Early Eocene sediments (north-west & central Australia), closely resemble Tertiary Indian species. Probable representatives of the important northern hemisphere Triprojectites and Normapolles floras are found in Late Cretaceous (*Integricorpus*) and earliest Eocene (*Myrtaceoipollenites*) assemblages (see Macphail, 1997a; M.K. Macphail & A.D. Partridge, unpubl. data).

Discussion

Why Eurasian plants failed to colonize northern Australia may seem an idle question to ecologists viewing the very strong contrasts that now exist in geology, tectonic activity and modern (and late Quaternary) climates, soils and topographic relief between mainland Australia and Indonesia. That analogous barriers should have existed throughout the globally warmer/wetter periods such as the earlier Tertiary is less 'self-evident' given compelling evidence that angiosperms with apparently low vagility did reach remote land masses in the Indian and Pacific Oceans during the same interval of geological time.

The most compelling evidence for transoceanic dispersal comes from Ninetyeast Ridge in the mid-Indian Ocean where emergent seamounts were colonised by a mixture of sclerophyll and rainforest genera during the Eocene-Oligocene (Kemp, 1974; Kemp & Harris, 1977). Distinctive families and genera included Myrtaceae, Casuarinaceae, the mangrove palm *Nypa*, at least two taxa with modern rainforest affinities (*Ascarina*, Cupanieae), herbs (Asteraceae, Poaceae, Sparganiaceae) and at least four Gondwanan gymnosperms (Araucariaceae, *Dacrydium*, *Phyllocladus*, *Podocarpus*).

During the same (not insignificant) span of geologic time, a minimum of 45 palynologically distinctive gymnosperms and woody angiosperms were dispersed from eastern Australia to New Zealand (Macphail *et al.*, 1994; Macphail, 1997c) and it is probable that other chance dispersal events were equally successful (see Pole, 1994). In contrast one Gondwanan gymnosperm (*Dacrydium*) appears in the Southeast Asian flora during the Oligocene and two others (*Dacrycarpus*, *Phyllocladus*) in the Plio-Pleistocene. Few data are available for angiosperms but it seems likely that the evergreen rainforest, *Nothofagus* (*Brassospora*) had migrated northwards along the humid eastern margin of Australia to reach New Caledonia and New Caledonia during the Oligo-Miocene.

These examples demonstrate that long distance dispersal of plant propagules is an ongoing, ubiquitous phenomenon although preferential directions of transport may well have altered as palaeowind and palaeo-ocean circulation patterns evolved in the Australasian region. For example, dispersal patterns of tephra from subduction-related volcanism along the Indonesian Arc (Sykes & Kidd, 1994) show that equatorial easterly winds increased in importance during the Tertiary.

If the above data are correctly interpreted, then Eurasian plants *potentially* were able to disperse to northern Australia before the mid Miocene. Their failure to do so is more likely to reflect the nature of 'target' habitats in northern Australia during the Tertiary than marine barriers or low vagility.

Possible limiting factors include seasonal aridity and the effects of highly leached/infertile soils on competitive abilities. A hint that climates were unable to support drought-sensitive taxa is provided by the strong contrast in relative pollen dominance between northern and southern Australia during and since the Late Cretaceous. For example, pollen of extinct taxa that are commonly found in coeval deposits in southern Australia, e.g. *Lygistepollenites balmei* (Podocarpaceae) *Nothofagidites senectus* (ancestral Nothofagaceae) and *Gambierina* (extinct angiosperm order) are found in trace amounts only in northern Australia. Unlike southern Australia, low photoperiods during winter are unlikely to have been a significant constraint despite the comparatively high latitude of the northern margin during the Late Cretaceous and Early Tertiary (ca. 45-55°S).

Climatic and edaphic explanations are unlikely to apply to north-east Queensland where the spectrum of habitats (very high rainfall/fertile soils/steep relief) now found in the Southeast Asia have been present through much of the Cenozoic (cf Hekel, 1972; Foster, 1982; Dudgeon, 1983; Kershaw & Sluiter, 1982; Wood, 1986; Feary *et al.*, 1991; Kershaw *et al.*, 1993; Martin & McMinn, 1993). Suitable localities include uplands such as the Atherton Tableland and the coastal plains in the Cairns-Townsville region.

Accordingly, it is not unrealistic to predict that the most accurate pollen and spore record of floristic interchange between Southeast Asia and Australia will be preserved in the near-shore and onshore basins in north-east Queensland rather than in sites along the northern and western margins. Crisp (1996) has proposed that the pan-tropical taxa which make up monsoon rainforest are much more dispersible than most of the other elements in the Australian flora. Testing this will require access to the Southeast Asian palynostratigraphic database and well-sampled core sequences spanning the Late Tertiary from the Cape York region.

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Mike Macphail

Archaeology & Natural History, Research School of Pacific and Asian Studies, Australian National University, Canberra. ACT 0200 [e mail macphail@coombs.anu.edu.au]

Nancy Burbidge Memorial Lecture

Conservation of the biota of the megadiverse South-west Botanical Province, Australia

Introduction

Nancy was one of the people who stimulated my interest in nature conservation. In my school years, I was often told about my aunt and her interest and increasing fame in the world of botany; and when she visited WA in 1961 to be awarded the degree of Doctor of Science at The University of Western Australia (the first woman to be awarded this degree by UWA), I realised that the fame was not just a family fable. In 1958 Nancy invited me to accompany her on a field trip to the Murchison and Gascoyne, collecting plants. At that time one of her major interests was a generic revision of *Nicotiana*, but she collected everything in flower to add to the collections of what was then the *Herbarium Australiense*. This was the first time that I had travelled outside the southwest, and the trip opened up new vistas for me and started my love affair with the arid areas of WA.

Nancy also introduced me to Dr Dominic Serventy, and I recorded bird observations for him on the field trip. I was amazed that Dom found my amateurish efforts of value and his encouragement and this introduction led later to my part-time summer employment by CSIRO Wildlife studying wading birds on the Swan River estuary and looking after captive shearwaters.

Later in life, Nancy was always there to provide advice and support to me in my fledgling career as a conservation biologist. Her untimely death in 1977 was a great blow to our family as well as the botanical world. To be invited to deliver this Nancy Burbidge Memorial Lecture is a great honour, especially as I am primarily a zoologist, not a botanist, and I thank the Australian Systematic Botany Society for asking me.

One of Nancy's enduring interests was the flora of the South West Botanical Province (SWBP). Her inability to work on it in the detail she would have liked was probably the one major regret she had about living and working in Canberra. As I have become more interested in nature conservation, especially of threatened species, I have come to appreciate and understand this flora more. I've even managed recently to co-author a paper describing a new species of *Beaufortia* and I plan to complete a revision of this south west endemic genus after I retire in a couple of years.

That the SWBP has an amazing flora is widely known and is the major reason why the southwest of Western Australia has been designated one of only 19 'megadiversity hot spots' in the world. That it has an almost equally diverse fauna is less well known, but becoming better understood among zoologists. An understanding of the level of endemism among the fauna has been somewhat clouded by consideration only of vertebrates, where there are relatively few endemic species. However, vertebrates account for only a few per cent of total biodiversity; about 95% of biodiversity is provided by invertebrates and we can still only guess at the diversity and endemism of most groups.

Floral biodiversity and endemism

The vascular flora of the SWBP of Western Australia is rightly famous for its visual splendour as well as its species diversity (Hopper 1979). Crammed into an area of about 310 000 km^2 are about 8 000 species, about 20% of which are still not formally named. The southwest flora has a very high level of endemism - about 70% (CALM 1992). Elsewhere in the world only the Cape Province of South Africa and a few oceanic islands eclipse the southwest in having higher levels of endemism (Hopper *et al.* 1990).

