Oxford Plant Systematics

With news from Oxford University Herbaria (OXF and FHO), Department of Plant Sciences, Oxford

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Foreword

This year has been extraordinary for plant systematics in Oxford, as in all spheres of life across the globe. However, there is opportunity for celebration. This issue of *OPS* marks the achievements of Robert Scotland and his colleagues in the publication of their monograph of *Ipomoea* (Convolvulaceae), the largest monographic research programme ever undertaken (and completed) in Oxford. The world's first taxonomic monograph, *Plantarum umbelliferarum distributio nova*, was written by Robert Morison, the University's Regius Professor of Botany, and published in 1672.

Ali Orr and Kate Loven report on progress towards making the University's botanical collections available to all. Gem Toes-Crichton gives a different photographic perspective on the Herbaria, as she uncovers some of the achievements of women 'lost' among the cupboards. Serena Marner presents the first catalogue of part of the vast botanical archive of George Druce, a former Curator of the Herbaria and recorder of the botanical achievements of Johann Dillenius, the first Sherardian Professor of Botany.

John Wood and his colleagues take us on modern collecting experiences and the surprises awaiting field workers. The value of field work and data are also themes running through contributions from William Hawthorne and Cicely Marshall in Africa, and Keith Kirby closer to home in Wytham Woods.

I trust you will find this issue of *OPS* of interest.

Stephen A. Harris
Curator of Oxford University Herbaria

Front cover images:
Six species of *Ipomoea* (Convolvulaceae) from Wood et al.'s (2020) monograph (see page 4).

Top left: *I. calyptrata* Dammer © Beth Williams; top right: *I. indica* (Burm.) Merr. © John Pink; middle left: *I pandurata* (L.) G.Mey. © Steve Turner; middle right: *I. bahiensis* Willd. © Maria Tatiana Martínez; bottom left: I. *aristolochiifolia* G.Don © Maria Tatiana Martínez; bottom right: I. *I. argentea* Meisn. © Darwin Initiative Project 16-004

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News

Staff news

In May 2020, **James Ritchie**, a technician in the Herbaria, died suddenly. James joined the Herbaria team as an apprentice, just after leaving school, in September 2014. On successful completion of his apprenticeship, James became a full-time herbarium technician. James was fascinated by the specimens in the Herbaria, the stories attached to them and even the obscure language used to describe them. James will be missed by all who work in the Herbaria.

Martina Boatfield left her post as digitisation technician in August 2019 and was replaced by **Kate Loven**.

Sophie Wilcox, Alexander Librarian of Ornithology, was also appointed Sherardian Librarian of Plant Taxonomy splitting her time between the two libraries in 2019. From 2020 she will be located principally in the Sherardian Library in the Department of Plant Sciences.

Pablo Muñoz-Rodríguez, winner of the 1st edition of the CETAF E-SCORE Award

Pablo Muñoz-Rodríguez, a postdoctoral researcher with Robert Scotland, is the winner of the first edition of the CETAF E-SCORE Award for Excellence in Research Based on Natural History Collections. This award has been launched by the Consortium of European Taxonomic Facilities to reward early-career researchers, within the fields of taxonomy, biodiversity and geodiversity science, who base their research on natural science collections. The award includes financial support to facilitate a visit to one of the CETAF institutes and an invitation to the CETAF governing board meeting for a presentation of the winner´s research. The award ceremony was held on 22nd May 2020, the International Day for Biological Diversity. For more information see https://cetaf.org/news/cetaf-e-score-award-excellence-research-based-natural-science-collections-first-edition-2020

Acalypha project in Robert Scotland's group

In summer 2019, Iris Montero Muñoz visited the Department of Plant Sciences for three months to work in Professor Robert Scotland´s group. Iris is a Teaching Assistant and Ph.D. candidate at the Autonomous University in Madrid, where she works on the systematics of *Acalypha*, a megadiverse genus in the Euphorbiaceae. Specifically, Iris' work focuses on *Acalypha* in the Western Indian Ocean region (WIOR) but her interests span the genus' global range. As part of her work, she and colleagues have described eight new species of *Acalypha* from the WIOR region and have published a synopsis of the genus in West Tropical Africa (Montero Muñoz *et al*., 2018; Cardiel and Montero Muñoz, 2017). Iris is now working to incorporate molecular analysis into her taxonomic studies, to expand the still limited knowledge of most species in the genus. The aim of her three-month project, supervised Pablo Muñoz-Rodríguez, was to become familiar with the main techniques of laboratory and computer work for phylogenetic analysis. Iris' visit to Oxford was funded by the European Molecular Biology Organization. For more information see https://acalypha.es

Montero Muñoz, I., J.M. Cardiel & G.A. Levin. (2018). Nomenclatural review of *Acalypha* (Euphorbiaceae) of the Western Indian Ocean Region (Madagascar, the Comoros Archipelago, the Mascarene Islands and the Seychelles Archipelago). *Phytokeys* 108: 85-116.

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BRAHMS: management of natural history collections

The BRAHMS database software has been extensively developed this last year with much of the focus on botanic garden management. Recent updates are reported on https://herbaria.plants.ox.ac.uk/bol/brahms/News. Collaboration with the RHS is also flourishing: https://www.ox.ac.uk/news/2020-07-10-oxford-teams-royal-horticultural-society-develop-innovative-plant-data-management.

Denis Filer and Andrew Liddell

Danby Patrons' Group

In January 2019, the Danby Patrons' Group held its inaugural event in Oxford University Herbaria. The Danby Group was formed by The Friends of Oxford Botanic Garden & Arboretum for the benefit of the Garden, Arboretum and Herbaria. The Group's name commemorates Henry Danvers, 1st Earl of Danby, who provided funds to purchase the lease, and erect the gates and walls, of the Botanic Garden in 1621.

