An archaeological dig through the information and specimens held on the Australian plant family Pittosporaceae R.Br. in overseas herbaria and botanic gardens

Report by
Lindy Cayzer, Churchill Fellow 2016

The aim of this Australian Biological Resources Study Churchill Fellowship was to unlock critical taxonomic information on the Australian plant family Pittosporaceae in overseas herbaria in Indonesia, Malaysia, Singapore, Netherlands, France and the United Kingdom.

I understand that the Churchill Trust may publish this report, either in hard copy, over 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.

Lindy Cayzer
31 October 2017

35 Beagle Street
RED HILL ACT 2600
lcayzer@netspeed.com.au
# Contents

**Executive Summary** 3

**Introduction** 4

Why has only the genus *Pittosporum* managed to escape the Australasian plate? .......... 4
Why is this family important? ................................................................. 4
What are the issues with this? ................................................................. 5
What is happening now? ............................................................................. 6
What is the aim of this current project? .................................................... 7

**The Visits** 8

Royal Botanic Gardens Kew, United Kingdom ............................................. 8
Department of Botany, Natural History Museum, London, United Kingdom .................. 10
Herbarium, Naturalis Biodiversity Centre, Leiden, Netherlands ......................... 11
Herbarium Bogoriense, Indonesian Institute of Sciences, Bogor, Java ..................... 15
Bogor Botanical Gardens, West Java ................................................................ 16
The Forest Research Institute of Malaysia, Kepong, Selangor, Malaysia ....................... 17
Mt Kinabalu Botanic Gardens, Sabah, North Borneo, Malaysia .............................. 19
Herbarium at Singapore Botanic Gardens, Cluny Road, Singapore ......................... 20

**Major Achievements of the Fellowship** 22

**Acknowledgements** 23

**References** 24

**Appendix A: List of authored plant names cited in this report** 26
Executive Summary

Pittosporaceae is a flowering plant family closely related to the Asterids, within an expanded Apiales group which includes the contentious Apiaceae/Araliaceae families (Chandler et al. 2007). All the higher level diversity is largely restricted to Australia (nine genera and about 90 species). Only Pittosporum species are found naturally across the tropical areas of Africa, Asia and Oceania, and estimates of the numbers of Pittosporum species overseas now vary.

With the increasing aridity in Australia, the relictual or ancestral forms of Pittosporum necessary to resolve this group’s evolution and spread, are now more likely to be found in remnant wetter sites in our near neighbours in Malesia: Malaysia, Indonesia, Papua New Guinea and the Bismark Islands. However, the information available on species in the Malesian area is generally sparse, and the taxa themselves may have long disappeared and/or their ranges have become inaccessible. Fortunately, the specimens and information from early taxonomists, naturalists, explorers and colonial administrators from Malesia’s past are still maintained in overseas herbaria and associated botanical gardens.

The aim of this project was to unlock this critical taxonomic information on this predominantly Australian family in relevant overseas institutions. The project ran over a six week period in July and August this year and involved visits to overseas institutions in Kew, London, Leiden, Paris, Bogor Indonesia, Malaysia and Singapore. The main achievements of this fellowship travel include:

1. A bank of information on overseas pittospora taxa held in relevant overseas institutions, for future research in this field. This includes digital images of types of names and other informative specimens, relevant taxonomic literature/protologues and synonymies including translations, ecological data (habit, habitat, substrates, etc.) and spreadsheets of collections with the collectors and the final taxon determinations.

2. Considerable progress towards the resolution of the taxonomy of large numbers of confused/lumped/ignored taxa in Australia, Malaysia, Indonesia, Papua New Guinea and the Solomon Islands including recognition of at least three species that are new to science or previously unrecognised, and several previously forgotten taxa in the region that now require re-instatement at species level.

3. Confirmation that the Pittosporaceae are characterised by narrow endemics both here and overseas, with very few wide ranging species between or even within regions.

4. Confirmation of the known taxa in New Caledonia (about 30 species) for combined molecular and morphological phylogenetic analyses in the near future.

