THE WINSTON CHURCHILL MEMORIAL TRUST OF AUSTRALIA

Report by – AMANDA SPOONER – 2004 Churchill Fellow

To examine the pioneer botanical collections of Australian plants held in European Herbaria

I understand that the Churchill Trust may publish this Report, either in hard copy or on the internet or both, and consent to such publication.

I indemnify the Churchill Trust against any loss, costs or damages it may suffer arising out of any claim or proceedings made against the Trust in respect of or arising out of the publication of any Report submitted to the Trust and which the Trust places on a website for access over the internet.

I also warrant that my Final Report is original and does not infringe the copyright of any person, or contain anything which is, or the incorporation of which into the Final Report is, actionable for defamation, a breach of any privacy law or obligation, breach of confidence, contempt of court, passing-off or contravention of any other private right or of any law.

Signed Dated

.....

Amanda Spooner 8th December 2005

CONTENTS

INTRODUCTION

Much of Australia's early botanical Type material is held in European herbaria presenting impediments to the study of botany and application of taxonomy in Australia. One such collection is that of Ludwig Preiss who collected in the south-west of Western Australia in 1839-1841. This collection is presently held in the Botanical Museum of Lund University and is significant because the specimens therein were used to write the first flora of Western Australia, *Plantae Preissianae.* My Fellowship allowed me to visit Lund to locate, examine and identify the Type specimens within this collection to facilitate their data accession and imaging.

Herbaria around the world are becoming increasingly concerned about sending priceless Type specimens away. An important strategy in overcoming this has been the use of specimen imaging as an alternative to loans. In the past, images have not proven useful due to low quality of resolution. However the recently launched African Plants Initiative (API) is using sophisticated image software to provide high quality images of African Type specimens through the web allowing access to information for botanists unable to examine the original material. In order to assess various approaches to digital specimen photography I visited the Muséum National d'Histoire Naturelle in Paris and Kew Gardens in London, both participants on the API, with the intention of gathering information on standard protocols, methodology and best practices in data management.

ACKNOWLEDGEMENTS

I would like to acknowledge the wonderful generosity and support of the following people and organisations without whom my wonderful trip would not have been possible:

- The Winston Churchill Memorial Trust of Australia
- My referrees Dr Neville Marchant, Nicholas Lander and Tom Alford
- My colleagues at the Western Australian Museum for their support, and in particular Alex Chapman for his invaluable help and advice during preparations for my trip and to him and Dr Terry Macfarlane for their prompt and valuable advice whilst I was away
- My academic colleagues at the Botanical Museum, Lund, Professor Ingvar Karnefelt, Sigvard Svensson and in particular Dr Håkan Witzell and Dr Susanna Riebe for always welcoming my constant interruptions to their work
- Messieurs Marc Pignal, Jean-Noël Labat and Laurent at the Muséum National d'Histoire Naturelle, Paris for their time and their willingness and enthusiasm in guiding me through their API programme
- Anna Saltmarsh, Laura Pleasance, Sarah Phillips and Melissa Trudgeon at Kew, for their extremely informative discussions on specimen imaging
- Juliet Wege, the Australian Botanical Liaison Officer (ABLO) at Kew for help, sustenance and lemon juice when I landed on her doorstep with 'flu
- Gerry and Brian Coventry my ever-patient aunt and uncle who allowed me to turn their house into a hotel at a moment's notice
- Åsa Persson and her lovely family in Lund for taking me into their home for a few days
- Tamzin and Daniel Jans in France
- My Copenhagen family, Sigrun, Jan, Christoffer, Cecelia and Zarah-Maria, for brilliant food, company and so much laughter

and, of course,

- My family, Chris and Christopher

EXECUTIVE SUMMARY

Name: Amanda Spooner

Address: 24/160 Mill Point Rd, South Perth, Western Australia, 6151

Position: Botanist, Dept. Conservation and Land Management, Kensington, Western Australia

Telephone: +61 8 9334 0513 email: amandasp@calm.wa.gov.au

Fellowship Objective:

To locate, curate, identify and prioritise Type specimens from the Ludwig Preiss collection in the Botanical Museum, Lund, in preparation for accession, imaging and web display and to investigate standard protocols, methodology and best practices of the African Plants Initiative specimen imaging project at the Muséum National d'Histoire Naturelle in Paris and Kew Gardens in London.

The major outcome from my Fellowship travels has been the realisation that the traditional paradigm of accessing Type specimens by visitation or by loans is rapidly changing. The new model involves delivery of important Type information through the Internet as exemplified by the African Plants Initiative (API). I gained much important information from my discussions with the supervisors of this project, which is contained in a detailed report available on request. For some years the botanical community has been moving towards creating standard protocols for sharing the world's biological data and the API is a practical project in this mode. It is important that the global community develops standard protocols for digitising specimens, their archival and distribution and that Australia is involved in this process.