Typesetting and layout of OPS by Serena Marner

Oxford Plant Diversity Research Group website: http://herbaria.plants.ox.ac.uk

Oxford University Herbaria database at: http://herbaria.plants.ox.ac.uk/bol/oxford

Six years of integrated systematic studies on *Ipomoea* at Oxford

Many groups of tropical plants have never been monographed, partly because of the pragmatic and regional nature of taxonomy. Tackling a study of this kind at a global scale and in a reasonable time frame is often seen as an overwhelming task. There is often a number of species with a global distribution and extensive synonymy; there is a large and increasing number of specimens (in some cases hundreds of thousands) housed in numerous and dispersed herbaria and there is an extensive, scattered and often obscure literature. In summary, taxonomic monographs are often seen as requiring so much investment that they are rarely undertaken.

However, monographic studies contribute not only to improving the taxonomy of the groups studied, but also to understanding the origin and evolution of these groups. With this in mind, Robert Scotland and John Wood published in 2012 a letter titled 'Accelerating the pace of taxonomy' (*Trends in Ecology and Evolution* 27: 415-416). In that letter, they introduced the concept of 'Foundation monographs' as an approach to overhauling the taxonomy of species-rich groups of tropical plants. This approach seeks to focus on those tasks that are tractable and can offer the maximum improvement in taxonomic knowledge in a given period of time. Importantly, it is novel in the sense that it combines standard techniques of morphological study with the use of online digital images and molecular sequence data. This integration allows a focus on species level taxonomic problems across the entire distribution range of individual species. A detailed explanation of this approach and multiple examples were published in November 2019 in *Nature Plants*.

The feasibility of the 'foundation monograph' approach was first tested in the study of *Convolvulus*, a medium-sized and relatively well-known genus of temperate plants. A global review of this genus was produced by Scotland, Wood and colleagues in as little as one year (*Phytokeys* 51: 1-282, 2015). Following this success, Scotland, Wood and colleagues embarked on a more ambitious project: the monographic study of the genus *Ipomoea*.

Ipomoea is a megadiverse group of plants and the largest genus in the family Convolvulaceae. *Ipomoea* includes herbs, shrubs, lianas and trees and is present in all tropical and subtropical regions of the world, from sea level to 4,000 metres and from tropical rain forests to semi-desert coastal environments. The genus is also present in other more temperate regions as far north as Canada and several widespread species present a worldwide distribution. Around two thirds of the currently recognised species

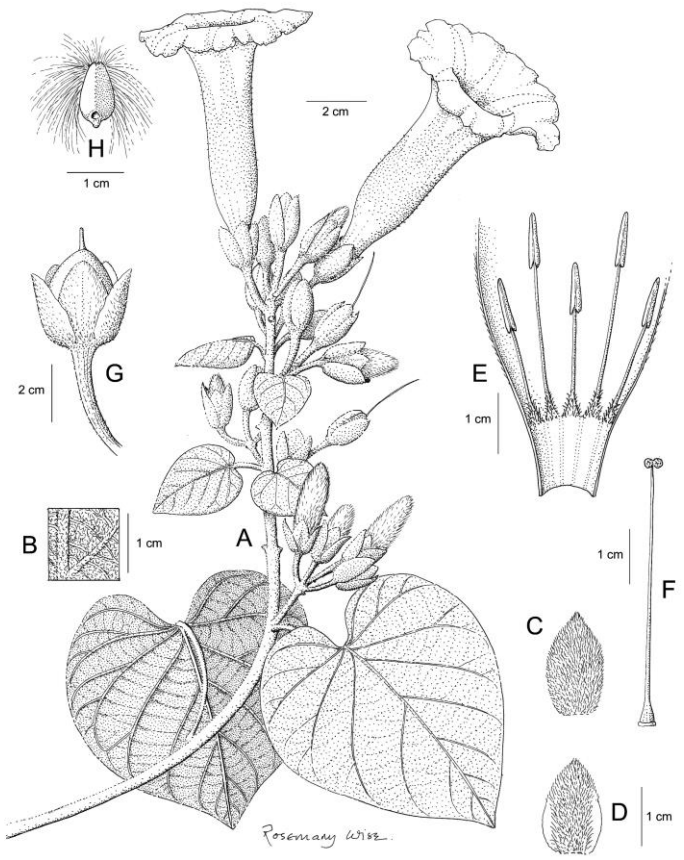


Illustration of *Ipomoea praecana* House by Rosemary Wise

are distributed in the Americas and the other third in the Old World. Among them, several species of global importance such as the sweet potato (*Ipomoea batatas* (L.) Lam.), the water spinach (*I. aquatica* Forssk.) or the Japanese morning glory (*I. nil* (L.) Roth) stand out. Finally, new species of *Ipomoea* are still described every year and the genus had never been monographed. In summary, a monographic study of *Ipomoea* was pertinent.

Six years of studies have resulted in 'A foundation monograph of *Ipomoea* (Convolvulaceae) in the Americas', published as an open access monographic volume in the journal *Phytokeys*. The 823-page work includes descriptions of all 425 species in the continent (including some 60 species described during this project), alongside information on their ecology and distribution — with over 12,000 voucher specimens cited. Authors also provide notes on salient characteristics and taxonomic issues related to individual species, a full synonymy and 272 new lectotypifications. Importantly, the work includes identification keys and over 200 photographs and illustrations drawn by botanical artists Rosemary Wise and Eliana Calzadilla. This publication, together with another twenty-two related papers published by the group in recent years and listed below, constitute the most comprehensive study of *Ipomoea* to date and an extraordinary resource for future studies of this group of plants. In addition, the recently launched website http://www.ipomoeaproject.org aims to facilitate access to all the data and resources generated by the researchers during this project. This website includes up-to-date taxonomic information on all species of the genus, images to aid identification of specimens and observations, molecular phylogenies, references and a BRAHMS database with information of all botanical records studied as part of the project.