This species diversity is often difficult to comprehend. One way of looking at it is to compare it with other countries. For example, the second most species-rich protected area in Western Australia, Stirling Range National Park, contains around 1 200 species of vascular plants (Table 1) – about the same number as the total British flora. Another way of looking at this diversity is to reflect on the high number of species in some genera (Table 2). Many genera are restricted to the SWBP (eg, *Beaufortia*) and others have many more species in the SWBP than in the rest of Australia, eg, *Banksia* (59 species out of 74).

Faunal biodiversity and endemism

Endemism among the vertebrate fauna is relatively low, but there are several endemic genera and one endemic monotypic superfamily of mammals-the Tarsipedoidea, represented by the Honey Possum, *Tarsipes rostratus* (Table 3).

The invertebrate fauna is also diverse, but lack of data for most groups makes it difficult to be precise. Ongoing surveys as part of the WA Salinity Action Plan (SAP) have revealed over 500 species of ground-dwelling arachnids (spiders, centipedes and scorpions) in the agricultural zone, compared with ca 165 species previously known for the area. Similar data have been collected for wetland invertebrates where Western Australian Museum and other data suggested a total fauna of about 250 species. The SAP surveys have collected 565 species so far.

Conservation status

Examining threatened species lists gives some idea of the conservation status of vascular plants and vertebrate animals statewide - and the vast majority of these are from the SWBP (Table 4). It does not, however, provide any indication of the conservation status of invertebrates. Of the 125 animals listed as threatened in WA, 39 are invertebrates and only 16 these are from the SWBP. Lack of legal listing in no way reflects the real level of threatened species - it is lack of knowledge that is preventing listing.

As knowledge of the vascular flora has increased, the number of taxa (species, subspecies and varieties) listed has increased. Many taxa are placed in CALM's Priority Flora List, which includes taxa that are though to be threatened but for which there are insufficient data to confidently list as threatened (Priorities 1, 2 and 3) and taxa that are rare and require monitoring. Recent targeted surveys of Priority 1 and 2 taxa show that at least 50% are threatened. Clearly, as knowledge continues to improve, more taxa will be added to threatened species lists. As the list has increased in size, so has the number of taxa ranked as Critically Endangered under IUCN (1994) Red List Criteria. A similar pattern exists for threatened fauna.

Legislation does not as yet allow the listing of threatened ecological communities (TECs) in Western Australia; however, CALM commenced a project to assess and database TECs in 1994 (English and Blyth 1999). At present, of the more than 300 communities suggested as possibly threatened by scientists and naturalists, 57 have

	Area (ha)	No. of species
South West Botanic Province	31 000 000	ca 8 000
Fitzgerald River National Park	329 000	1 750
Stirling Range National Park	116 000	1 200
Lesueur National Park	27 000	820
Tutanning Nature Reserve	2 000	???

Table 1. Number of species of vascular plants in some protected areas in the South West Botanical Province.

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Acacia (Mimosaceae)	ca 350
Eucalyptus (Myrtaceae)	ca 150
Grevillea (Proteaceae)	ca 150
Caladenia (Orchidaceae)	91
Banksia (Proteaceae)	58

Table 2. Number of species in selected genera of vascular plants in the South West Botanical Province.

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Mammals	*Tarsipes* (Honey Possum)
Birds	*Purpureicephalus* (Red-capped Parrot)
Reptiles	*Pseudemydura* (Western Swamp Tortoise) *Aclys* (a legless lizard)
Amphibians	*Arenophryne* (Sandhill Frog) *Myobatrachus* (Turtle Frog) *Spicospina* (Sunset Frog)
Freshwater fishes	*Lepidogalaxias* (Salamanderfish) *Bostockia* (Nightfish) *Nannatherina* (Balston's Pygmy-perch)

Table 3. Some endemic South West Botanical Province vertebrate animal genera.

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	Plants	Animals	TOTAL
Presumed extinct	23	13	36
Threatened			
Critically endangered	95	12	107
Endangered	128	25	153
Vulnerable	104	88	192
Total threatened	327	125	452

Table 4. Number of extinct and threatened taxa in Western Australia, May 1998

been databased, of which 19 are Critically Endangered, 10 are Endangered, 14 are Vulnerable, 11 are Data Deficient and two are classified as Lower Risk. So far, we are only a short way down the track as far as fully documenting threatened ecological communities is concerned.

Threatening processes

While there are many threatening processes affecting some taxa, there are a few over-riding ones that are threatening suites of taxa and the ecological communities they form.

Land clearance has been the major threatening process in the southwest. The resulting habitat destruction and fragmentation is the major reason for the threatened status of so many endemic plants. Land clearance has caused the extinction of 20 taxa of vascular plants on current data and has led to the threatened status of more than 300. Once better survey data are available, this figure is likely to rise to perhaps as many as 1,000 taxa. While land clearance has almost ceased, the results of clearing and fragmentation continue. The most dramatic of these is increasing salinity.

The agricultural zone has an estimated vascular flora of ca 4,000 species, of which 60% are endemic. It is the centre of diversity of many of the species-rich genera that characterise the SWBP, eg, *Acacia*, *Dryandra*, *Eucalyptus*, *Grevillea* and *Verticordia*.

Saline groundwater is rising under vast areas of agricultural land. It will not only cause an enormous loss of agricultural productivity, but will destroy many areas of remnant native vegetation, including numerous nature reserves. Salinity is predicted to effect 30% of the agricultural zone within a few decades. Recent research by CALM, as part of the Western Australian Government's Salinity Action Plan, suggests that up to 450 taxa of vascular plants will become extinct in the wild due to salinity. This extinction event will not be restricted to plants: many species of animals dependent on fresh or slightly brackish waters will also be lost, as will invertebrates dependent on the plant communities that will disappear.

Phytophthora dieback is a threat to many plant taxa and communities. While many taxa of *Phytophthora* have been introduced to Australia, *P. cinnamomi* is the main agent that kills native plants in the wild. In the southwest 29 of the 327 taxa of listed threatened plants are known to be susceptible to *Phytophthora* and 39 taxa are possibly susceptible (Table 5). *Phytophthora* has already brought some plants to the edge of extinction and has almost totally destroyed some plant communities. Areas of the Stirling Range National Park are badly infected. *Persoonia micranthera* (Small-flowered Snottygobble) is known from only three plants in the wild and the 'Eastern Stirling Range Montane Heath Community' in which it occurs is also Critically Endangered. Both are threatened by *P. cinnamomi*.

Feral animals are affecting many species. Introduced predators (foxes, feral cats, rats) have caused the local or total extinction of many mammals and are clearly threatening many other animal species. A wide variety of native mammals have already been lost from the SWBP because of exotic predators (Table 6), and many more species of mammals and other vertebrates are threatened (Tables 7 and 8). Introduced herbivores (eg, pigs, goats, sheep, rabbits, honey bees) are degrading vegetation and competing with native animals for food. Several introduced birds are competing with native species and in some cases may interbreed with local endemic taxa. These include the Laughing Kookaburra, Sulphur-crested Cockatoo, Eastern Long-billed Corella and Rainbow Lorikeet).

Environmental weeds are invading many areas. They change the structure and composition of communities, prevent native species recruiting, and eliminate native plants and the animals that depend on them. The large number of weeds and their relatively restricted distributions make controlling them difficult.

Conservation management

It is one thing to document the problems - it is another to actually do something to solve the problems. While it is not possible to reverse many of the happenings of the past, it is possible to prevent further extinctions by ameliorating or controlling threatening processes and reconstructing local floras and fauna. I now want to describe and discuss some of the conservation actions being undertaken in the SWBP.

Conservation through reservation

The declaration of national parks, nature reserves and equivalent protected areas has been the major nature conservation technique and continues to be a very important one. Table 9 shows the proportion of each of the IBRA regions in the SWBP that are in protected areas. Note that the proportion of the Jarrah Forest region in Protected Areas will rise to 10.43% once recent RFA decisions are implemented.