In Lund, I located 1424 Preiss specimens including 694 Types and negotiated an agreement whereby they will be digitally photographed before the rest of the collection and made available through the Internet as soon as possible. An agreement was reached covering conditions for the loan of the collection to the Western Australian Herbarium.

There has been much interest in my project and I intend to communicate both my specimen image project findings and details about the trip to Lund in the following manner:

- By lodging copies of my Specimen Imaging report and Notes on the Preiss collection in the Western Australian Herbarium library,
- in a variety of presentations to interested community and professional groups
- through a series of articles, to be published in such journals as the Australian Systematic Botany Society newsletter, Landscope, the magazine of the Dept. of Conservation and Land Management in WA and the newsletter of the Wildflower Society of Western Australia.

PROGRAMME

SWEDEN: AUGUST 8 – SEPT 15

Botanical Museum, University of Lund

Locating and curating the specimens from the Preiss collection and identifying, documenting and prioritising the West Australian Type specimens from the Ludwig Preiss collection, in collaboration with Dr Håkan Witzell and Dr Susanna Riebe, in preparation for accession, imaging and web display.

FRANCE: SEPTEMBER 19

Muséum National d'Histoire Naturelle, Paris

Discussion on specimen digitisation with particular reference to data management and quality control and digital camera protocols, using the African Plants Initiative (API) as an example, with Dr Marc Pignal, Herbarium Collections manager, Dr Jean-Noël Labat, responsible for African Collections and M. Laurent, coordinator of the API project.

ENGLAND: JULY 28 and SEPTEMBER 26 – 27

Royal Botanic Gardens, Kew, Richmond, Surrey

Discussion on standards and hardware and software specifications of specimen digitisation programme with Anna Saltmarsh, API supervisor, and Laura Pleasance, subsequent to preliminary meeting with database and QC team on July 28, 2005 during which the set-up and working environment of the project was observed.

THE FELLOWSHIP PROJECT

BACKGROUND

Western Australia is one of the great natural gardens of the world with a range of flora far surpassing most other locations. The south-west of Western Australia has been identified as one of the world's top 34 biodiversity hotspots for flora (Mittermeier, 2004) and therefore the subject of great conservation effort. Underpinning these efforts is the correct application of plant names. Names anchor the concept of the species and enable effective communication about that species. The standard reference specimen for a species name is called the 'Type specimen'. Type specimens are critical for verifying names or deciding if a new species has to be described with a new name. It is imperative that Australian botanists have access to the Types through loans or other means.

All early Western Australian collections, beginning with those of William Dampier in 1699, were sent to Europe as there were no facilities in Australia to safely store the specimens. Although some collections were housed in Perth from the 1890's, the official State Herbarium was not formed until 1928. This means that Type specimens of most Western Australian plant species are held in major overseas herbaria. Due to the lack of resources to find and post the required specimens, concerns about fumigation treatments by customs, and the possibility of damage to the specimens during transit, specimens world-wide are becoming increasingly difficult to borrow.

Originally my Churchill Fellowship objective was to locate and identify the historical Australian Type plant collections of Ludwig Preiss and Robert Brown and to arrange their repatriation to Australia, thus enabling Australian botanists access to these specimens to correctly name hundreds of Australian plant species. These Type collections are housed in the herbaria of the Lund University Botanical Museum (LD), Sweden, and the Royal Botanic Garden, Edinburgh (E), UK, respectively. This project was planned following offers received from both institutions to allow the repatriation of relevant Type specimens from the Preiss collection and duplicates of the Types from the Robert Brown collections. to the Western Australian Herbarium (PERTH).

The director at Lund Herbarium had generously offered PERTH custodianship of the Preiss collection at a time when the Botanical Museum had few resources to curate the collection or service loan requests. In June 2005, PERTH received notification they had received a substantial grant to enable them to database and digitise all their type specimens including the West Australian Preiss types, rendering them unable to continue with their generous offer. Subsequent discussions with Lund enabled a re-arrangement of my Churchill project that still kept true to the Fellowship objective of obtaining type specimens for scientific purposes. It was decided that Lund would

provide images of all the Types, online or by CD, for Australian botanists to consult and use. This has recently become a valid and accepted botanical procedure provided images are of high quality (see below). A short to medium term loan agreement has also been negotiated if close study of the actual specimen is deemed necessary.