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Pablo Muñoz-Rodríguez
Post Doctoral Researcher

Expeditions and visits

John Wood made two visits to Bolivia, each of about a month, one in March-April and the other in July-August. The main focus of both visits was to support Kew's Bolivian TIPAS project (Tropical Important Plant Areas), in collaboration with botanists from Kew and the Natural History Museum in Santa Cruz. Fieldwork involved delimiting potential sites, recording endemic species and assessing potential threats to the sites and species. Both visits also provided the opportunity to obtain records and photographs for forthcoming publications on *Ipomoea* and *Jacquemontia*.

In November **John Wood** and **Tom Wells** visited Ecuador for just over a week. The main purpose was to develop contacts for Oxford's BBSRC project to study wild populations of the sweet potato and its wild relatives. Visits were made to the herbaria of six Ecuadorean institutions in four cities and, rather surprisingly, several new species of *Ipomoea* were found amongst specimens of Convolvulaceae, as well as several examples of *Jacquemontia peruviana* Helwig, not collected in Peru for over a hundred years.

Caroline Pannell made several visits to herbaria, attended a conference and made some field trips. She visited Leipzig (LZ) twice to collaborate with Alexandra Muellner-Riehl and Jan Schnitzler on molecular work on two new species of *Aglaia* in New Guinea and the extension of the range of the cassowary-dispersed species, *Aglaia mackiana* Pannell. She wrote the new descriptions during visits to Kew (K) and Glasnevin (DBN). Rosemary Wise prepared plates of four species, based on material from FHO and loans from K and L.

In April, Caroline attended the joint British Ecological Society and Society for Tropical Ecology conference in Edinburgh, where dispersal biology of fleshy tropical fruits was the theme for one of the sessions. This was followed by a day in Edinburgh herbarium (E) to continue her work on the Meliaceae for the Flora of Thailand. This project was also pursued on two week-long visits to Kew and during three weeks in Bangkok (BKF) in October.

After a week in Michigan (MICH) in September, she attended the launch in Singapore of the special issue of the Gardens' Bulletin Singapore, published to celebrate David Mabberley's 70th birthday. Her contribution was a new species, *Aglaia mabberleyi* Pannell, named in recognition of David's fieldwork and his taxonomic contribution to revision of the Meliaceae (excluding *Aglaia*) in Malesia, Sri Lanka, India, China, Australia and New Caledonia. Caroline spent a total of five weeks in Singapore, working on her accounts of the Meliaceae, Salicaceae and Achariaceae for the Flora of Singapore.

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Abstracts of systematic theses submitted in 2019

The following D.Phil. theses were submitted and successfully defended in 2019:

What can we learn about plant evolution from a robust phylogenetic framework?

Tom Carruthers
Department of Plant Sciences, University of Oxford

Supervisor: Professor Robert Scotland (Oxford)

A robust molecular phylogeny provides insights into evolutionary history because it illustrates the order that different taxa have diverged from each other, and the changes that have accumulated between different taxa over evolutionary history. However, a molecular phylogeny does not provide information about a range of other fundamental parameters in macro-evolutionary research. This includes the absolute time-scale over which a clade has evolved, and the rate that different clades have diversified. In order to estimate absolute time-scales (referred to as divergence time estimation), and infer net diversification rates, speciation rates, and extinction rates (referred to as diversification parameter estimation), additional analyses are therefore required. As robust phylogenies are inferred for an increasing number of groups, and complex analyses are performed to infer macroevolutionary parameters in a greater variety of contexts, evaluating the robustness of methods for inferring divergence times and diversification parameters is more important than ever. Here, I evaluate the robustness of methods for inferring divergence times and diversification parameters. I show that even in the context of genomic scale datasets, among-branch-substitution rate-variation that acts consistently across entire genomes causes considerable error in divergence time estimates, regardless of the quantity of molecular sequence data that is sampled. I then show that methods that implement multiple fossil calibrations with relaxed clock methods, which are designed to account for among-branch-substitution-rate-variation, make unrealistic assumptions about the fossil record. I show that these unrealistic assumptions are likely to be a further source of error in divergence time estimates. I then characterise the implications of these problems for estimating divergence times and diversification parameters within *Ipomoea*, and show that they can lead to very uncertain inferences. However, I show that if questions are carefully framed, and the assumptions of different methods fully accounted for, robust inferences can be made. This includes the inference that the storage root of the Sweet Potato (*Ipomoea batatas*) evolved in pre-human times, challenging the existing paradigm that it evolved relatively recently as a result of human domestication. It also includes the inference that there is a significant increase in net diversification rates for a clade of Neotropical *Ipomoea* that is of a scale equivalent to some of the most iconic radiations in the plant kingdom. Taken together, this thesis illustrates fundamental problems 135 that underlie methods in macroevolutionary research, but highlights that when methods are used in the right context, they can serve as a basis for making novel and robust inferences about the natural world.

Monitoring and managing plant diversity in field margins in southern England

Claudia Havranek
Department of Plant Sciences, University of Oxford

Supervisor: Professor Stephen Harris (Oxford)

Biodiversity is severely threatened by human activity; one of the greatest threats is from agriculture. To reduce the impacts of agriculture on biodiversity, one conservation strategy, incentivised by UK governments, is to exclude strips of land with herbaceous vegetation, termed field margins. Conserving field margins preserves a valuable habitat for plant and animal species and are therefore predicted to boost biodiversity. However, despite being a widely implemented policy, results from monitoring plant diversity in field margins are lacking, and the ecological impacts of management in field margins are not well understood. This thesis aims to provide suggestions for ecologically effective ways to monitor and manage plant diversity in field margins, based on three years of fieldwork across four farms in Oxfordshire, England.

Based on my extensive fieldwork I present four main findings. Firstly, I found that only a limited amount of variation in plant community composition can be explained by margin-level characteristics. This suggests that management at margin-level can only have a limited impact. Secondly, I observed little variation in the plant communities between different farms. This suggests that management recommendations for plant diversity in field margins can be generalised across farms. Thirdly, I observed higher butterfly species richness in field margins with higher plant species richness and intermediate vegetation height. This suggests that management of plant height and diversity, will have a positive effect on butterfly diversity. Finally, I found that assessing plant biodiversity using either

transect or quadrat survey methods, resulted in biases in the plant species recorded. These results suggest that plant surveys in field margins should use both transects and quadrats, to reduce bias in plant species lists. Together, these four main findings provide ecological evidence to improve the efficacy of conservation efforts for farmland biodiversity, through monitoring and management of field margins.