5. The opportunity to collaborate on other regional floras (Flora of Siam and Flora of Madagascar) which in turn will enhance our knowledge of taxa in these areas, and perhaps most importantly:

6. The re-establishment of an international, largely volunteer, collaborative Pittosporum study group, to revise this family across its range, the first attempt at a comprehensive revision of the family since Pritzel in 1930.
Introduction

Pittosporaceae R.Br. is a flowering plant family with all the higher level diversity largely restricted to Australia (nine genera and about 90 species). Only one of these genera *Pittosporum* is also found naturally across the paleotropics: East Africa, South East Asia, China, India and the Pacific as far as Hawaii, but not the Americas. This distribution suggested an East Gondwanan origin for the family (Crisp *et al.* 1989), and recent morphological and molecular phylogenetic analyses support an Australian origin (Chandler *et al.* 2007). Estimates of the numbers of *Pittosporum* species now overseas vary depending on the differing concepts of species used by earlier taxonomists, many of whom were working in ignorance of the wider family’s characteristics. The family has not been comprehensively revised across its range since Pritzel in 1930.

Why has only the genus *Pittosporum* managed to escape the Australasian plate?

This is still unclear, but may be due to the unique sex structures and strategies of this genus, which is functionally dioecious but never completely so. Other successful strategies include the clever packaging of seeds into a resinous, cohering balls for easy predation by birds and animals. The ongoing rapid range expansion of *Pittosporum undulatum* in eastern Australia (and California and the Azores last century) is indicative of the group’s capacity for weediness in the right circumstances. Despite this, overall, the family appears to be generally characterised by having a very high number of narrow endemics, or species with very restricted ranges, such as on an island or mountain tops, or a particular substrate in a region. This results in very few wide-ranging species between or even within regions. For example, only three *Pittosporum* species in Northern Australia have natural ranges extending to (or from) Indonesia and/or Papua New Guinea, still within the Australasian plate (Cayzer *et al.* 2000).

Why is this family important?

Traditionally this little known family has been placed near Rosales, the Rose family in the sense of the American Botanist Cronquist, in 1981. This classification was also followed by the *Flora of Australia* series (Australian Biological Resources Study: ABRS) and most Australian herbaria until recently. Since Cronquist, a series of studies has confirmed the very close placement of Pittosporaceae amongst the Asterids, within an expanded Apiales group which includes the Apiaceae and Araliaceae families (see Plunkett *et al.* 1996; Chandler and Plunkett 2001; Chandler *et al.* 2007). These very large plant families, Apiaceae (herbs and vegetables such as carrots) and Araliaceae, (temperate and tropical trees and shrubs such as Schefflera, the umbrella trees) have hundreds of genera and thousands of unresolved taxa between them. The Pittosporaceae has only nine genera, with the taxonomy of the 90 or so species in Australia now largely resolved (*eFlora of Australia* in test). Further, there has been remarkable agreement between the recent morphological and molecular phylogenetic analyses of the family in Australia. This stands in ‘stark contrast’ to similar analyses in Apiaceae and to a lesser extent, Araliaceae (Chandler *et al.* 2007). Therefore, Pittosporaceae is an ideal, small, *entire* family to investigate and possibly map:

- the possible evolution of sex forms and strategies in the wider related group (Apiales); and,
• how these strategies have contributed to the successful (and often weedy) establishment and spread into new areas.

With the increasing aridity in Australia, the relictual or ancestral forms of Pittosporum necessary to resolve this group’s evolution and spread are now more likely to be found in remnant wetter sites in our near neighbours in Malesia. Malesia is used here in the sense of countries to Australia’s north, including Malaysia, Indonesia, East Timor, Papua New Guinea and the Bismark Archipelago. Future phylogenetic or evolutionary reconstructions of this family will require expanded collections of molecular markers and of taxa, including a greater representation of the poorly sampled taxa in Malesia (Cayzer et al. 2000; Chandler et al. 2007).

What are the issues with this?

There is very little information on, or specimens of overseas pittospora available in Australia. The information on species in the Malesia area is particularly sparse. Both the taxonomy and herbarium specimens of early European botanists and plant collectors/explorers in the region have largely been overlooked, and sometimes ignored, and this has led to a great deal of taxonomic confusion in names in all plant families both here and overseas.