In March 2005, the offer from Edinburgh for duplicate Type specimens was withdrawn as a new directorship and policy had been established. In the UK, in Oxford, there is a similar and equally significant Western Australian Type collection – that of James Drummond collected between 1829 and 1863, and before commencing my Fellowship it was decided to approach Oxford University with a view to establishing a similar project. They were initially amenable to the idea but were loath to offer a workplace in their institution without a substantial fee to cover their costs. This latter development occurred after I had left Australia and was attending the XVII International Botanical Congress, in Vienna.

Whilst in Vienna, I became aware of one exciting direction in which the study of plant taxonomy was heading, which was very relevant to my project. Australia is not the only continent to suffer the inconvenience of having remote Type specimens. It is also the case for Africa and I attended the launch of a new collaborative project, the African Plants Initiative (API), in which 39 institutions from 20 countries have agreed to database and image their African type specimens and to make them available to African taxonomists. The resulting images are of extremely high quality and allow close examination of particular plant parts. The standard and quality specifications for this project were created in consultation with the Global Biodiversity Information Facility (GBIF), which is, in part, funding a project imaging Australian plant types in Kew Herbarium (K), London, and is the organisation under whose umbrella specimen data is stored and distributed world-wide. The Australian herbaria contribute data to GBIF via the Australian Virtual Herbarium (AVH) scheme.

Here was an excellent opportunity to investigate a new international innovation that was highly relevant to my Fellowship objective. Therefore, in view of the change in attitude to specimen exchange and loan procedures and the development of improved scanned images, I decided to build on the information received in Vienna and to adopt the following additional approach to my Fellowship:

> examining the various approaches to digital specimen photography in the Muséum National d'Histoire Naturelle in Paris and at Kew Gardens, London, two major contributors to the API, with the intention of gathering information on standards, methodology and best practices in data management.

THE PREISS COLLECTION

Johann August Ludwig Preiss (1811–1883) collected extensively in Western Australia around the Swan River Colony from 1839 to 1841, at a time when there were no facilities for adequately storing herbarium specimens locally. Although he wanted to sell a set of his collection to Britain, the offer was not accepted and his collection was dispersed throughout Europe. It is estimated that there are Preiss specimens in over 25 European Herbaria.

His specimens were used by the European botanists to describe our flora, much of it for the first time. Hence, by definition, much of the Preiss material is 'Type' material. He collected over 2,800 species of algae, fungi, lichens, bryophytes and flowering plants.

J.G.C. Lehmann, Professor of Botany in Hamburg bought a number of sets of Preiss' Western Australian collection. He and nineteen other European botanists used these to write the first flora of Western Australia, *Plantae Preissianae,* under Lehmann's direction. Work by Crisp (1983) and Wilson (1983) determined that the actual set used by the authors to describe the flora for *Plantae Preissianae* is the collection in Lund, which was bought by C.A. Agardh, the Director of the Herbarium, after Lehmann's death. The specimens in this collection are actually annotated by the authors of *Plantae Preissianae* and most of the labels were written by Preiss. He was meticulous in his collection data, unlike many of his contemporaries, and there is much valuable information on each label. Preiss arranged his collections systematically and assigned numbers to the specimens before he sent them to Lehmann. These are the numbers cited in *Plantae Preissianae* (see Marchant, 1990).

Preiss was accompanied on several occasions by James Drummond, an honorary Government Naturalist, resident in the Colony and living just outside Toodyay. Drummond collected the native flora from 1835 to 1863 and his collections are also of great significance to Western Australia as many of them became Types.

THE TYPE SPECIMEN PROJECT

My objective in Lund was to locate specimens from the Preiss collection and identify, document and prioritise the West Australian Types in preparation for accession, imaging and web display.

Lund, situated in the region of Skåne, was established around 990 and is one of the oldest cities in Europe, with a long tradition of meetings, discussions and dialogue and a reputation for ideas and creativity. The University of Lund is the largest institution of research and higher education in Sweden, with over 38,000 students; this in a town with a population of 100,000. About 28,000 people commute to Lund to work every day, of whom I was one.

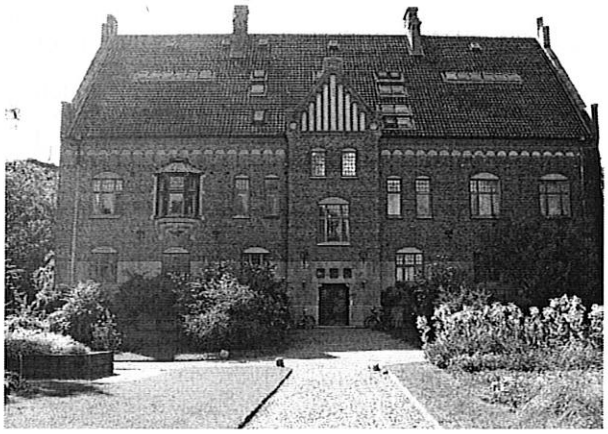

Figure 1. Botanical Museum, University of Lund

The Botanical Museum, a large 4 storey stone building sits in the botanic gardens, and houses the Lund Herbarium (LD), a collection of 2.5 million plant and algae specimens from around the world (Figure 1).