Known to be susceptible	29
Possibly susceptible	39
Not susceptible	155
Unknown	82

Table 5. Number of threatened Western Australian plants susceptible to *Phytophthora cinnamomi.*

****

*Pig-footed Bandicoot, *Chaeropus ecaudatus*
Western Barred Bandicoot, *Perameles bougainville*
Bilby, *Macrotis lagotis*
Boodie, *Bettongia lesueur*
*Broad-faced Potoroo, *Potorous platyops*
Mala, *Lagorchestes hirsutus*
*Crescent Nailtail Wallaby, *Onychogalea lunata*
Banded Hare-wallaby, *Lagostrophus fasciatus*
Djooyalpi (Shark Bay Mouse), *Pseudomys fieldi*
*Koolawa (Long-tailed Hopping-mouse), *Notomys longicaudatus*
*Noompa (Big-eared Hopping-mouse), *Notomys macrotis*

*extinct species

Table 6. Mammals lost from SWBP because of exotic predators

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Chuditch, *Dasyurus geoffroii*
Dibbler, *Parantechinus apicalis*
Red-tailed wambenger, *Phascogale calura*
Numbat, *Myrmecobius fasciatus*
Quenda, *Isoodon obesulus*
Western ringtail, *Pseudocheirus occidentalis*
Woylie, *Bettongia penicillata*
Gilbert's potoroo, *Potorous gilbertii*
Tammar wallaby, *Macropus eugenii*
Western brush wallaby, *Macropus irma*
Black-flanked rock-wallaby, *Petrogale lateralis*

Table 7. Some listed SWBP mammals threatened by exotic predators

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Brushtail possum, *Trichosurus vulpecula*
Brush-tailed phascogale, *Phascogale tapoatafa*
Rakali (Water-rat), *Hydromys chrysogaster*
Malleefowl, *Leipoa ocellata*
Bush stone-curlew, *Burhinus magnirostris*
Carpet python, *Morelia spilota*
Western swamp tortoise, *Pseudemydura umbrina*
Oblong tortoise, *Chelodina oblonga*

Table 8. Some other SWBP vertebrates threatened by exotic predators

IBRA region	%
Avon Wheatbelt	1.72
Jarrah Forest	3.45
Swan Coastal Plain	11.16
Geraldton Sandplains	13.70
Mallee	16.98
Warren	25.75
Esperance Plains	28.01

Note: Jarrah Forest figure will change to 10.43% when all RFA decisions are implemented.

Table 9. Conservation through reservation. Per cent in Protected Areas.

****

The reservation of major national parks and nature reserves such as Kalbarri, Lesueur, Dryandra, Dragon Rocks, Lake Magenta, Stirling Range, Fitzgerald River, Cape Le Grand, Cape Arid and so on, has protected significant southwestern communities. Significant as these areas are, however, the nature conservation reserve system faces many problems and challenges, eg,

- no reserve system can conserve all taxa and communities in an area as diverse as the SWBP,
- species are being lost from conservation reserves because of threatening processes acting within them, eg, fox and cat predation, *Phytophthora*,
- native title means that a number of parks and reserves will probably be successfully claimed, with currently unknown consequences for nature conservation, and
- increasing salinity will destroy many smaller reserves in agricultural landscapes.

These problems do not mean that we should abandon efforts to improve the reserve system. CALM is continuing to pursue the addition of areas to the conservation estate, both by reallocation of Crown land and by purchasing privately-owned land.

Reservation is a first, vital step. Adequate management must follow. Many people still think that having one or two rangers looking after a large national park equates to adequate management - clearly it does not. Most park rangers' time is fully taken up with recreation management and they are often unable to carry out any significant biodiversity conservation tasks. A land management agency needs adequate staff and financial resources to manage the conservation estate on behalf of the public. In Western Australia, CALM has good scientific research and land management staff, but not in numbers sufficient to properly manage the parks and reserves entrusted to its care. Shrinking budgets do not make for good conservation outcomes.

Recovery planning

The development and implementation of recovery plans is becoming the major technique for saving threatened species and ecological communities. Two approaches are evident - single species recovery plans and multiple species recovery plans. Western Australia has been a leader in the development of recovery plans for multiple species of plants. Here we are managing over 50 taxa under the umbrella of a single recovery team and plan based on a CALM administrative district. We are also endeavouring to conserve threatened plant communities under the same umbrella, as the large number of threatened species and communities prevents the creation of large numbers of recovery teams, even if this were an efficient way of handling the problem. CALM has also pioneered the development of Interim Recovery Plans for Critically Endangered taxa. Currently we have completed about 80 such plans.

Combating exotic predators

Following the demonstration through scientific research that foxes were threatening many native vertebrates and that fox control was feasible and effective, CALM developed 'Western Shield' a major exotic predator control and animal reintroduction program. Major features of Western Shield include:

- >3,500,00 hectares currently baited for foxes,
- 82 translocations of vertebrates since 1971, 70 of these since 1990,
- Woylie, Tammar Wallaby and Quenda de-listed,

- Chuditch and Numbat moved from endangered to vulnerable,
- other species becoming more abundant, eg, Brushtail Possum, Western Swamp Tortoise, and
- effective feral cat control near.

Western Shield is the largest and most ambitious feral animal control and native animal recovery program in Australia and possibly the world. It has led to the delisting of the Woylie from national and State threatened species lists; the first time that a species has been delisted because of a recovery program. Predator baiting has been successful partly because of the natural advantage that the SWBP fauna has in having co-evolved with *Gastrolobium* species, which synthesise fluoroacetate (1080) as a predator defence mechanism.

Fighting Phytophthora

Another significant achievement is the demonstration that a simple chemical – phosphite - can trigger defense mechanisms in plants allowing them to fight infection by *Phytophthora cinnamomi*. Phosphite can be injected or sprayed by hand or from vehicles or aircraft and is being used to prevent the spread of *Phytophthora* infections in high quality plant communities and to prevent extinctions of some plant species. The most ambitious project so far is the spraying of the critically endangered community 'Eastern Stirling Range Montane Heath and Thicket', which includes several threatened plants such as the almost extinct *Persoonia micrantha*. Much work still needs to be done before phosphite can be widely used, eg, better surfactants are needed. Unfortunately, phosphite is a holding action, not a cure, and repeated re-sprayings are required to maintain its effectiveness in a plant community. Many taxa that are threatened by *Phytophthora* are being collected and stored as germplasm.

Fighting rising salinity

Two main strategies are being developed. The first involves the planting and harvesting of tree crops and is based on the view that private landholders will not shift from annual shallow-rooted crops such as cereals to deep-rooted species unless there is an economic return. CALM has been leading the development of tree crops for farms in the SWBP - Blue Gum (*Eucalyptus globulus*) for the higher rainfall areas (> 600 mm annual average), Maritime Pine (*Pinus pinaster*) for 400 to 600 mm areas and oil mallees (*Eucalyptus* spp.) for lower rainfall areas. These projects are showing considerable promise with tree crops in many areas now approaching economic parity with cereals.

The second major strategy is the selection and promotion of Recovery Catchments under the State Salinity Action Plan. The scene has been set for recovery catchments with the work undertaken to recover a threatened ecological community - 'Perched wetlands of the Wheatbelt region with extensive stands of living sheoak and paperbark across the lake floor (Toolibin Lake)', where, with financial support from the NHT Endangered Species Program and the State Salinity Action Plan, whole of catchment management is a major recovery action. Under the SAP, some recovery catchments have already been selected and more will be identified in the future.

The future

The megadiverse SWBP is at a fork in the road. One turn leads to a depauperate biota and much more homogeneous ecosystems and landscapes that we possess now. The other leads to the maintenance of much of the rich and diverse biota currently present. The latter road has a significant toll and will not be easy to achieve.

What have we learned?