To illustrate how complicated some of these name searches can become, even the genus name *Pittosporum* has had to be conserved relatively recently. Under the International Code (ICN) for nomenclature of algae, fungi and plants an earlier genus name *Tobera* took publication precedence (Greuter et al. 1988). The genus/species combination *Tobera s. tobira* was published by the German naturalist Kaempfer in 1712 from a species he had collected earlier in Japan. The name *Pittosporum* was only published by another German botanist, Gaertner in 1788, based on a specimen Cook and Solander collected in New Zealand in 1770.

Kaempfer’s original names, *Tobera s. tobira* were republished in post Linnean times (from when modern plant names date) in the genus *Euonymus* (as *Euonymus tobira*) by the Swedish naturalist Thunberg. The final recombination into the genus *Pittosporum* (*Pittosporum tobira*) was made by the British botanist W.T. Aiton in 1811. At the time, Aiton cited the two previous name combinations in full in the protologue, and so was aware of this nomenclature history and its possible implications.
This widespread taxonomic obtusification is compounded in the Pittosporaceae by the underlying morphological variability displayed in this family: juvenile/adult forms, sun/shade forms, mesic/drier forms, high/low altitude forms and quite often, everything in between. For the unaware, this variation is very difficult to recognise in herbarium specimens and historically resulted in:

- The splitters: responsible for a proliferation of so called ‘paper’ species in the family often due to this inherent polymorphism. For example, *Pittosporum* is functionally dioecious so frequently, unrecognised male and female ‘forms’ were described as separate species.
- The lumpers: taxonomists with very wide species concepts who ‘lumped’ related taxa into a single species on the basis of the very variable or ‘plastic’ characters commonly used by taxonomists last century to delineate species, such as leaf and fruit size (Schodde, 1972).

While revising the family in the Malesian area, the Dutch botanist K. Bakker (1957) claimed he was confronted by about 46 ‘paper taxa’ and taxa of ‘rather chaotic’ species delineation, which he reduced to just 10 species (ibid: 347). This included his very broad taxonomic concept of *Pittosporum ferrugineum*, that incorporated about 10 superficially similar taxa. From this, *P. ferrugineum* in its widest sense, is now purported to range from Mauritius in the Indian Ocean to the Solomon Islands in the Pacific, and from Australia to almost the Bay of Bengal (Cooper, 1956). This is most unlikely given the family’s now recognised propensity for very restricted ranges.

**What is happening now?**

These days the delineation of species and higher level diversity (genus, family recognition and beyond) in plant families is generally done by standardised computer modelling of possible phylogenetic relationships, using both morphological and molecular analyses. Basically these models build hypothetical phylogenies or trees from the end taxa, usually species, which are the smallest set of organisms that share an ancestor and can be distinguished from other such sets by a set of characters or molecular markers (Anon. 2017). This results in possible evolutionary trees such as the following tree illustrating a possible set of higher level relationships using *Ensatina* salamanders.

![Diagram](image)

*Fig. 3 (Anon 2017): Here B and C are separate lineages sharing a common ancestor unique to this branch. Lineage B could be a monotypic species (one ‘form’ only) whereas lineage C has multiple forms. These lineages B and C are then the sister taxa at a higher taxonomic level (for example genus) to A. In turn, lineages A, B and C share a unique common ancestor and set of characters at the next taxonomic level such as family.*
These phylogenetic reconstructions are hypothetical and thus depend on the robustness of the end taxa and the differentiating markers used in the analyses. As with all predictive modelling, the old adage applies: rubbish in (paper taxa, confounding/unrecognised taxa, widely variable characters) results in rubbish out (incongruence, mis delineation, etc.). Hence future phylogenetic reconstruction analyses for the pittospora group will depend on unravelling and resolving the existing taxonomy of taxa occurring at least in our near neighbours north of Australia.

As mentioned, the information available on species in the Malesian area is generally sparse, the taxa themselves may have long disappeared and/or their ranges have become inaccessible. Fortunately, the specimens and information from early taxonomists, naturalists, explorers and colonial administrators from Malesia’s past are still maintained in overseas herbaria and associated botanic gardens and institutions.