At present the Preiss specimens are incorporated throughout this substantial collection, not stored together as a distinct collection.

As in most herbaria, the specimens are grouped in folders and stored on shelves in compactus' or cupboards, up to 3.2 m high, in closed areas called 'wings' or 'vaults' (Figure 2). The vascular plant collection, in which I was interested, is located over three floors and divided into Monocotyledons, Dicotyledons and Gymnosperms, arranged alphabetically by family, genus and species within those divisions, and then further divided into countries. Herbaria are sometimes arranged according to the classification system followed by that institution but the alphabetical arrangement at LD certainly facilitated my task.

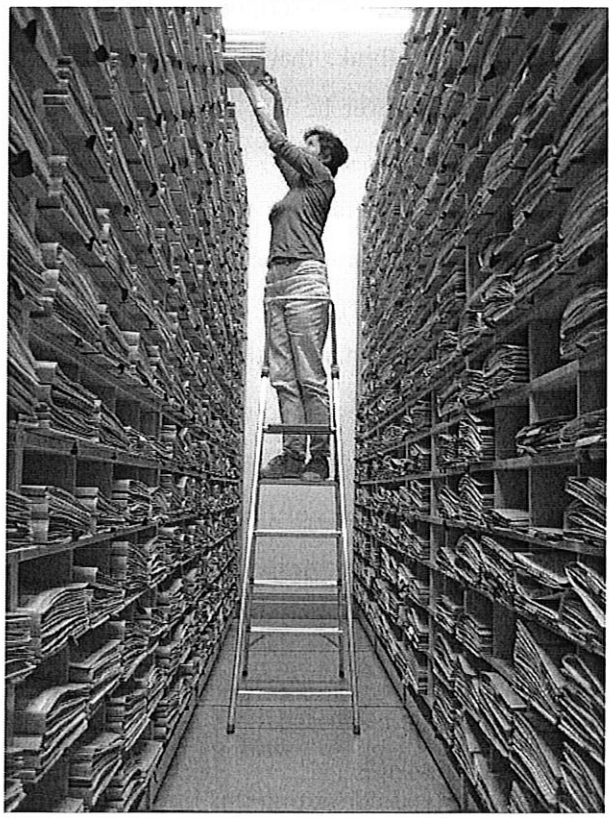

Figure 2. Main herbarium storage vaults.

My office was situated on the third floor, overlooking the gardens, and where there were two long benches to store and sort specimens. After a time spent carrying selected specimens up to my office and back to the wings I decided to relocate my primary workplace to the wings (Figure 3). This worked very well and the staff and volunteers were very accommodating and allowed me to take over one area of bench space. It also meant much less specimen movement and less wear and tear on my knees.

Figure 3. Bench space in the wings.

To house and protect the Preiss types two large cupboards in one of the wings were allocated for the project (Figure 4).

I spent six weeks working at LD and during that time I sorted through 33 families (Appendix 1) finding 1424 Preiss specimens of which 694 were Types. It was very helpful to have access to Agardh's own copy of *Plantae Preissianae,* which is held in Lund, as he had annotated some of the species descriptions with 'ticks' indicating, we think, that these were in his collection. However he was not consistent in his marking so this can only be used as a guide in determining whether the specimen was ever in Lund. I also used The *Australian Plant Name Index* (APNI), a four-volume list of all published names of Australian vascular plants and their bibliographic and typification details (Chapman, 1991) and samples of the handwriting of authors of *Plantae Preissianae.*

Figure 4. Herbarium shelving for Preiss specimens.

I determined whether the specimens were Types by referring to the type citation and Preiss number recorded in APNI and the original description written in *Plantae Preissianae* and comparing this information to

the label on the specimen sheet. I also compared the writing of the name on the label with that of samples I had obtained of the contributing botanists to *Plantae Preissianae,* as this was indicative that the specimen so annotated was in fact the specimen used in the original description.

Some of the Preiss Types have been synonymised due to subsequent taxonomic work but nevertheless are invaluable as a source of species concept and history of the plant. Of the 694 Types located, 604 are listed in APNI. Within the families I researched, there were 68 types which, according to APNI and the Agardh copy of *Plantae Preissianae*, should have been in Lund, but that I was unable to locate. This information will be sent to the curators at LD.