Experience in recent years shows that

- the loss of biodiversity is rapid and significant, research and management in recent years have shown that techniques can be developed and applied to arrest the decline, and
- reversing the trend will require a cooperative approach between governments and the community, plus increased resources.

While some threats appear to be rampant and almost impossible to solve now, we need to remember that in the recent past some apparently intractable problems, such as the world's worst modern decline of a mammal fauna, have proved, with appropriate research and the application of that research, to be solvable. We need to define current problems and work optimistically to solve them.

What is needed to conserve the biota of the SWBP?

I suggest that requirements for the future can be broken down into a number of major points:

1. Close cooperation between governments, the community, landowners and scientists.

The loss of biodiversity is so significant and will be so rapid that no single sector of the community can

provide a solution on its own. It is essential that coalitions are forged and all sectors work together.

2. Greatly increased planting of native and tree crop species in cleared catchments.

The Salinity Action Plan (1998) recognised that of the options available to combat salinity, perennial plants offer the best prospect for significant increase in water use within agriculture.

3. Compensation of farmers for lost productivity.

It is both unfair and unrealistic to expect landowners to bear the brunt of the over clearing of the past - clearing that was done with government and community support to promote the State's economy. We must either develop alternative crops that will prevent increased loss of productive and conservation land to salt - crops that provide at least as much economic return as present shallow-rooted crops - or we must as a community compensate farmers for the loss in productivity and income. The former is much more desirable, as it maintains production and individual initiative and will cost less.

4. Improved data on what is threatened and what can be saved.

At present we have insufficient information on which ecological communities and species are most threatened. As discussed above, even for vascular plants, there are about 1700 taxa on CALM's Flora Priority List under Priorities 1, 2 and 3 - taxa that are rare but for which there is insufficient information to evaluate whether they are threatened. Experience shows that about 50% of Priority 1 and 2 taxa are actually threatened once detailed searches are carried out. We need comprehensive biogeographic surveys, such as are being carried out under the SAP at present, as well as targeted surveys for particular species.

5. More translocations, especially plants .

Translocations are necessary if we are to maintain species in the wild, noting that some ecosystems (habitats) are likely to disappear. Translocations that move species to areas where they did not occur naturally will be necessary. While there have been many vertebrate animal translocations in the SWBP in recent years, plant translocations are in their infancy.

6. For plants threatened by *Phytophthora* and salinity, long term storage of germplasm until ecosystem reconstruction is possible.

The setting up of CALM's Threatened Flora Seed Centre and close cooperation between CALM and the Botanic Gardens and Parks Authority (BGPA) has resulted in the seed of many threatened plants being stored under appropriate conditions. Research by BGPA shows that long-term cryostorage of plant germplasm is both possible and cheap, and this technique has much promise for the future.

7. Research into ecosystem reconstruction techniques.

Ecosystems are degrading and some will disappear. We need to learn how to reconstruct ecosystems in the future if we are to use the germplasm being stored now. While this appears to be an extremely difficult skill to develop and master, we certainly won't achieve the aim unless research into this area increases and is funded over the long-term.

8. Increased recurrent government funding, including funding for long-term science and land and species/ecosystem management.

Government funding for biodiversity conservation has increased significantly in recent decades, but is still very low by any measure when the scale of the problem is considered. A worrying trend is to fund short-term local projects at the expense of long-term science.

9. A shift in political priorities.

Above all else, political priorities must reflect the scale of the problems that require solution. Politicians reflect community concerns, so unless the community understands the issues and increases its support for the conservation of the SWBP biota, government and other funding will not be provided at the needed scale. In recent years the community has focused on the forests of the southwest corner. While these are important in their own right, they harbour less biodiversity and have many fewer problems of loss of biodiversity than the wheatbelt (or agricultural zone). Scientists who understand biodiversity conservation issues have a responsibility to provide accurate information to the public and influence public opinion.

Changing attitudes and obtaining increased resources is, to a significant extent, up to the people attending this lecture.

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Andrew A. Burbidge
Department of Conservation and Land Management,
Western Australian Threatened Species and Communities Unit,
PO Box 51, Wanneroo, WA 6946, Australia

REVIEWS

Flora of Australia Volume 1: Introduction 2nd Edition

Melbourne: ABRS/CSIRO Australia (1999)

The first edition of the introductory volume was released for the Sydney IBC in 1981, and the developments in Australian botany since that time have seen the need for a carefully revised and updated second edition. In this second edition of the *Flora of Australia* Volume 1, the editors have endeavoured to produce a book which not only introduces the Flora and its history, but which covers a much wider range of topics, including the vegetation of Australia, its fossil history, environment and conservation biology. In doing this, the new edition is more like a text book for the Flora than just an introduction.

The first section is an overview of the history of taxonomic research in Australia, including a detailed and well justified explanation of why the Cronquist (1981) classification is retained for pragmatic reasons when more phylogenetically supported systems have been developed since that time. A flora which is produced over such a time frame as the *Flora of Australia* project needs to be anchored to a stable framework, and where there are major dpeartures in family circumscription from Cronquist, these have been addressed on a family by family basis by the authors of those treatments. This section also provides a useful bibliography of major taxonomic works on the Australian flora, divided into convenient periods, the early sections of 50 years, the last two decades each listed separately, reflecting the dramatic increase in taxonomic activity as a direct response to the establishment of the *Flora* project.

Section 2 sees an updated exposition by Prof. Frakes of the geological history of the continent and the effects that past climatic changes have had on the flora, as well as a subsection by Marilyn Fox covering the present major floristic divisions across the continent and the effects of soil, fire and anthropogenic influence, both pre and post-European. Although this section is a potential book in its own right, the authors of the two subsections have between them provided a balanced and easy to follow review of the current knowledge of the factors which influence vegetation types and distribution through space and time in Australia.

The third and largest section covers the vegetation of Australia, both using the fossil record and modern techniques in biogeographic studies, as well as examining present day patterns of vegetation types and with sections on specialised aquatic vegetation types, both freshwater and marine. The fossil subsection uses the expertise of several palaeobotanists specialising in both macro- and microfossils, and uses the data from both of these fields to complement each other and produce a story

which is well supported from all the available evidence. This section is a major revision on the earlier volume and corrects a number of omissions as well as updating the history of major lineages based on much more and better evidence from the work of Australian palaeontologists over the last two decades. Similarly the discipline of biogeography has undergone a methodological revolution since the previous edition was published, and the coverage provided here by Crisp *et al.* is not only broad in representing the different approaches favoured by various researchers, but balanced in its review of these techniques. Using some of their own and other's research, the authors present some of the major biogeographic regions into which Australia can be divided and which appear to have been stongly influential on the evolution and diversification of the flora.

The review by Groves of the division of the flora into major structural and associative floristic vegetation types underscores the two different strategies used to create vegetation classifications in Australia. In addition, he presents a good summary of the complex topic of the contributions of aridity, salinity, fire and anthropogenic influences on the present day vegetation around the country. By combining information from the structural and floristic studies, he suggests that better conservation strategies which preserve both vegetation types and distinctive species associations can be developed. Similarly, the sub-sections on the major components of the aquatic floras are very detailed and underscore the wide diversity, floristic richness and significance of the water-based ecosystems, reminding the reader that these systems are far more important for biodiversity than their apparent low coverage of the continent would suggest. As these systems also represent sources of water for many anthropogenic activities, understanding their diversity and significance is crucial for their preservation in the face of increasing demand for water and near shore coastal environments.

In the fourth section, the significance of the Australian flora to horticulture, forestry and other economic uses is covered. There is a very brief mention of the use of native plants by indigenous peoples, and the subsequent commercial development of bush foods and medicines by restaurant and other interests Although genera such as *Eucalyptus* and *Acacia* are of major economic importance to forestry for timber, paper and essential oils, there is a significant range of taxa being developed for other uses - floriculture, apiary, dyes and other chemicals as well as some construction materials. The chapter covers all of these, listing the main taxa used for each purpose as well as indicating the potential for further development in these areas. Similarly, the utilisation of the flora by artists throughout the history of white colonisation is covered nicely by Helen Hewson. The section by Ian Creswell on conserving the flora has to cover an extremely wide topic in limited space. It covers the main legislative protections on a state by state basis, with maps showing the conservation reserves in each state. Although there is no comparison of the different approaches between the states, it does provide a good mechanism for researchers working to conserve taxa which extend across state boundaries to see the extent and nature of the conservation issues before them.