Endemism hotspots in the flora of Belize

Gail Stott
Department of Plant Sciences, University of Oxford

Supervisors: Dr William Hawthorne (Oxford) and Dr David Harris (Royal Botanic Garden Edinburgh)

This thesis is aimed at improving the understanding of endemism (or 'bioquality') hotspots (areas where globally rare species are concentrated) within the flora of Belize, with a view to informing conservation priorities at scales suitable for practical land management. Research is framed within a standardised bioquality scoring system, whereby all species are allocated to 'Star' catgeories of global rarity. Based on this, the bioquality of different areas is calculated as a weighted average of the Star of species found there.

Chapter 2 describes the curation of a database of botanical records for Belize. Patterns in historical data are explored, revealing bias in the dataset; spatially, and in terms of taxonomic groups and habit types. Parts of Belize are found to be under-sampled. Areas close to settlements, research stations, and unusual geomorphological features are associated with high numbers of botanical records. Chapter 3 examines distribution patterns in observed bioquality data to determine how these relate to underlying geology and topographic diversity. A high percentage of hotspots are found on rugged limestone at mid - high elevations, and where there are transitions in underlying geology. Chapters 4 and 5 use two modelling methods to predict bioquality at a 1 km grid square resolution. Chapter 4 describes a bottom-up approach to predicting bioquality, based on stacking individual species distribution models (SSDM). Results showed affinities to observed bioquality patterns, but a general tendency to over-inflate bioquality. Chapter 5 describes the use of a top-down, macroecological (MEM) approach to modelling bioquality. This method produced more accurate predictions than those arising from the SSDM model. Three main areas where hotspots overlap on the SSDM and MEM maps (the western end of the Colombia River Forest Reserve, including Little Quartz Ridge and the Burgos Plateau; on the Vaca Plateau, near the border with Guatemala and eastwards into the Chiquibul Forest Reserve; and the limestone foothills on the eastern side of the Maya Mountains, in the Bladen Nature Reserve) are considered priorities for further research (*in situ* sampling).

In the concluding chapter, hotspot predictions are examined within the context of the national protected areas system of Belize. Several areas that were predicted as high bioquality occur in places where there is currently little or no on-the-ground management. Several suggested refinements for the methodology are presented, and this chapter concludes with recommendations for the development of a national strategy for plant conservation.

Student reports

Ben Jones (M.Sc. Res., 2nd year) Bioquality and forest plantations in Japan

Supervised by Professor Stephen Harris (Oxford) and Dr William Hawthorne (Oxford)

Japan's land has 70% forest cover: mixed forests of coniferous and deciduous trees in Hokkaido; deciduous beech forests in northern Honshu; broad-leaf evergreen forests in western Honshu and the south; and mangroves in the coastal areas of the South-West Islands. According to the Red List of Japan, 25% of the flora is threatened with extinction. Japan is a good study area for investigating biodiversity hotspots and issues surrounding their conservation due to the high number of rare and of threatened species and the well-established taxonomic framework. In a large part of Japan, forestry is based on clearcutting and the artificial regeneration of conifers. Plantations now occupy 40% of total forest area, principally as monocultures of Japanese cedar (*Cryptomeria japonica* (Thunb. ex L.f.) D.Don), Hinoki cypress (*Chamaecyparis obtusa* (Siebold & Zucc.) Endl.), and larch (*Larix kaempferi* (Lamb.) Carrière). These areas cover approximately 10 million hectares, with more than half being over 45 years old and ready for harvesting. These plantations are believed to support a relatively low diversity of indigenous plants and animals, and management options enhancing biodiversity are required to meet the increasing demand of non-timber forest ecosystem services.

A comprehensive database has been compiled from the Global Biodiversity Information Facility (GBIF), global online herbaria, as well as samples and checklists provided by colleagues in Japan. The database contains 1,153,642 unique occurrence records of vascular plant species linked to an area or a place across Japan, and holds 37,062 taxon names in total, including synonyms. Using the database, the Genetic Heat Index, a measure of bioquality, is being calculated and will reveal patterns at different scales across Japan. Maps of the floristic composition across Japan created from the database will inform us where a species is or was, and thus identify the potential for increasing the bioquality of plantations in their next management cycles, and for them to become higher biodiversity-value forests through changed management.

Alex Sumadijaya (D.Phil., 4th year) Systematics of *Stictocardia* Hall.f.

Supervised by Professor Robert Scotland (Oxford). Funding: LPDP (Indonesia Endowment Fund for Education)

In the final year of my D.Phil., I am analysing and writing chapters for my thesis and preparing a taxonomic revision of *Stictocardia*, a small segregate genus now known to be nested within Old-World *Ipomoea*. My focus is on reciprocal illumination, a circular process that repeatedly re-evaluates taxonomic hypotheses relative to morphological and molecular data, to deliver a robust taxonomic account and phylogeny.

Tom Wells (D.Phil., 2nd year) Documenting diversity in natural history collections of sweet potato (*Ipomoea batatas* (L.) Lam.) and its wild relatives

Supervised by Professor Robert Scotland (Oxford). Funding: Interdisciplinary Biosciences DTP (BBSRC)

In the first full year of my D.Phil. I have focused on producing a comprehensive account of the morphological variation present in previously collected specimens of *I. batatas* and its closest wild relatives. Alongside visits and loan requests to herbaria in Europe, the US, and Latin America, and accessing digitised collections online, this has also involved requesting seeds and in vitro material from global germplasm repositories (CIP, NARO, USDA) for cultivation in the Dunstan Greenhouses at the Oxford Department of Plant Sciences.