What is the aim of this current project?
Encouraged and financially supported by the ABRS Australian Churchill Fellowship, the aim of the current project was to unlock this critical and often forgotten/overlooked taxonomic information in herbaria and Botanic Gardens overseas, for future research on this Largely Australian plant family. The following report details the success of this venture in July and August 2017.

Note: Authored plant names cited in this report appear in Appendix A.
The Visits

Royal Botanic Gardens Kew, United Kingdom (herbarium acronym: K)
Visit: 3–6 July 2017

Main Contact: Tim Utteridge, Head of Science (Identification and Naming).

Main Issues:
- The sheer numbers of specimens available on this family (common to all institutions visited) meant that work had to be prioritised to concentrate on:
  1. Type specimens (the original specimen to which a particular plant name refers/is tied);
  2. specimens from the Malesian areas; and,
  3. specimens from other regions as time permitted.
- The state and lack of features of many of the older specimens that have been variously preserved/treated over the centuries with various holding solutions to resist insect attack. This includes the treating of older sheets with mercuric chloride, and soaking specimens in alcohol before mounting on sheets, thus rendering all specimens a particular shade of dark brown.
- The curation of the specimens reflected the confusing taxonomy in this group over the centuries. This resulted in literally, an archaeological dig through the layers of species.
determinations and taxonomic literature to work out which specimen was what (see the type specimen of *P. microcalyx* (Fig. 2) which illustrates this problem perfectly: more misdeterminations than available plant specimen).

**Achievements/Treasures**
During this visit, over 1 500 specimens from Malesia, as well as surrounding areas in the Pacific, Thailand, Indo-China and East Africa were studied resulting in:

- 85+ type and other informative specimens examined and photographed for the species Bank (most species without information previously in Australia), for species ranging from New Guinea, west to East Africa and north to the Himalayas
- Several ‘new’ species confirmed or recognized, including the Malaysian form of *Pittosporum ferrugineum s.lat.*
- Immediate resolution of several Pacific area taxa: *P. campbellii* is a distinct species endemic to Vanuatu (previously considered conspecific (lumped) with a New Caledonian species; *P. brackenridgei* is also a distinct species, endemic to Fiji (previously queried by Bakker 1957)
- Introduction to the species in the Sino-Indian region and the clearly related East African species for future research.

**Future networking/promotion of the family opportunities**
Working with Tim Utteridge to resolve several more taxonomic furphies in New Guinea Pittosporum species (e.g. finally splitting *P. ledermannii* from the *P. pullifolium* complex (*sensu* Bakker). There may also be an opportunity to collaborate on the genus treatment in the upcoming *Flora of Siam*, which is being coordinated through both Kew and Singapore herbaria.
Department of Botany, Natural History Museum, London, United Kingdom (BM)
Visit: 7–10 July 2017

Main contact: Ranee Prakash, Curator, Flowering Plants, Natural History Museum

The Darwin Centre Cocoon in the Natural History Museum now contains the thousands of specimens previously in the British Museum, many predating the herbarium at the Royal Botanic Gardens at Kew.

The herbarium at the Darwin Centre is state of the art modern but rather confusing to exit.

Main issues
The BM collections include over 250 specimens from India (11 species), China, Japan, Australia, New Zealand and New Caledonia, but few specimens from New Guinea and the Malesian region generally. These later area specimens were probably directed to Kew.

Achievements/Treasures:
• Over 250 specimens examined particularly the rich collections for India, which is also overdue for revision
• Finally managing to navigate my way out of the Darwin Centre without having to ask someone (anyone I could find) the way
• Between examining specimens, I was able to visit Winston Churchill’s birth place, magnificent Blenheim Palace, and to see his grave in the next village.
Herbarium, Naturalis Biodiversity Centre, Leiden, Netherlands (L)  
Visit: 12–14 July 2017

Main contact: Roxali Bijmoer, Senior Collections Manager

This herbarium is the main repository of the collections from the early explorers and collectors associated with the Dutch East Indies, based in Batavia and Ambon in the Moluccas, or the Spice Islands, to Australia’s north. Leiden has over 4000 Pittosporaceae collections, most of these being in the genus *Pittosporum*, and including critical type material from this region that was largely overlooked in the following centuries by other European and British taxonomists. Interestingly the supply of specimens from Malesian areas appears to have dried up once these former colonies became independent countries and established their own herbaria.