For many readers, the most important sections of the volume are the Key and Glossary chapters. All families of flowering plant represented in Australia are identified using a numbered artificial keying procedure. Particularly appreciated is the listing with each couplet of the couplet number from whence you were referred. This makes back-tracking in the event of suspected error a much simpler process. Although many readers will probably want to use instead the interactive CD-ROM version of the key (not provided here for evaluation), those who prefer the traditional hard-copy style key should have their needs amply catered. The characters are mostly easy to interpret, and the glossary is lavishly illustrated and provides clear, concise definitions.

In summary, this 2nd Edition of the *Introduction* represents the closest thing so far to a text book of Australian plant systematics for undergraduate-level students. The text is well written and concise, and the sections make interesting reading - a feature not always shared by texts covering such a broad range of topics from so many authors. The latter and the editors are to be congratulated for the level of internal consistency within and between the sections. There is good coverage of the range of views found in each of the subjects covered and for the most part, where there is controversy, the authors have been very balanced in their approaches. I commend this book to anyone interested in a good overview of the history, nature and diversity of the Australian flora, regardless of whether they are systematists, ecologists, physiologists or interested non-botanists.

John Conran
Department of Environmental Biology
The University of Adelaide

Book notices

Rock of Ages

Ian Bayly
Tuart House, an imprint of the University of Western Australia Press, Nedlands, W.A. 6907 (1999). xii + 132 pp.
ISBN 1 876268 19 0. Price $34.95

Beautifully illustrated with many colour plates, this gives an excellent introduction to the geology, landforms, natural history and human use of granite outcrops throughout Australia, ranging from offshore islands to the Snowy Mountains. If there is a bias towards Western Australia then that is because the largest areas of granite are in that State.

Life on the Rocks

Philippa Nikulinsky and Stephen D. Hopper
Fremantle Arts Centre Press, P.O. Box 158, North Fremantle, W.A. 6159 (1999). 184 pp.
ISBN 1 86368 258 9. Price $19.95

A second book on granite rocks, this one, about Western Australia only, is quite different from Ian Bayly's. Seventy-four plates reproducing watercolour paintings by Philippa Nikulinsky are accompanied by text written by Steve Hopper in this delightful book. Most subjects are botanical (including mosses and lichens) but several feature animals such as the honey possum and blue-tongue skink. The text is in the form of extended captions discussing essential points of interest about the plants and animals in the plates.

Looking for Milligan

John Brine and friends
The Milligan Society, Perth, W.A (1991). (iv), 207 pp. $9.95.

A soft-cover book of 13 chapters about one of Western Australia's first medical pracitioners, William Milligan (1795–1851). Most of the book describes the efforts of the various authors to unearth information on Milligan. He came to the Swan River in 1829 with the 63rd Infantry Regiment and worked first as assistant to the colonial surgeon but soon took charge of the first hospital in the colony. In 1837 he left for service in India. It seems that he had a strong interest in the flora, giving a short account in his 'Report on the Swan River colony', written in India in 1837. The botanical names used are a mixture of eastern and western species. The report, apparently unpublished, also covers other aspects of the environment, the Aborigines, seasons and weather. I have seen no plant collections by Milligan and would be interested to know of any that others may have come across. He seems to have been unrelated to Joseph Milligan who collected in Tasmania in the 1830s and '40s.

Alex S. George
'Four Gables', 18 Barclay Road, Kardinya, W.A. 6163

INCITES

Main news article:
One of Australia's most successful science administrators Dr Malcolm McIntosh has died at the age of 54 (News) 8/2/00
http://WWW.ASTO.COM.AU/mctribute.htm

Other items:
Beyond the linear view of innovation in science park evaluation: an analysis of Western Australian Technology Park (Summary) 24/2/00
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A Primer on the Knowledge Economy - provides a brief guide to way in which the ground rules for economic activity are changing. (Summary) 23/2/00
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Vision for Australian Science: Science capability fundamental economic growth (Media Release) 8/2/00
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Commercial arms of Australian universities rank with US counterparts, survey shows. (Media Release) 6/2/00
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http://WWW.ASTO.COM.AU/record_usbudget.htm

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Invitations for applications for the seventh selection round of the Cooperative Research Centres (CRC) Program. (Media Release) 19/1/00
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FASTS calls for a proper analysis of Government figures to assess the extent of the "brain drain" - Top Ten Issues. (Media Release) 13/1/00
http://WWW.ASTO.COM.AU/fasts_on_brain_drain.htm

Release of White Paper on research and research training. Long awaited white paper on research and research training released near Christmas (News)
http://WWW.ASTO.COM.AU/whitepapsum.htm

Research reforms just re-arrangements. Australian Vice Chancellors' Committee (AVCC) response to the White Paper. (Media Release) 11/1/00
http://WWW.ASTO.COM.AU/whitepaper-avcc.htm

Too late - too simplistic Australian Academy of Science response to the White Paper on Higher Education Research, New Knowledge and Innovation (Media Release) 21/12/99
http://WWW.ASTO.COM.AU/whitepaper_resp_aaa.htm

Queensland Innovation Council set up. (Media Release) 25/11/99
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PO Box 4599 Kingston ACT 2604
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CONFERENCES/WORKSHOPS

Jupiter Botanicus Down Under

The two hundredth anniversary of Robert Brown's visit to Australia is fast approaching. Brown's endeavours while in Australia (1801-1805) and his later contributions to Australian systematic botany will be well known to members. ASBS Council have co-opted a small group of members to explore ways in which the botanical community might recognise this important anniversary. This group currently comprises Alex George, David Mabberley and John Clarkson. Brown's association with Matthew Flinders and his circumnavigation of the continent provides a wonderful opportunity to gain some publicity for Australian botany and systematics. Several groups have already begun planning major events where the focus will be primarily on Flinders. A newsletter recently produced by the Royal Geographical Society of Queensland summarises what is already on the drawing board (included in your last newsletter). One of the challenges facing ASBS is to co-ordinate our activities with these events where possible.

Ideas at present include a symposium in the south west of Western Australia in December 2001 to coincide with the first point of contact with the Australian mainland, the launch of Vallance, Moore and Grove's transcription of Brown's diary, a public lecture tour on Brown and botanical survey work and ethnobotanical studies in poorly collected areas around the Gulf of Carpentaria. It is early days yet and we are sure that more ideas will surface. We will keep you informed via the newsletter as things progress and we would welcome further ideas.

Alex George
'Four Gables', 18 Barclay Road, Kardinya WA 6163
Phone: 08 9337 1655; fax: 08 9337 9404; email: alextris@iinet.net.au

David Mabberley
National Herbarium of NSW, Mrs Macquaries Road, Sydney NSW 2000
Phone: 02 9231811; fax: 02 92517231; email: david_mabberley@yahoo.co.uk

John Clarkson
Centre for Tropical Agriculture, PO Box 1054, Mareeba QLD 4880
Phone: 07 4092 8445; fax: 07 4092 3593; email: john.clarkson@dnr.qld.gov.au

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Hobart: October 12-13

Presenters Toss Gascoigne and Jenni Metcalfe have backgrounds in journalism, science communication and education. They work in daily contact with scientists and journalists, and have been running Workshops for seven years.

Cost: $595 per participant (plus GST after June 30) per workshop. Numbers are limited to 10 participants each, and special workshops can be arranged if the above dates and locations do not suit.