As well as specimens of eight of the closest wild species to sweet potato, a number of accessions of unknown determination, some originally collected as far back as the 1950s, are now growing well and providing material for morphological, cytological, palynological and molecular phylogenetic analysis. These specimens are poorly known and their taxonomy is disputed. Some have been hypothesised to have played a role in the origin of sweet potato, which I aim to further explore as part of my thesis.

All analysed specimens are documented in BRAHMS 8, and in the near future I hope to undertake a comprehensive round of whole genome sequencing, as well as fieldwork to collect more material and ascertain the contemporary status of these plants in the wild.

Something new or something rare?

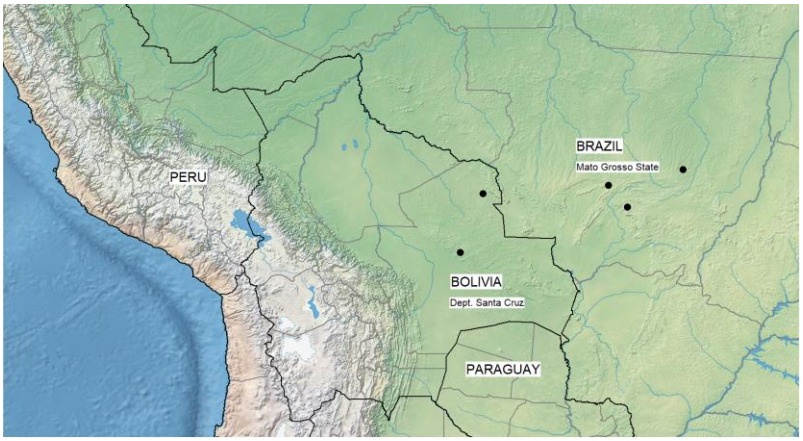
What motivates a plant hunter? It is a question I am often asked. I can only answer for myself. It is the delight of having a purpose to travel into mountains or remote forests to be entranced by the beauty and wildness of nature. It is the possibility of finding something new or of unravelling a puzzle about a poorly known plant. And it is sometimes the delight in finding a long-lost species or a rarity you have never seen.

I have studied the Acanthaceae of Bolivia for a quarter of a century or more, wrote an account of the family with Dieter Wasshausen in 2004 and have seen almost all species at one time or another. One that had always eluded me was the mysterious *Lepidagathis riedeliana* Nees, a species found in Mato Grosso in the 1830s and named after the collector the German Ludwig Riedel. It was recollected at an unknown location in Brazil, probably later in the nineteenth century and that specimen is now housed in the Natural History Museum in Paris. It was again collected in Mato Grosso early in the twentieth century by Thomas Meyer and described as the type of a new monotypic genus under the name *Acanthura matogrossensis* Lindau, which was recently shown to be the same as *Lepidagathis riedeliana*. There has been only one other collection from Brazil made by Gert Hatschbach, in 1997, also from Mato Grosso.

Meanwhile it was collected twice in Bolivia, once from an unspecified location in Velasco and once from the flooded pampa near El Refugio in the Noel Kempff National Park. Although this last record was the only fully georeferenced record, it had never been refound either by me or any other botanist who has visited the area. Last July I was in another part of Eastern Bolivia travelling with Rosie Clegg from Kew and Maira Martínez from the Natural History Museum in Santa Cruz when we stopped by a grassy hollow in a rather nondescript cerrado. I scrambled through the barbed wire and into the grassy hollow, where I spotted the *Lepidagathis*. Although I had only seen dried herbarium specimens before, I knew exactly what it was. It was that rare event for a field botanist – a eureka moment.

Unlike most rare plants, *Lepidagathis riedeliana* does not inhabit a single threatened location but is distributed over a huge area of eastern Bolivia and Mato Grosso in Brazil. However, it has only been found three times in Bolivia and four times in Brazil over a period of 200 years, and two of the seven records are unlocalised. It appears to be a plant of seasonally flooded grassland in cerrado vegetation and a partial explanation for the few records is that it flowers at the height of the dry season when much of the surrounding vegetation is desiccated. Nevertheless, it is clearly very rare and the population I saw consisted of around ten plants. It is difficult to explain its rarity given its wide distribution and the relative frequency of its preferred habitat, although the cerrados are disappearing to be replaced by "improved" pasture for cattle ranching or soya cultivation.

What of the future? Who knows? At least we now know its habitat and flowering season so there is a better chance that dedicated searches will result in the discovery of further populations in the extensive area where it is known to grow. The wide distribution is reassuring to some degree, but it makes it difficult to focus efforts at conservation. Fortunately, at least one location where it grows lies within the Noel Kempff National Park in a seasonally flooded pampa of little agricultural potential but we know nothing of the fate of the Brazilian populations.



Map of the distribution of *Lepidagathis riedeliana* Nees in Brazil and Bolivia



Figure 1.
Lepidagathis riedeliana Nees

Photo © Maira Martínez



Figure 2.
Seasonally moist cerrado habitat where *Lepidagathis riedeliana* Nees was found in July 2019.

Photo © Maira Martínez

Reference

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John R.I. Wood
Research Associate



Map of tropical Africa with arrows pointing to the western ends of the two RBS transects
Basemap source: Esri (World Street Map https://server.arcgisonline.com/ArcGIS/rest/services/World_Street_Map Jan., 2020)

Recent Rapid Botanic Survey from West and East Africa

Two African Rapid Botanic Surveys (RBS) coordinated from Oxford (and now the University of Cambridge, where Cicely Marshall has relocated) were completed 2018-2019 and have provided new detail on the vegetation and plant biodiversity at the eastern and western flanks of tropical Africa.

In East Africa, a two-country RBS was part of an Environmental and Social Impact Assessment (ESIA) for a large East African pipeline project (EACOP). The EACOP pipeline would carry crude oil from the shores of Lake Albert in western Uganda to the coast north of Tanga in Tanzania, impacting a narrow corridor about 1,500 km long but only tens of metres wide, either side of the trenched pipe. The EACOP pipeline plan has raised environmental and socio-economic concerns in the media; our task was to provide a botanical perspective: to survey this corridor and flag any patches of species and habitats of conservation concern. Such a long and thin transect presented tougher logistical challenges than usual.