The Preiss collection has undergone many changes in systematics over the last 150 years and this was reflected in some of the classifications under which I located various specimens. Much detective work was often required to track some specimens down. One, interestingly, was found in an Asian species folder, and it is highly likely that other Preiss specimens are similarly 'lost'. However, as in most Herbaria there is a real resource problem, and searching the entire collection is not possible.

I decided which families to prioritise through discussion with my colleagues at PERTH. After I had worked through their suggestions, based on existing and pending taxonomic projects, I made my own decisions based on APNI and on the numbers of Types I thought I could locate in the short amount of time I had available. Some obvious families have been omitted eg. Asteraceae, and this is because they were being prepared for fumigation and were wrapped up in plastic bags. I decided that the time taken to undo and then redo all the work of the curators for this preparation was unnecessary. Whilst searching for Type specimens I naturally came across other Preiss specimens. I removed all these non-types from the main collection, as they will also be imaged at a later date. I also searched unsuccessfully for a species of *Chara,* an algal genus. This was a useful exercise because it showed that the algal collection which was thought to be at LD by the curators wasn't where they thought it was.

In the main collection specimens are often placed one on top of the other within species folders. This can lead to some damage to the plants. During my curation all the non-types were placed in separate folders and then grouped together by genus or species in larger folders. The Types were placed in a thin folder, called a 'flimsy' and then further protected by another, thicker, cardboard folder. This is standard herbarium practice and many of the specimens I located had already been treated this way by preceding Australian botanists eg. Barlow, George, Macfarlane and Marchant.

All the folders were stored in the Preiss cupboards under Family name. While I was looking for the Preiss specimens I located 303 Drummond specimens but was unable to spend the required time to verify their type status, if any. I noted the putative name and number of each Drummond specimen

and placed 107 specimens that were Types or possible Types, into the folders for imaging. Some of these specimens had already been examined by visiting botanists, who had determined their status.

Whilst I was at LD I was asked to do a talk FloraBase, which is the WA Herbarium's botanical website. This was attended by approximately 25 people from various sections of the university and was received very well and with great interest. Many of the botanists, in particular the students were very interested in the 'Description Language for Taxonomy' (DELTA) system, on which the specimen descriptions are based. It was wonderful to be able to show-off some Australian expertise in a country renowned for innovation.

Although my primary task at the Muséum National d'Histoire Naturelle in Paris was to discuss their imaging projects I was also offered the opportunity to confirm the existence of a Type specimen of an eastern Australian grass species, *Elymus subpaniculatus* Steud. that was collected in New Holland by the French navigator/collector Dumont D'Urville and about which little is known. This was a very successful exercise as we not only located the specimen in question but discovered, with it, another specimen, possibly a Type, described as *Elymus subpaniculatus* Steud. var. *glabrescens*. Photographs have been given to Dr. Terry Macfarlane.

PERTH / LUND COLLABORATION

Whilst at Lund the collaboration between our two institutions regarding the Preiss collection was discussed. We agreed on the following procedure:

- Perth to download image and data from botanical museum website in the first instance. If the photo was inadequate, another photo could be taken
- Identify any material for loans using images from the website (Figure 5) – Lund is happy to arrange short or medium term loans
- Loans would be of small numbers of specimens
- Each loan would have to be returned before the next is issued. This was in relation to a planned project involving the whole collection, not as a guide for individual taxonomists working on specific groups eg. *Goodeniaceae*, *Sterculiaceae*
- Material that is not databased is not available for loan

The findings of my API investigation will be sent to Susanna Riebe, who is responsible for LD's image programme. She is aware that the Lund photos are not of appropriate resolution for detailed photo identification but is hopeful of being able to upgrade to a more efficient system, and as such is very interested in how other Herbaria are imaging their types. It will be of great benefit to us in Perth, if LD is able to match the API standards.

Figure 5. A scan of one of the Preiss types at Lund.

AFRICAN PLANTS INITIATIVE (API)

The objective for this element of my Fellowship was to gather information from various institutions who were involved in Type specimen digitisation. An innovative new project, the African Plants Initiative was introduced at the XVII International Botanical Congress in Vienna, Austria in July, illustrating a new approach to the problem of remote Types. The aim of the API is "to reproduce efficiently and cost-effectively a set of images of the type specimens, and appropriate associated information, of the African flora kept in northern and southern herbaria and to make them accessible through appropriate electronic and other means for use by anyone for scholarly purposes" (Aluka 2005).