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NEWS FROM FASTS

Two steps in the right direction

The ALP policy announced today (Monday) to encourage more top school graduates to enter teaching was applauded as "two steps in the right direction".

Ms Jan Thomas, Vice-President of the Federation of Australian Scientific and Technological Societies (FASTS), said ALP policy unveiled by Education spokesperson Michael Lee at the Sydney Institute would help address shortages bedevilling the Australian education system.

"Public recognition of this problem will come as a great relief to a profession under siege," she said.

"The policy provides support where it is needed most. It will encourage bright and committed people into the teaching of science, mathematics and IT courses; and it will help those already in the field to upgrade their skills."

"But no dollar figures are attached to this policy, and we still need to see the colour of the ALP money."

The combination of a HECS-free life for teachers in these key areas reverses an anomaly. Currently, teachers of science and mathematics take home less pay than colleagues of the same experience in other teaching areas such as English.

This is because degrees in science and mathematics attract a higher HECS debt.

Ms Thomas said that offering more mature teachers an incentive scheme to upgrade their skills and

knowledge through a Teacher Development Contract would help teachers keep abreast of change in rapidly-moving times.

"Most of our teachers began working when computers were just a gleam in Bill Gates' eye," she said. "For many, their formal training stopped then. But the world has moved on, particularly in mathematics and science."

"Teachers need to be able to talk to their students about the exciting things that are happening today in their areas."

"Although teachers have worked hard to keep their skills up to the mark, it has been an uphill battle. This new scheme will make it easier, even though the training will be completed largely in their own time."

"It will be particularly useful for teachers who have to work outside the areas where they have been formally trained."

But she was critical that the programs unveiled by the ALP would not cover people who decided to enter teaching after several years in another job in the workforce.

"Some of the best teachers come from people who train as engineers or scientists and subsequently decide they want to go into education. Their experience in life makes them a valuable part of the teaching profession, and the policy unveiled tonight does not cover them," she said.

Australian investment in scientific instruments falls

A survey of companies supplying scientific instruments to Australian industry and research bodies has found a significant softening in demand in their most recent audited survey.

Sales of analytical instruments such as mass spectrometers and gas chromatographs plunged to their lowest levels since the survey process began in January 1997.

On a scale indexed for foreign exchange rates, most recent quarterly sales measured 89 against a base rate of 100 in 1997.

The survey is commissioned by the Scientific Suppliers Association of Australia, an industry body representing 90 companies with total sales of about $1 billion per annum. It measures quarterly sales by a representative group of companies.

The surveys are conducted by Pricewaterhouse-Coopers.

Mr Alan Lawrenson, Manager of the SSAA, said that the plunging sales for analytical instruments and flat sales for other scientific products indicated that Australia is losing ground in the battle for international competitiveness.

"These sales cover a period when our competitors overseas are making massive new investment in science infrastructure," he said. "We have to run faster just to maintain our place in the international pecking order."

Mr Lawrenson said a further indication of sector activity would be provided by industry response to The Millennium Science 2000. Over 2500 laboratory managers and scientists are expected at this event, to be held at the Rosehill Function Centre in Sydney from March 21-23.

He described it as Australia's largest scientific event for professional scientific staff. It features seminars and technical discussions as well as a trade exhibition.

Mr Lawrenson said there are signs of hope on the horizon. The Innovation Summit had sparked calls for increased investment in research and modernisation of equipment.

"Our members are hoping recent Government measures like the reduction in capital gains tax will encourage activity in this sector, but there is a lot of lost ground to make up," he said.

Professor Sue Serjeantson, President of the Federation of Australian Scientific and Technological Societies (FASTS), said her members are concerned about the steady erosion of facilities and equipment in Australian research organisations.

"Universities are increasingly operating on outdated and failing equipment which reached the end of its useful life a long time ago," she said.

"Baling twine, Aussie enterprise and goodwill can carry our research effort only so far. It's time to put dollars into science."

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FASTS circular for January-February 2000

In summary
This year, FASTS has

- met with Minister David Kemp
- released the Ten Top Issues
- held detailed discussions with officers of ISR on a range of policy matters
- media coverage on the Innovation Summit, Minister Kemp's White Paper, the death of Malcolm McIntosh, commercialising science, the brain drain and the decline in government funding for universities in the Australian, the SMH, the Financial Review, ABC radio, the Age, the Telegraph
- assisted Member Societies with media releases
- written to Minister Minchin on the brain drain issue
- met with key Parliamentarians to discuss science issues
- participated in the Innovation Summit

1. Innovation summit
The Innovation Summit has come and gone, and worked better than most people expected. I attended as President of FASTS, along with Past-President Peter Cullen, FASTS' Executive Director Toss Gascoigne and Board Member John Pilbrow.

There WAS a positive mood during the three days, despite the absence of any hard announcements (Minister Minchin missed a big opportunity to offer something in his final statement. It didn't have to be big, just a sign...)

It was a big plus to have the attention of Australia's politicians focussed on research and innovation, if only for a week. The Summit was addressed by Cabinet Ministers Minchin, Alston and Kemp, as well the Prime Minister.

In addressing the dinner, the Prime Minister said that people interested in innovation would be entitled to judge the Government by its actions.

Given that the Government has presided over a period of plummeting rates of business expenditure on R&D and a university sector facing varying degrees of crisis, it is hardly in a position to stand on its record. Its strategy of trying to starve the universities into innovation has been a failure.

In fairness to the Government, some of these problems were inherited from the previous administration.

The Prime Minister's statement has been widely interpreted as a strong hint of good things in the air. Certainly he succeeded in raising expectations across the sector.

There was broad agreement on what has to happen before Australia can take full advantage of our high-quality science. The final reports of the thirteen breakout sessions are peppered with words like "broad support ... consensus."

General agreement on steps to be taken was characteristic of the event. The degree of unanimity probably surprised delegates, given their different backgrounds in the business, Government, higher education and research sectors.

The Summit opens up new possibilities for Australia. If it is to be judged a success, the Summit must lead to:
a. increased national investment in research
b. change the reward structure in research organisations, to encourage innovative behaviour
c. a new culture which recognises R&D as the driver of innovative industries
d. mentoring and incubators to assist commercially-minded scientists and technologists
e. structures to encourage movement between industry and research organisations
f. more realistic and sophisticated handling of IP issues

We are told that this year's Budget will be tight, but the Government needs to start now. The issues have been well analysed - what's missing is the funding to accompany the rhetoric.

Further information on the Summit is available on the ISR web site.

2. "Science meets Parliament" day
We invited all Federal politicians to meet a pair of scientists from their electorate last year, and response was overwhelming. One hundred and forty Parliamentarians (two-thirds of the total) agreed to meet with 170 scientists from all over Australia.

Participating scientists were very positive, scoring the overall event at eight and a half out of ten. A clear highlight was meeting Parliamentarians. Scientists were impressed (and surprised) by their general grasp of issues, and the value they placed on investing in S&T. The meetings often lasted longer than the scheduled half hour, another good sign.

Science education issues were the most popular topic, mentioned in nearly half the meetings. Fifty MPs were asked how science was travelling, and 42 of them responded "not well". For some, the problem was lack of funds; others blamed scientists' poor communication with the public.

The Physicists made great use of the Day by scheduling a meeting of the AIP in Canberra that week. This meant they were able to stay on for SmP Day at minimal cost.

FASTS discussed S&T issues with Senator Grant Chapman (SA, Chair of Liberal Party ISR Policy Committee) and Danna Vale MP (Member for Hughes) over dinner last week. Developing closer links with prominent backbenchers who have demonstrated strong interest in science and higher education issues complements our relationships with Ministers, shadow Ministers and bureaucrats.

Watch the FASTS' web site for a full report: www.usyd.edu.au/fasts/

3. Fresh science
ScienceNOW! is seeking 16 young-ish scientists to talk about their research to the media and the general public at ScienceNOW! in Melbourne from May 4 to 7.