As illustrated, the Herbarium is currently warehoused in outer Leiden while the state (which now owns the collection, not the University) considers building a new institution.
Issues:

- Again, the sheer numbers of available specimens meant that the game plan followed at Kew was used here again: type specimens, Malesia region, other regions as time permitted.
- Access by public transport to the warehouse herbarium was difficult.

Achievements/Treasures

Examination of over 30 type *Pittosporum* specimens, and about 300 really informative specimens including:

- Three early type collections by Alexander Zippelius, a Dutch naturalist who collected plants in the Dutch East Indies: Moluccas (Ambon based), south western New Guinea and Timor, where he died in 1828. These and related specimens studied at Leiden will help resolve the *P. sinuatum* complex in Papua New Guinea.
- Six other early type collections of taxa currently ‘sunk’ into in the ‘moluccanum complex’ (sensu Bakker 1957) in Indonesia, which can now also be resolved.
- Confirmation that the taxon currently known as *P. moluccanum* in the northern Territory and Cape York is not that species at all, and the species that it is, requires reinstatement from the moluccanum complex.
- Numerous other informative specimens that will assist in later revisions of taxa in other regions such as the Philippines and apparently floristically related Taiwan.
- Good specimens including a second type sample (isotype) of *P. versteeghii* (a montane species from the central mountain range in New Guinea) which was sunk into the *P. ferrugineum* complex by Schodde in 1972.
- Sufficient specimens of what is currently known as *P. ferrugineum* in the Dutch East Indies to recognise that it is quite different to the form in Australia and Malaysia.

Future networking opportunities

The specimens in Leiden have provided the critical taxonomic information needed to resolve a number of complex taxonomy issues in overseas taxa, including the *P. ferrugineum* complex (sensu Bakker 1957). The staff at the herbarium continue to work to resolve some outstanding issues such as:

- very early publications of taxa by Dutch Botanists in obscure journals where translations from an earlier, high Dutch technical language are required; and,
- resolving type specimens of obscure plant names without any details of where the protologue was first published, if at all.
Herbier National de Paris, Museum National d'Histoire Naturelle, Paris, France (P)
Visit: 17–20 July 2017

Main contacts: Peter Phillipson and Pete Lowry II (absent) research scientists/curators attached to both Paris and the Missouri Botanic Gardens, US

Located in the Jardin des Plantes adjacent to the Seine River, the Paris Herbarium is a 17th Century, building which has recently been completely outfitted with state of the art compactus, temperature and insect control management. This herbarium has rich and extensive collections of specimens from former and continuing colonies in the Pacific and Indian Oceans. Paris is currently working with the Missouri Botanic Gardens to publish the *Flora of Madagascar*. The herbarium also has the main type and extensive supportive collections for the nearly 30 species now known from New Caledonia.

Main Treasures:
- A second specimen of Banks and Solander’s *Pittosporum ferrugineum* collection from Palm Island in northern Queensland which has helped to confirm that this species is not the same species as the type specimen at BM (ex the garden at Kew dated 1795).
- Revision of specimens of all species in *Flore de la Nouvelle-Caledonie* to obtain morphological characters (sex forms, strategies needed for ongoing phylogenetic analyses by the now reconstituted Pittosporum working group).
• Introduction to the *Flora of Madagascar* species and surrounding areas (Seychelles, Reunion and Mauritius) and East African Pittosporum species.

• Collections from interesting early collectors, such as Dr Henry (Thailand), and M. L’Abbe Delavey (China), and

• Types and other collections of species in the Philippines, largely ignored by the taxonomic establishment in the 1950s and now also overdue for revision and reappraisal.