The first step was to pre-stratify the sample corridor: using satellite imagery we defined 58 sections based on apparent vegetation and location. We started off the fieldwork and trained two RBS teams from herbaria in Kampala Makerere and from Dar Es Salaam universities. The two field teams then each carried on to complete most of the hard work, sampling in two field seasons, working towards the national border near Lake Victoria. Fortunately, most of the pipeline route had been planned by EACOP to avoid protected and other known sensitive areas, but there were still many thousands of hectares of previously unsampled vegetation in which rare or otherwise valued species might lay hidden.

In total, 186 RBS sample areas were enumerated (92-94 in each country), in each of which as many plant species as could be found by the teams were identified on the spot or from voucher specimens. We rejoined the teams to help identify and database the large bales of RBS specimens acquired during fieldwork. For the 11,607 plant records, 8,561 specimen vouchers were made, covering 1,620 species. The specimens remain in East Africa, but have been photographed and further identification is ongoing. In spite of the secondary nature of much of the vegetation sampled, all show the distinct floristic signature of one of the several phytochoria (broad-scale floristic region as defined by White, 1983) and vegetation formation passed through: Sudanian, Guineo-Congolian, Zambezian, Somali-Masai and Zanzibar-Inhambane variants of woodland, grassland, bushland, thicket, swamps, rocky areas, gallery and other forest patches.



Setting up the specimen drying "facility"

Photo © William Hawthorne

As we have previously classified all tropical African species into 'Star' categories of global rarity, it was relatively straightforward to analyse the data for species and habitats that might be of global conservation concern, and to score the vegetation for bioquality (the weighted concentration of rare species; Marshall et al, 2016) and to note IUCN Red Listed species. Given the general lack of distinction in the satellite imagery between the sliver of corridor and the vast expanses of apparently homogeneous vegetation that it ran through, it was no surprise that most of the plant communities traversed have rather low bioquality, being dominated by widespread species. Even threats to local uses of the plants would be limited, considering the vast expanses, for instance of papyrus swamp or Acacia woodland on either side of the corridor. However, there were some 'flecks of gold' in the pan, and red flags for developers to note. For instance, in Uganda, the corridor bisects patches of gallery forest that link protected forests on either side of the corridor, not least potentially for chimpanzees living in those forests. In Tanzania, a previous outlying patch of the Itigi-Sumbu thicket biome was discovered, c. 100 km north of its previously mapped (and very limited) extent (White, 1983), with several characteristic global rarities such as *Millettia paucijuga* Harms, *Bussea massaiensis* (Taub.) Harms ssp. *massaiensis*, *Maerua eminii* Pax and *Pavetta burttii* Bremek. Near the coast in Tanzania,

especially in patches of gallery forest, several globally rare coastal species were found in the corridor, including *Byttneria fruticosa* K.Schum. ex Engl., *Julbernardia magnistipulata* (Harms) Troupin, *Pseudoprosopis euryphylla* Harms ssp. *puguensis* Brenan, *Stuhlmannia moavi* Taub., *Saintpaulia ionantha* H.Wendl. and *Warburgia stuhlmannii* Engl. These discoveries and fragments of vegetation have been reported by RSK to EACOP.

On the other side of Africa, a RBS was conducted in northwest Guinea of an area planned for development of bauxite mining and haulage to the coast. Whilst much shorter, the process was fairly similar, starting with pre-stratification and planning helped by remote imagery. In this case, we worked with experienced RBS surveyors Ouo-Ouo Haba and David Bilivogui and their assistants. Over a few weeks, we moved nomadically in tented camps along with zoologists and sociologists to sample areas inland from Boké before sampling the Boké environs itself. This area is poorly resourced, with few opportunities for much more than subsistence agriculture, and a very low density or absence of schools, clinics, electricity, and mobile phone masts (and beer).

Although there have been historical herbarium collections around Boké itself, almost nothing was known for the vegetation of the proposed quarry areas 100 km inland. We found only about 120 species recorded for Boké environs in online herbaria, including collections of the type of the globally rare *Cathormion rhombifolium* (Benth.) Keay made by Heudelot in 1837 from the Rio Nunez river estuary, where we refound it on several occasions. The survey found 643 species in 130 sample areas, increasing our knowledge in just a few weeks by more than 500%, and with much better resolution.

The target area is an interesting mosaic of sparsely vegetated hardpan ('ferrocrete') terraces called bowé, interspersed with streamside woodland, strips of gallery of forest and scattered fields with scattered tree and other crops like mango, oil palm, groundnut, maize and rice mostly near watercourses. A small group of chimpanzees had been observed by the zoologists in the mangrove near Boké, and the scattered strips of coastal gallery forests and thickets there included stands of several interesting species, including an as yet unidentified specimen of a *Strombosiopsis* (the first record of the genus in the country). A set of species largely restricted to these ever-diminishing Western Guinean gallery forests found here include *Cathormion rhombifolium*, *Byrsanthus brownii* Guill. and *Placodiscus riparius* Keay. The wetlands on some bowé also have a distinctive (and therefore fairly high bioquality) community of species, several of which are restricted to this sort of scattered landform in West Africa, including *Bryaspis lupulina* (Benth.) P.A.Duvign., *Dopatrium senegalense* Benth., *D. longidens* Skan and *Utricularia tetraloba* P.Taylor, alongside a few uncommon species typical of bowé in general, include *Eriocaulon* species and *Djaloniella ypsiphylla* P.Taylor. We focused on primary vegetation. The top, high bioquality areas requiring conservation action are the gallery forests and the wet bowé. The predominant savanna-woodland and associated dry forests are of generally low bioquality, but locally important for fuelwood and other products; the little time spent surveying fallow, roadside or ruderal vegetation was adequate to confirm it has a low bioquality and is of low conservation concern.