They want good peer-reviewed research by scientists without a public profile but with the ability to tell a good story. Research must have been conducted in Australia or by an Australian, must have been released since 1 January 1999, must have gained peer recognition, and must NOT have had significant media coverage.

The selected researchers will be flown to Melbourne and provided with training and media support. The event last year attracted over 150 media mentions.

For further information: www.sciencenow.org.au Or contact Niall Byrne: 03 5253 1391, fax 03 9923 6008, e-mail: niall@byc.com.au

4. Prime Minister's Science Council
I attended my first meeting of the Prime Minister's Science Council last November. This is an excellent opportunity to raise issues on behalf of Australia's scientists and technologists with the Prime Minister and his cabinet.

I am chairing a working group preparing a presentation on Science and Technology in Fighting Crime, with a report to be presented to the June PMSEIC meeting.

5. Support for visitors to Australia
The rules governing ISR's Technology Diffusion Program seem to changing, and it should be considered a possible source of funding to bring top overseas speakers to Australia.

Applicants need to demonstrate that this will promote innovation and industry competitiveness by helping industry and researchers to access and adopt new and leading edge technologies.

Further information ON TDP: www.ausindustry.gov.au/tdp or by calling the AusIndustry Business Hotline on 13 28 46

6. Meeting with David Kemp
Ken Baldwin and I met David Kemp as part of the "Science meets Parliament" Day event. The discussions were friendly and useful, and we are following up several points by correspondence.

7. New FASTS policy document
The new Policy Document was launched late last year in Parliament House, and formally presented to Minister Minchin who promised a comprehensive response from his Department.

Clearly the Document is a valued contribution to policy formulation. In our discussions with ISR officers it has been described as a "great basis for all sorts of decision-making".

Thanks to Ken Baldwin, Chair of the Steering Committee, for steering the Document through. It is available as a pdf file on our web site, or in hard copy from the FASTS' office.

8. Discussions with the department
We have had a series of meetings with ISR officers. FASTS has earned the confidence of ISR, and we are able to talk constructively on a whole range of issues.

Matters raised in the most recent meeting included:
- measuring the brain drain
- a scheme to fund major national research projects
- detail in the FASTS' Policy Document
- a consolidation of cost-benefit analyses of Australian research

FASTS will react to the Budget more quickly and more accurately this year, after arranging a Budget night briefing from the Minister and officers of his Department.

9. Ten top issues for 2000
The list was released in mid-January and is available from our web site. The 10 selected issues are:
- Invest in the future
- Science for the bush
- More science and maths teachers
- Brain drain becomes express train
- Keeping Australia in touch
- Establish the future of the CRC program
- Bringing the boys (and girls) back home
- A national map and compass
- Reversing the decline: industry investment in R&D
- Changing the culture through science awareness

10. FASTS' brochure
We have a new version of the FASTS brochure available. The flyer sets out the benefits of membership, and lists our Members. Some Societies have posted the brochure out with their newsletters. If others would like to do this too, copies are available from the FASTS' office.

11. CSIRO and Malcolm McIntosh
The death of Malcolm McIntosh will be universally mourned through the world of science and technology. He won the respect and admiration of the Australian community, and was a rare person who could command the same respect in the laboratory and the Cabinet office.

FASTS hopes the Minister is able to make a speedy appointment to this key position, as challenging issues face CSIRO.

12. Neuroscience Society and the FASTS' lecture
The Neuroscience Society presents the FASTS' Lecture as a major invited talk at its annual conferences. These public lectures have attracted good media coverage, and FASTS is able to assist with the drafting and distribution of a media release.

This offer is open to any other Member Society which would like to add the FASTS' Lecture to their program.

Sue Serjeantson
President
18 February 2000

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FASTS salutes Malcolm McIntosh

The death of Malcolm McIntosh will be universally mourned through the world of science and technology.

Professor Sue Serjeantson, President of the Federation of Australian Scientific and Technological Societies (FASTS), said Dr McIntosh had won the respect and admiration of the Australian community.

"We respected his judgment and admired his courage," she said. "He guided Australia's largest research organisation through challenging times with a sure hand."

"Dr McIntosh's intellect was matched by his personal qualities, and he made a huge difference to CSIRO as Chief Executive Officer."

Professor Serjeantson said Dr McIntosh was an important advocate for science and technology in Australia, and was a rare person who could command the same respect in the laboratory and the Cabinet office.

"He inspired warmth and loyalty among CSIRO staff. They had confidence in him as a leader who could take the case for science to the highest levels in Government and industry, and win support from the most uncompromising quarters."

Professor Serjeantson said it was particularly poignant that Dr McIntosh should die on the eve of the Innovation Summit.

"This is an occasion when the mind of Government and industry will focus on the linkages between industry and research, a relationship on which Dr McIntosh spoke passionately."

"This is a sad day for Australia."

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"Ten Top Issues" for 2000.

"Ten Top Issues" finger science brain drain

Australia's peak council for scientists and technologists called for a proper analysis of Government figures to assess the extent of the "brain drain" of Australian scientists, when it released its 'Ten Top Issues' for 2000.

Professor Sue Serjeantson, President of the Federation of Australian Scientific and Technological Societies (FASTS), says the brain drain is an indication that research science is tottering on a see-saw in Australia, and scientists are voting with their feet to escape to a better world.

"Our 'Ten Top Issues' for 2000 is a wish-list for scientists," she says. "If these issues were rectified, we'd have booming new high-technology industries, and top-level scientists and technologists from overseas clamouring to join Australia's vigorous research effort.

"The 'Ten Top Issues' should also be a wish list for every Australian. Unless we change our complacent attitude to science as an investment, Australia will continue its gentle slide into mediocrity."

She says the issues boil down to three key factors:

... greater Government investment in public good science
... increased investment by industry in research to generate the products of tomorrow
... a shared determination by Australians to seek a future based on satisfying, well-paid jobs in high-technology industries

"Anecdotal evidence about the draining away of talented Australian scientists is mounting. Every Australian scientist has farewelled friends and colleagues to better jobs overseas," she says. "Conditions are better, research funds are more available, job security is better."

"Australian scientists working overseas say they'd love to be able to return, but they can't afford the career insecurity, difficulty gaining research funds and the crumbling infrastructure."

"We want Australians to go overseas to broaden their experience and gain new contacts. But we need a way to encourage them to bring their new skills back to Australia, so they return at least for extended periods of research."

Professor Serjeantson says there is no evidence to support claims the brain drain is being matched by a flow of talent into Australia.

"There is a suspicion that Australia is losing potential Einsteins, but gaining tradespeople in return," she says. "The statistics available to the public are very unreliable, and may well cover up the true picture."

"There is a natural tendency by people wishing to move to Australia to inflate their qualifications."

Professor Serjeantson says she is calling on the Government to undertake an analysis of highly qualified people moving into and out of the country. This should include a close examination of the confidential records of immigrants, including a careful assessment of their qualifications.

Only the Government has access to these confidential records and the resources to analyse them.

FASTS "Ten Top Issues" for 2000

1. INVEST IN THE FUTURE
Australian scientists are starved of research money, and the Government's White Paper contains no new funding. Government funding for research should be increased in the same way funding for medical research was boosted in 1999.

2. SCIENCE FOR THE BUSH
Coordinate Australian science to create jobs, improve existing industries, solve environmental problems and improve digital communication in regional and rural Australia.

3. MORE SCIENCE AND MATHS TEACHERS
Science and mathematics teachers take home less money than other teachers because they have a higher HECS debt to repay. Removing the inequity would help overcome the shortfall of qualified science and mathematics teachers.

4. BRAIN DRAIN BECOMES EXPRESS TRAIN
Job insecurity, lack of career paths and low salaries are driving good young scientists away from jobs in research. Australia is in danger of losing a generation of scientists and technologists, to jobs overseas or to other professions.