**Future networking opportunities**

Peter Phillipson and Pete Lowry II are members of the now reconstituted Pittosporaceae working Group and hence there is the opportunity in the near future to collaborate on their ongoing New Caledonia analyses, as well as the *Flora of Madagascar* project. This will enhance our scanty knowledge here on the taxa in these regions.
Herbarium Bogoriense, Indonesian Institute of Sciences, Bogor, Java (BZ)
Visit: 25–28 July 2017

Main contact: Atik Retnowati, acting for the Director of the Herbarium

Bogor is approximately 60km South of Jakarta, which seems to almost encompass this area now in its urban sprawl. Bogor Herbarium has moved out of the 200-year-old Botanic Gardens and is now in a purpose built herbarium in a scientific park on Bogor outskirts. As a label on each piece of equipment proudly declares, the compactus and other equipment were provided by the People of Japan in 2007.

Main Treasures:

- Several type specimens including the type collection of *Pittosporum microcalyx* (illustrated earlier at Fig. 2 to show the difficulties taxonomists face), which consists of an envelope containing part of a leaf, a fruit in halves and a seed. However this was just sufficient to work out where this taxon fits in the *moluccanum* complex sensu Bakker.

- A specimen of *Pittosporum spinescens* from Java. This species was always stated as being in Indonesia (as well as northern Australia and rarely, New Guinea), but specimen evidence was lacking. Interestingly this taxon does not occur in the Northern Territory, which is closest to Java, only Western Australia and Queensland.

- A wide range of more recent specimens from across the supposed range of the *P. moluccanum* complex which confirmed the earlier evidence that this was about five distinct and easily distinguishable species, and that *P. moluccanum* (in the strict sense, the species not the complex) is endemic to Eastern Indonesia only.
The Bogor Botanical Gardens are celebrating their 200th year of operation in 2017. The herbarium used to be in the gardens grounds but moved to its current site in outer Bogor in 2007.

Issues
Despite the two institutions being run by the Indonesian Institute of Sciences, since separation of gardens and herbarium, different permits are now required for collecting samples at either, which I only discovered in Leiden. Fortunately, the staff at the Botanical Gardens had met with staff from the Australian National Herbarium (CANB) previously, and the Curator at CANB, Brendan Lepschi, was able to quickly provide the supporting documentation required for me to collect samples in the gardens.

Of seven species recorded originally here only two specimens remain: a splendid spreading 6m high and wide tree of *P. pentandrum* (Blanco) Merr. in full fruit and flower; and, a very old and large specimen of a taxon in the *P. moluccanum* complex that now needs reinstatement. The traditional belief that *Pittosporum* species are small, subcanopy trees may need revision (see *P. sp. aff. moluccanum* illustrated in Fig. 15).
The Forest Research Institute of Malaysia, Kepong, Selangor, Malaysia (FRIM)
Visit: 57 August 2017

Main contact: Dr Richard Chung Cheng Kong

The herbarium at FRIM consists of the specimens held at that institution at and after the departure of Singapore from the Malaysian states in 1965. Many of FRIM’s original specimens remain in Singapore. Consequently FRIM is a relatively ‘new’ herbarium but has an extensive collection of recent Pittosporum collections from every state in Malaysia.

Main Treasures:
• A very good specimen from Jahore, collected by Ummal-Nazrah et al., with duplicates in many other herbaria (KEP, K, SING, L, SAN, SAR, BKF). This will now become the type specimen for the new *P. ferrugineum* taxon requiring a new name in the Malaysia region.

• Good collections of the new species from Mt Kinabalu Park in Sabah state described by John Sugau: *P. peridoticola, P. linearifolium*, from Bukit Hampuan on the southern border of the Park, and *P. silamense* from Bukit Silam in Eastern Sabah, all narrow (described by the authors as ‘hyper’) endemics restricted to and rare on ultramafic soils/outcrops in the Park

• Dialogue initiated with the author of these species, and the *Tree Flora of Malaysia*, John Sugau on future collaboration on the genus in Malaysia.
Finally, FRIM has good collections of *P. reticosum*, which Ridley described in 1922 from only fruiting specimens. Ridley commented at the time that he thought this was a fairly narrow endemic restricted to Pahang vegetation at higher altitudes in Malaysia. The current study provided confirmation of Ummal-Nazrah & Kiew’s contention in 2010 that *P. reticosum* is endemic to Malaysia and is not the same as *P. kerrii* in Thailand, as suggested by Bakker in 1957. A flowering specimen discovered the following week at Singapore confirmed that these two species have quite different flowering structures.
Mt Kinabalu Botanic Gardens, Sabah, North Borneo, Malaysia
Visit: 8 August 2017