Moving camp: priority to the specimens



Stuhlmannia moavi Taub. a rare tree found in the coastal woodland near a river, Tanzania



RBS sampling in stream over bowé.

All images © William Hawthorne

The resulting databases of species assemblages along such broad-ranging transects, all from a discrete time frame, is a valuable addition to knowledge of African flora, especially in an era when there is an increasing need to watch out for gross changes in biodiversity over time. Botanical collectors often focus on known hotspots and discrete large blocks of vegetation, so there is a large gap in our knowledge corresponding to the many small groves, ponds and tiny strips of gallery forest throughout tropical Africa, important local refuges or corridors for animals, and often relied on by local communities for their local supply of important commodities. Sampling in this patchwork can be difficult and time-consuming, but it is important because increasingly this is how the front line between biodiversity loss and human use looks. RBS provides an ideal sampling protocol for these types of patch, as a basis for historical monitoring against which changes can be measured, and to pinpoint the flecks of gold that lie hidden in unexpected places in the landscape.

RBS teams (plus the authors) were: (Uganda) James Kalema (team leader) with Ahmad Bukenya, Kennedy Mullasa and Serunjugi Derick; (Tanzania) Henry Ndangalasi (team leader), Frank Mbago (curator), Haji Selemanji and Josephat Kalughasha; (Guinea) Ouo-Ouo-Haba and David Bilivogui with Faya Simbiano and Koikoi Bilivogui. Guides were also recruited locally for each day's work. The field work was funded by EACOP and AMC with environmental work coordinated by the companies RSK, TEC and Sally Johnson.

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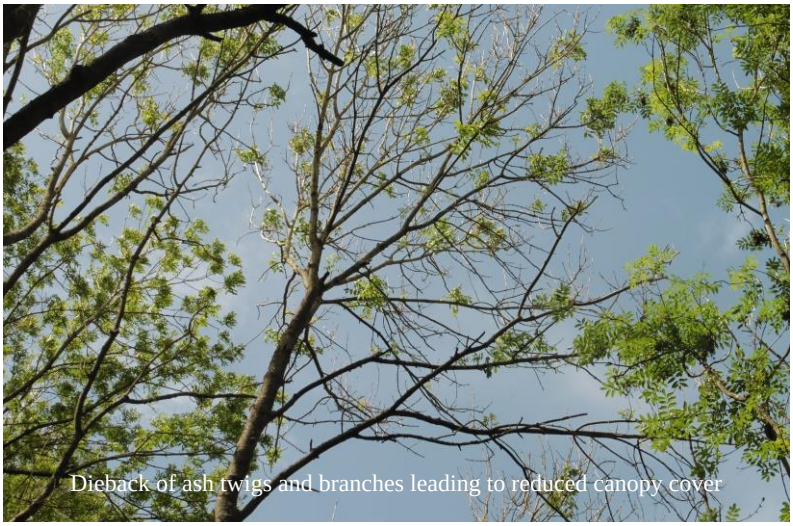
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***William Hawthorne**, Research Associate (Oxford) and **Cicely Marshall** (Department of Plant Sciences, Cambridge)*



Dieback of ash twigs and branches leading to reduced canopy cover

Ash dieback – what will it mean for the woodland ground flora?

Tree species, like humans, are continually being exposed to potential pest and disease organisms, but most trees, most of the time are not affected by them. However, every so often one appears in a form that the host species cannot cope with, and that can cause widespread damage and death. In the late 1960s this is what happened when a new form of Dutch Elm Disease appeared in Britain and we are seeing something similar now with Ash Dieback.

The fungus causing the dieback *Hymenoscyphus fraxineus* Baral et al. (2014) comes from the Far East where it does not cause problems for its host ash species. However once introduced to Europe, damage to and death of European ash *Fraxinus excelsior* L. started to be reported. The first outbreaks were recorded from Poland in 1992, then the disease spread westward across the Continent. Affected trees were first confirmed from Britain in 2012, but it is likely the disease had been in the country for several years prior to that. It is now present throughout Britain and canopy dieback is starting to become common.

There will be multiple consequences: for example many roadside ash trees will need to be felled to reduce the risk of traffic accidents; foresters have lost the use of a tough, fast-growing timber tree; the ecology of many semi-natural woods will alter as a major component of their canopy is reduced or lost completely (Hill *et al.*, 2018; Mitchell *et al*., 2014).

In Wytham Woods ash is one of the commonest trees and in 2017 we picked up the first definite signs of the presence of the disease. Assuming the disease behaves as elsewhere we can expect the tree canopy to open out, to varying degrees across the Woods according to the present abundance of ash. Promising stands of ash saplings have already died and it will be other species that eventually may fill the canopy gaps. The implications for the ground flora are part of ongoing research into understorey changes in Wytham Woods.

We will use results from 164 10x10 m vegetation plots established across the Woods between 1973 and 1976 and subsequently re-recorded in 1991, 1999, 2012 and 2018 (Dawkins and Field, 1978). These data provide us with a baseline of what the vegetation was like and how it varied prior to the disease having a significant impact. A further full recording is planned for 2023. In the meantime, the 10% of plots with the greatest ash cover will be checked annually for the extent of the disease in the canopy, along with a quarter of the other plots.

What sort of responses might we expect from the ground flora? From analysis of past changes, we can expect that where the canopy opens out substantially (>30%) species richness in the ground layer is likely to increase initially, because more light reaches the ground floor. Bramble (*Rubus fruticosus* L. agg.) in particular can show a strong response to canopy gaps, but this is reduced when there is high deer grazing and browsing. Initially there may be increased nutrient availability as trees die and this might favour competitive, more eutrophic-type species. We will however need to allow for the general trend towards eutrophication that has been happening from nitrogen compounds given off by cars and from the nearby dairy farm (Corney et al., 2008; Kirby and Thomas, 2000).