5. KEEPING AUSTRALIA IN TOUCH
Australia is losing touch with international science as the price of scientific journals rise and libraries cancel subscriptions. We need a national arrangement to buy electronic academic publications, to enable all Australian researchers access to the latest scientific ideas.

6. ESTABLISH THE FUTURE OF THE CRC PROGRAM
Cooperative Research Centres help industry and researchers work more closely on key national issues. The CRC Program should be on a regular footing, with an annual schedule to consider proposals for funding new centres.

7. BRINGING THE BOYS (AND GIRLS) BACK HOME
Introduce a scheme of fellowships and stipends to enable Australian scientists working overseas to return for short and medium-term research activities, to bring their knowledge back and take Australian ideas overseas.

8. A NATIONAL MAP AND COMPASS
Does Australia know where it is going in a rapidly-changing world? Setting national goals and national priorities, and identifying where S&T fit in is a key job for the Prime Minister's Science Council. Mechanisms to coordinate science and promote a whole-of-Government approach need strengthening.

9. REVERSING THE DECLINE: INDUSTRY INVESTMENT IN R&D
Industry investment in research continues to slump. Australia needs a range of incentives to encourage investment in R&D, including tax deductibility at internationally-competitive rates and a tax credit system. The Ralph Review reforms are just a start.

10. CHANGING THE CULTURE THROUGH SCIENCE AWARENESS
Australians are proud of their science, but know little about its value. A vigorous program of science and mathematics awareness targeted at the business community would help the nation appreciate the central role S&T play in invigorating existing businesses and generating new industries.

A.S.B.S. PUBLICATIONS

History of Systematic Botany in Australia

Edited by P.S. Short. A4, case bound, 326pp. A.S.B.S., 1990. $10; plus $10 p. & p.

For all those people interested in the 1988 A.S.B.S. symposium in Melbourne, here are the proceedings. It is a very nicely presented volume, containing 36 papers on: the botanical exploration of our region; the role of horticulturists, collectors and artists in the early documentation of the flora; the renowned (Mueller, Cunningham), and those whose contribution is sometimes overlooked (Buchanan, Wilhelmi).

Systematic Status of Large Flowering Plant Genera

A.S.B.S. Newsletter Number 53, edited by Helen Hewson. 1987. $5 + $1.10 postage.

This Newsletter issue includes the reports from the February 1986 Boden Conference on the "Systematic Status of Large Flowering Plant Genera". The reports cover: the genus concept; the role of cladistics in generic delimitation; geographic range and the genus concepts; the value of chemical characters, pollination syndromes, and breeding systems as generic determinants; and generic concepts in the Asteraceae, Chenopodiaceae, Epacridaceae, *Cassia*, *Acacia*, and *Eucalyptus*.

Ecology of the Southern Conifers

Edited by Neal Enright and Robert Hill.
ASBS members: $60 plus $12 p&p non-members $79.95.

Proceedings of a symposium at the ASBS conference in Hobart in 1993. Twenty-eight scholars from across the hemisphere examine the history and ecology of the southern conifers, and emphasise their importance in understanding the evolution and ecological dynamics of southern vegetation.

Australian Systematic Botany Society Newsletter

Back issues of the Newsletter are available from Number 27 (May 1981) onwards, excluding Numbers 29 and 31. Here is the chance to complete your set. Cover prices are $3.50 (Numbers 27-59, excluding Number 53) and $5.00 (Number 53, and 60 onwards). Postage $1.10 per issue.

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Evolution of the Flora and Fauna of Arid Australia

Edited by W.R. Barker & P.J.M. Greenslade. A.S.B.S. & A.N.Z.A.A.S., 1982. $20 + $5 postage.

This collection of more than 40 papers will interest all people concerned with Australia's dry inland, or the evolutionary history of its flora and fauna. It is of value to those studying both arid lands and evolution in general. Six sections cover: ecological and historical background; ecological and reproductive adaptations in plants; vertebrate animals; invertebrate animals; individual plant groups; and concluding remarks.

Special arrangement: To obtain this discounted price, post a photocopy of this page with remittance to: Peacock Publications, 38 Sydenham Road, Norwood, SA 5069, Australia.

A.S.B.S. CHAPTER CONVENERS

Adelaide
Bob Hill
Department of Environmental Biology
University of Adelaide
South Australia 5005
Tel: (08) 83036313
Email: bob.hill@adelaide.edu.au

Armidale
Jeremy Bruhl
Department of Botany
University of New England
Armidale, NSW 2351
Tel: (02) 677324209

Brisbane
Laurie Jessup
Queensland Herbarium
Meiers Road
Indooroopilly, Qld 4068
Tel: (07) 38969320

Canberra
Greg Chandler
Australian National Herbarium
GPO Box 1600
Canberra, ACT 2601
Tel: (02) 62465499

Darwin
Clyde Dunlop
Northern Territory Herbarium
Parks & Wildlife Commission of the NT
PO Box 496
Palmerston, NT 0831
Tel: (08) 89994512

Hobart
Andrew Rozefelds
Tasmanian Herbarium
GPO Box 252-40
Hobart, Tasmania 7001

Melbourne
Andrew Drinnan
School of Botany
The University of Melbourne
Parkville, Victoria 3052
Tel: (03) 93445252
Email: drinnan@botany.unimelb.edu.au

Perth
Jenny Chappill
Department of Botany
University of Western Australia
Nedlands, WA 6009
Tel: (08) 93802212

Sydney
Peter Jobson
National Herbarium of NSW
Mrs Macquaries Road
Sydney, NSW 2000
Tel: (02) 92318131

Telephone and Fax Numbers for Major Australian Herbaria

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tel: (02) 62465108	tel: (02) 62509450	tel: (03) 92522300	tel: (02) 92318111
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ABRS Fax: (02) 62509448 publications; (02) 62509555 grants
Phone: (02) 62509442 A.E. Orchard;
Email: tony.orchard@ea.gov.au

This list will be kept up to date, and will be published in each issue.
Please inform us of any changes or additions.

AUSTRALIAN SYSTEMATIC BOTANY SOCIETY INCORPORATED

The Society

The Australian Systematic Botany Society is an incorporated association of over 300 people with professional or amateur interest in botany. The aim of the Society is to promote the study of plant systematics.

Membership

Membership is open to all those interested in plant systematics. Membership entitles the member to attend general meetings and chapter meetings, and to receive the *Newsletter*. Any person may apply for membership by filling in a "Membership Application" form and forwarding it, with the appropriate subscription, to the treasurer. Subscriptions become due on January 1 each year.

The Newsletter

The *Newsletter* appears quarterly, keeps members informed of Society events and news, and provides a vehicle for debate and discussion. In addition, original articles, notes and letters (not exceeding ten published pages in length) will be considered.

Contributions should be sent to the editor at the address given below. They should preferably be submitted as: - an unformatted word-processor file on an MS-DOS or Macintosh diskette (Microsoft Word 6 or an earlier version is preferred), accompanied by a printed copy; as an email message or attachment, accompanied by a fax message reporting the sending of the file; or as two typed copies.

The deadline for contributions is the last day of February, May, August and November.

All items incorporated in the *Newsletter* will be duly acknowledged. Authors alone are responsible for the views expressed, and statements made by the authors do not necessarily represent the views of the Australian Systematic Botany Society Inc. *Newsletter* items should not be reproduced without the permission of the author of the material.

Notes

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Advertising space is available for products or services of interest to A.S.B.S. members. Current rate is $100 per full page, $50 per half-page or less, with a 20% discount for second and subsequent entries of the same advertisement. Advertisements from ASBS members are usually exempt from fees. Contact the *Newsletter* editor for further information.

Editor

Bob Hill
Department of Environmental Biology
University of Adelaide
South Australia 5005
tel: (08) 83033120
fax: (03) 83036222
email: Bob.Hill@adelaide.edu.au

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