Unfortunately, arrangements made to visit the Mt Kinabalu National Park and Botanical Gardens headquarters were less successful. On the only day available for this visit, the contact person was away, and the herbarium closed when we arrived. Fortunately, we were able to examine and photograph extant specimens of *P. resiniferum* in the Mt Kinabalu Botanic Gardens. We then located a large fruiting tree of this species growing naturally in the carpark opposite the herbarium and were allowed by other Park staff to collect herbarium and DNA samples from this tree.
Herbarium at Singapore Botanic Gardens, Cluny Road, Singapore (SING)
Visit 6–10 August 2017

Main contacts: Serena Lee, Senior Manager, Collections and David Middleton, Keeper of the Herbarium

Singapore Botanical Gardens are always a delight to visit. The herbarium is in the garden grounds in the third purpose built building on this spot, just across the road from Australia’s High Commission, and adjacent to the upheaval being caused by construction of Napier Road Subway Station.

Treasures:

- Type specimens for *P. glaberrimum* Merr., *P. pentandrum*, Ridley’s *P. reticosum*,
- Previously unrecognised specimens of *P. reticosum*, including a flowering specimen hence reinforcing that this species is not the same as *P. kerrii* from Thailand.
- Specimens of the *P. ferrugineum* ‘form’ found around the Dutch East Indies including Java, which reinforced that this form is not the same as either the Queensland form, nor the Malaysian form, but IS the same as that growing in the Bali Botanic Gardens that hadn’t been identified to date.
- Following Henry Ridley’s collections of taxa in this family throughout Malaysia, Borneo and Java. Henry Ridley, an outstanding field Botanist was the first Scientific Director of the Singapore Botanic Gardens from 1888 to 1911. His wooden desk is appropriately preserved amongst the current compactus for guests to use. He collected the Malaysian form of *P. ferrugineum* on numerous occasions across the Malaysian states and was aware that his ‘common’ Malaysian species was not the same as the species he collected on the lava flows of Java. There is a specimen of this Java taxon at the BM annotated by Ridley as ‘not ferrugineum’ (BM794020).
Unfortunately, I was unable to locate the population of Ridley’s common species collected near Changi Museum Kiosk on my previous trip to Singapore as a Singapore Botanic Gardens Fellow in 2007. As happens in suburbia, Changi Prison seems to have expanded into most of the remnant woodland space in the area in 2017.

Future networking opportunities
The Singapore Herbarium has recently started a new taxonomic journal and are keen to publish the new name for the Malaysian form of *P. ferrugineum*. This has been agreed to by the staff at FRIM who are providing the type species for the protologue.
Major Achievements of the Fellowship

In summary, the main achievements of this ABRS/Churchill Fellowship grant are:

1. Establishment of a bank of information on overseas pittospora taxa held in relevant overseas institutions for future research and regional revisions. The data compiled includes:
   - digital images of types of names and other informative specimens,
   - relevant taxonomic literature/protologues and synonymies including translations,
   - ecological data (habit, habitat, substrates, etc.) and
   - spreadsheets of collections with the collectors and the final taxon determination. This is particularly important for the Papua New Guinea specimens as hundreds of duplicate specimens were despatched to herbaria around the world, and most will now need curation and new species determinations.

2. Resolution of the taxonomy of large numbers of confused/lumped/ignored taxa in our region:
   - Australia: one species that was considered Australian but is an extension of the same species widespread in the Spice Islands, and taxonomic resolution of the Queensland form of P. ferrugineum,
   - Malaysia: Peninsular Malaysia has two species, both of which have now been sorted out and one requires publication under a new name at species level,
   - Indonesia: the focus of the P. moluccanum complex. Not surprisingly, the four species making up this complex require reinstatement with all but one restricted to/endemic to Eastern Indonesia, including P. moluccanum, the actual species, that turned out to have the smallest range of all,
   - Philippines: one of the moluccanum complex species is endemic to the Philippines and floristically closely related Taiwan, and requires reinstatement. The pittospora in this region are also overdue for revision, which can now start with the information in the species bank.
   - Papua New Guinea: the revision of Schodde’s Papuasian taxa is going to require considerable work. In the interim, the resolution of the ferrugineum complex in this area alone has resulted in the recognition of about two species new to science, and several more that require reinstatement and recircumscription at species level.
   - In the Pacific generally: headway on sorting out the taxonomy of a number of taxa, including narrow endemics in both Vanuatu and Fiji,
   - The current research indicates that the Sino-Indian region pittospora, last revised by Gowda in 1951 are now also overdue for comprehensive revision.