At a recent meeting between the European Network for Biodiversity Information (ENBI) and the Global Biodiversity Information Facility (GBIF), convened to discuss the techniques and challenges involved in the digital imaging of biological type specimens and thence to develop a manual of best practices, it was noted that the flag project for herbarium digitising is the API project (Häuser & Steiner 2004). As Australian types at Kew are being imaged under a project partially funded by GBIF and Australian herbaria are also working towards data sharing under GBIF protocols, it is important to be aware of accepted best imaging practices for delivering GBIF compatible data.

In August, before I had left for Sweden, I had the opportunity to visit Kew Gardens to speak to some of the team involved with the Kew API project. This gave me an insight into the project and enabled me to formulate some guidelines for my investigation.

My preparations for investigating the African Plants Initiative involved arranging meetings with the project co-ordinators at the Muséum National d'Histoire Naturelle, Paris and at Kew Gardens, London. Prior to these meetings I discussed with the coordinators, by email, the sort of information I was seeking and created a proforma of discussion points to guide me on the day.

My meeting in Paris with M. Pignal, M. Labat and M. Laurent included discussions on equipment issues and management 'best practices'. They also demonstrated all the components of their project, including their in-house software and databases and their quality control programme.

In London, I visited Anna Saltmarsh, the API supervisor, and Laura Pleasance, who was involved in the final QC of the images. Their team had been disbanded at the end of August and they were involved in finalising the image transfer to America (Figure 6). Anna discussed management and procedural issues with me, showed me the API prototype web-display and supplied me with two raw data images, the entire specifications for the project as set by Aluka, and the users' manual for

their imaging system. The API project coordinators at Kew had also constructed an innovative scanner cradle to aid specimen scanning in the least damaging way for fragile material (Figure 7).

I have included all this information plus the results of further research into a report written for the Western Australian Herbarium, who wish to set-up their own imaging programme.

Figure 6. API project team at Kew.

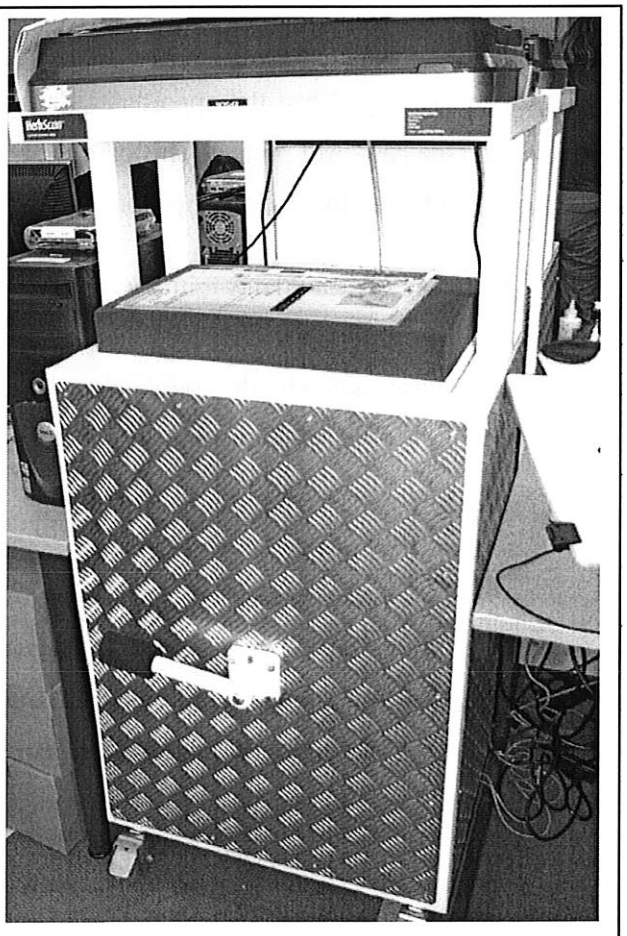

Figure 7. Herbscan specimen scanner at Kew.

LESSONS LEARNT – UNDERSTANDING THE CHANGES

Whilst undertaking my Fellowship I came to realise that the traditional paradigm of accessing Type specimens by visitation or by loans is rapidly changing. The new model involves delivery of important Type information through the internet as exemplified by the African Plants Initiative.

This development heralds a new approach to our interaction with European herbaria. Examining high-resolution Type specimen images may answer many questions and help to identify those specimens that must be studied in closer detail. It is hoped that this approach will reduce the amount of loan material travelling between countries, thereby preserving the specimen, and also reduce the financial and curation pressure on the host institution. Viewing the Type images is not a replacement to sending specimens but should be seen as an adjunct greatly facilitating the taxonomic process.