3. Confirmation from the extensive specimens available at these overseas herbaria that this family is characterised by narrow endemism, with very few wide-ranging specimens within and between regions both here and overseas. Why some species subsequently become weedy needs further investigation.
4. Confirmation and investigation of the known taxa in New Caledonia (about 30 species) for combined molecular and morphological phylogenetic analyses in the near future. Taxonomically resolved already, there is now more than sufficient information to attempt combined morphological and molecular phylogenetic analyses in the near future, using Australian and Papua New Guinea species as outgroups to resolve ingroup relationships, and any untoward species delineations.

5. The opportunity to collaborate on new, regional floras (Flora of Siam, Flora of Madagascar) which in turn will enhance our knowledge of taxa in these areas, and perhaps most importantly,

6. The reestablishment of an international, largely volunteer, collaborative Pittosporum study group. This group will continue to revise the phylogeny of this predominantly Australia family across its range as resources permit, commencing with the Malesian and New Caledonia area taxa. This will be the start of the first comprehensive revision of the family since that of Pritzel in 1930.

Acknowledgements

This project would not have been possible without the support and encouragement of this taxonomic research by the Australian Biological Resources Study and the Australian Churchill Foundation. As taxonomy is not a research priority at this time in Australia, the resolution of the ferrugineum complex across its range has been ongoing since 2007 as resources permitted. This fellowship has now allowed the finalisation of this research by having access to this critical taxonomic information in overseas herbaria.

The staff at the overseas institutions were extremely helpful and accommodating, and I thank them for their interest and suggestions. I would also like to thank Robin Cayzer, who wards off equatorial/Malaysian black spitting cobras (Naja sumatrana) and Changi prison fences on field trips for me, and Brigitte Kuchlmayr who sorted out the images into a coherent paper.
References

Anon, Berkeley Education. *Understanding Evolution*
http://evolution.berkeley.edu/evolibrary/article/side_0_0/otherspecies_01.


*Australian Systematic Botany Society Newsletter** 60**: 20.

See also http://www.environment.gov.au/biodiversity/abrs/online-resources/flora/main/


Appendix A:
List of authored plant names cited in this report

Families

*Apiaceae* Lindl.
*Araliaceae* Juss.
*Pittosporaceae* R.Br

Genera

*Pittosporum* Banks ex Gaertn. [Nom. Cons.]
*Schefflera* J.R. Forst. & G. Forst

Species

*Euonymus tobira* Thunb.
*Pittosporum campbellii* F. Muell.
*Pittosporum brackenridgei* A.Gray
*Pittosporum glaberrimum* Merr.
*Pittosporum kerrii* Craib
*Pittosporum ledermannii* Pritz.
*Pittosporum linearifolium* Sugau
*Pittosporum microcalyx* Koord. & Valeton
*Pittosporum moluccanum* (Lam.) Miq.
*Pittosporum pentandrum* (Blanco) Merr.
*Pittosporum peridoticola* Sugau & Ent.
*Pittosporum pullifolium* Burkill
*Pittosporum resiniferum* Hemsl.
*Pittosporum reticosum* Ridl.
*Pittosporum silamense* Sugau
*Pittosporum sinuatum* Blume
*Pittosporum spinescens* (F.Muell.) L. Cayzer, M. Crisp & I. Telford
*Pittosporum tobira* W.T.Ait.
*Pittosporum undulatum* Vent.
*Pittosporum versteeghii* Merr. & L.M. Perry
*Tobera s. tobira* Kaempf