As an added bonus, Type collections from other countries have become valuable to the home institution because they attract significant imaging funding. Not only will it be possible for collections to be easily accessed by botanists but they could also be used by the greater community and should be regarded as valuable teaching aids and useful examples of historical documents. Certainly if the interest shown in my Fellowship is any indication, the Preiss collection and story would be a very popular exhibition.

PRIMARY OUTCOMES

- helped European botanists understand and gain insight into the difficulties faced by Australian botanists due to remote location of Type specimens
- negotiated a priority image sequence in LD to ensure that Western Australian Preiss Types would be digitised first
- established good working relations- assuaged the natural concerns in LD about lending the Preiss collection to PERTH and negotiated conditions of such loans
- negotiated copyright conditions for PERTH to use images as Type surrogates
- PERTH will increase its type collection with 607 images of Preiss Types – this represents 5% of vascular flora for the state, previously unavailable
- curated Preiss collection – put into separate folders for greater protection of these priceless specimens
- located 1424 Preiss specimens, 694 of them Types
- located 303 Drummond specimens, 107 of them Types
- improved local knowledge of Type material in foreign herbaria which has already proved useful
- located a significant Australian Type specimen in the Muséum National d'Histoire Naturelle
- prepared detailed report of the API as seen in London and Paris, including descriptions of software, hardware and management practices
- highlighted improvements to imaging work practices of host institution –the Preiss project was a catalyst for the intention to improve the imaging system at Lund Museum
- established valuable contacts in London and Paris for the API project
- learnt about digital image production

CONCLUSIONS

MAJOR FINDINGS

- the perception of static botanical information is rapidly changing as botanists the world over apply new technology to the modern problem of disseminating information
- many European herbaria are now organising themselves to present this information in a standard way
- loans are increasingly difficult to obtain around the world and this makes the use of specimen images an extremely important new strategy
- Australia is perfectly placed to be a leader in the field of specimen imaging in our region by developing, integrating and disseminating information about image protocols through the AVH
- many Australian Types are held in European herbaria and projects such as this Fellowship should be encouraged
- face to face discussion will overcome difficulties and misunderstandings far better than remote correspondence
- many botanical institutions are hampered in their attempts to improve their work practices, both financially and politically

DISSEMINATION OF INFORMATION

The information and findings from this Fellowship will be communicated through the following media:

- presentations of Preiss and API studies to interested community and professional groups eg. the Wildflower Society of WA, Western Australian Herbarium
- article detailing findings to the Australian Systematic Botany Society Newsletter
- article in *Landscope*, the Western Australian Department of Conservation and Land Management's Conservation, Parks and Wildlife magazine explaining my Fellowship and the new developments in taxonomic procedures
- detailed report on findings of the API investigation. This has been lodged in the WA Herbarium will be sent to my colleagues in Lund to inform them of the latest technology and approaches in this field
- support the specimen imaging initiative in PERTH by presenting findings from my Fellowship investigation to the committee charged with the creation of the new project
- assist in the preparation of users manual and specification document for PERTH
- informal notes on the Preiss collection will be collated and lodged in the WA Herbarium library for consultation when necessary

RECOMMENDATIONS

- that Australian herbaria embrace the approach that loans are preceded by image retrievals thus reducing the traffic of this irreplaceable material around the world
- that Australian herbaria and conservation agencies develop specimen image standards and protocols together – this will contribute to biodiversity material becoming widely available
- that Australian herbaria have a standard mechanism for Type imaging, display and archiving and a strategy for obtaining and archiving Type images of Australian plants from overseas herbaria. Often botanists take Type photographs but there are no protocols for housing these collectively in Australia
- that Australian herbaria consider imaging their types using the evolving standards as illustrated by the African Plants Initiative
- that all images for the Australian Virtual Herbarium project meet API standards and that steps be taken to implement this
- that old loans of Preiss specimens from Lund be returned from Australia to enable their accession and digitisation
- that the verbal agreement between the Botanical Museum in Lund and PERTH covering issues of priority image access, use of the Type specimens and loan conditions, be formalised as soon as possible

REFERENCES

Aluka 2005. *Aluka: Mission and Audience.* http://www.ithaka.org/aluka/

Chapman, Arthur D. (1991). *Australian Plant Name Index.* Australian Biological Resources Study

Conservation International (2005). *Priority Areas - Biodiversity Hotspots.* http://www.conservation.org/xp/CIWEB/regions/priorityareas/hotspots.xml

Crisp, M.D. (1983). Plantae Preissianae types at Lund. *Austral. Syst. Bot. Soc. Newsletter* 36:4–6

Häuser, C. & Steiner, A. 2004. Report from the general workshop on the selection of key taxa and standards and methods for digital imaging of type specimens. ENBI Report Number: WP6_D6.5_05/2004. European Network for Biodiversity Information (ENBI) http://www.enbi.info

Ithaka (2005). *About Ithaka.* http://www.ithaka.org/

Lund University (2005). Botanical museum website. www.botmus.lu.se

Marchant, N.G. (1990). The Western Australian collecting localities of J.A.L. Preiss. *In* Short, P.S. (ed) *History of systematic botany in Australasia.* Australian Systematic Botany Society Inc.,Melbourne, Australia, pp. 131–135.

Mittermeier, R.A., Gil, P.N., Hoffman, M., Pilgrim, J., Brooks,T., Goettsch Mittermeier, C., Lamoreux, J., and Da Fonseca, G.A.B. (2004). *Hotspots Revisited: Earth's Biologically Richest and Most Threatened Terrestrial Ecoregions.* Cemex, Mexico City.

Wilson, K.L. (1983). Plantae Preissianae specimens. *Austral. Syst. Bot. Soc. Newsletter* 34:5–6

APPENDICES

1. FAMILIES SEEN

- Adiantaceae
- Anthericaceae
- Calectasiaceae
- Casuarinaceae
- Characeae
- Colchicaceae
- Cupressaceae
- Cycadaceae
- Dasypogonaceae
- Dilleniaceae
- Droseraceae
- Epacridaceae
- Fabaceae
- Goodeniaceae
- Haemodoraceae
- Lauraceae
- Liliaceae
- Lobeliaceae (Campanulaceae)
- Mimosaceae (incomplete)
- Myrtaceae
- Orchidaceae
- Phormiaceae
- Polygonaceae
- Polygalaceae
- Portulacaceae
- Proteaceae
- Restionaceae (only *Anarthria*)
- Rutaceae
- Rhamnaceae
- Santalaceae
- Sapindaceae
- Sterculiaceae
- Tremandraceae
- Thymelaeaceae
- Xanthorrhoeaceae

2. IMAGE PROFORMA

SCANNER

Hardware
Make & model
Upside down/normal: can normal scanners be inverted?
If so, which ones, how, costs
Any modifications?
What for? Ease of modification, cost thereof
How is the scanner mounted?
Who makes the cradle, what does it include, costs, contacts
Specifications: what software/hardware runs it?
Cost of requirements
Twain driver?
Are specifications and standards set by Ithuka?

PROTOCOLS AND PROCEDURES

Imaging only type specimens or all specimens
If type, all or only holotype
What is the next focus? eg. taxonomic groups, geographic area, countries, types
Earlier scanned images
will you be redoing them to new standards?
Quality Control procedures
What percentage of images are checked
What is checked?
image quality eg. label readability, databasing destination, spelling, properties eg. size
Management of project
'Best Practices'
Personnel
Who does what? One job eg. scanning, per person or one specimen pp
Databases used and why
Availability – commercial/ cost?
In-house db
What platform
Copyright issues

IMAGE PROCESSING

Software
Photoshop, version
Standards
colour calibration
Resolution
Sizes
Archive raw data
Edited data
web photo
Any other treatments
Making background white/transparent?
Metadata
Eg. barcode
How is name added – is there a nomenclature checklist
Time taken to acquire and edit image

RAW DATA

Image files
Size
How was size determined?
Specifications: resolution, colour
(If these are scanned at 600 dpi and 24 bit colour the minimal size of their HerbScan images is 200 Mb each (Ravintsara, from Missouri))
Do they really need to be scanned at this resolution? Who are potential and what is their equipment

POST-PROCESSING
who does it
cost
what requirements

RESOURCES
Staff resources are required for image scanning, editing, management?
Equipment needed
Spacial considerations

TRAINING
What skills are required to make and edit scans
What training needed

STORAGE /ARCHIVE
How are images stored? eg. hard disc, CD
How many copies of each

DISPLAY
Image accessibility
Over web
Can better resolution image be asked for if downloading
Thumbnails
Link with associated data
Index
Distribution
How will these images be distributed? eg, CD, DVD, FloraBase, Image Server

DATABASES

MAINTAINENCE
use of OCR, NHR
updating names

EQUIPMENT
High end computer with substantial storage and RAM
Heavy duty graphics card
Image server
Dedicated work station.

ADVANTAGES/DISADVANTAGES
What worked well
What would you do differently do differently

DISCUSSION
It would be very helpful to have some examples of full-size high resolution HerbScan images to examine.
System questions
What types of images does this system produce ie. thumbs, gif, tif, jpg
Issues associated with the photographing of thick specimens, depth of field issues,
Digital camera vs scanner

How will the work proceed? eg. focus on taxonomic group, geographic area, calm region, types ....