We can also learn something from how the ground flora changed in woods that were affected by Dutch Elm Disease, although in Wytham, elms *Ulmus* spp. were previously not a major canopy component. Where death of the main canopy elms did create large gaps, dense thickets of bramble, thistles *Cirsium* spp., cleavers *Galium aparine* L. and nettles *Urtica dioica* L. often formed. These might persist as open glades for several years, depending on how quickly the canopy regrew. At Hayley Wood in Cambridgeshire, with smaller gaps, the ground flora response was initially rather like that after a coppice

cut: *Primula elatior* Hill, the oxlip, did well and buried-seed plants such as ragged robin *Lychnis flos-cuculi* L. emerged. Deer were attracted to these areas and grasses became abundant (Rackham, 2003). By 2018 the gaps had mostly closed over but could still be distinguished as patches of young ash over low bramble, grass, nettles and meadowsweet *Filipendula ulmaria* (L.) Maxim.. Time will tell whether, at Wytham with Ash Dieback, a similar difference emerges between the ground flora changes in large versus small gaps.

Ash Dieback is only the latest of a series of new and emerging pests and diseases to affect our trees. Often the arrival of a pest or disease organism appears to be linked to increased international trade in plants. The presence of other damaging pests and diseases on the continent that have not yet reached Britain emphasises the need for tough biosecurity measures. In addition, trees in Britain are being put under more stress from climate change and pollution, such that they may be more susceptible to pest and disease damage. What we learn about the impact of Ash Dieback on our woods may help us to assess the likely significance of future pest and disease problems for our woodland flora.

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Keith Kirby, *Woodland Ecologist*

Researching hidden histories of women in botany

My photographic practice and passion for plants are tightly entwined. As a child my mother would lead me around the garden, pointing out the plants, using their scientific names and explaining how to tend them. I was instantly captivated by the rich colours and forms, and this curiosity for plants never left me.

I began working at the Department of Plant Sciences almost a decade ago, supporting research, teaching, communication and outreach activities. I still have vivid memories of my first tour of the Herbaria with Herbarium Manager, Serena Marner.

I remember being introduced to the botanical illustrations of artist Rosemary Wise. They were like nothing I had seen before, and I was amazed to learn that she had illustrated over 14,000 species in her career spanning 55 years! Rosemary and I have become fond friends since then, discussing her expeditions, art, photography, and our love of plants.

In January 2018 I enrolled as a part-time student at Falmouth University to undertake a two-year Masters degree in photography. I had already been working with plant scientists, photographing plants, events and outreach to communicate visually the exciting research taking place.

Last summer I had just six months to design, produce and deliver my final university project, and was granted access to explore the collections within the Oxford University Herbaria. The aim of the project was to research and explore botanical illustrations, specimens and objects, highlighting some of the key methods used to depict and record plants since the seventeenth century, focussing specifically on the important contributions made to date by women in the field of botany.

Rosemary Wise introduced me to the work of Victorian biologist and botanical artist Marianne North, taking me to the Royal Botanic Gardens at Kew for a working visit to the herbarium, as well as a tour of the Marianne North Gallery. I continued discussing my ideas with Druce Curator Stephen Harris and Serena Marner who showed me a vast number of specimens, books and illustrations created by women.

I developed a timeline and a number of case studies dating back to the seventeenth century. I was researching the work undertaken by women botanists, artists, illustrators, designers and printmakers. I learned how to press the plants correctly, spending time identifying, collecting, pressing and rearranging plants for my herbarium. I specifically sought out plants growing in the interstices of pavements and walls. Those plants that are all too often overlooked and considered ‘weeds’, this became an important metaphor within the project.

I began locating plants, (digitally) photographing them, taking location and habitat notes, along with GPS coordinates before pressing them. This evolved into working purely with camera-less techniques, laying the plant specimens on light-sensitive black and white photo paper to create photograms/lumen prints, as well as using paper treated with light sensitive cyanotype chemistry.

The decision to stop using a camera stemmed from thinking about these women and the absence of a camera within their work. Materiality, time and the unique nature of each illustration and specimen grew in importance for me.

I began by creating 1-2-hour exposures, and later experimented over longer periods to see how this might affect the results. As the seasons turned, I realised I could extend the exposure times by creating the prints using the LED grow-lights in the rooftop greenhouses in the department. I also began to use research plants as well as those I had collected and pressed.

Whilst working in the Herbaria this idea of uncovering layer upon layer of history and discovering stories was something I wanted to visualise. Oxford University Herbaria are filled with hundreds of thousands of specimens which are designed to be handled and used for research, but this handling causes unavoidable degradation over time.

The dried plant specimens and botanical illustrations are an endless source of fascination for me, helping me understand the meticulous methods and materials used in creating, preserving and cataloguing. There is a plethora of specialist stationery used for each element of the plant specimen pressing and mounting processes. This includes origami-style folded plant specimen fragment and dissection packets/capsules that are used to hold seeds and small flowers.

I became increasingly interested in materiality, spending the day at the London Centre for Book Arts learning to construct and sew a book to present the project. I decided to harness the herbarium materials as a method of sharing my experience with the viewer. I wanted to emulate the experience of working in an herbarium, handling plant specimens, books and objects.

The book contains my own photographs, photographs I found in my studies and archival materials for each case study, as well as herbarium specimen mounting materials. These were mounted alongside individual written case studies, which were printed on the specific watercolour paper Rosemary Wise uses for her work.

The book was designed and created as a response to the research I had undertaken and my experience of working in the Herbaria. I mounted the prints and case studies into the book in chronological order, along with some other ephemera and materials from the Herbaria. I purposefully chose not to fix my



Cyanotype print of *Arabidopsis thaliana* (L.) Heynh.
© Gem Toes-Crichton



Lumen print of *Nicotiana benthamiana* Domin
© Gem Toes-Crichton

images using chemicals, instead scanning them and storing them in the dark to preserve them as a way to echo the unique and fragile nature of the preserved plant specimens.

The Fielding-Druce Herbaria provided the perfect setting to display my book and prints. It was important to me that my book was viewed in context, and I wanted to share my experience of exploring these precious collections within my research.

I gave a talk about my project to a broad audience of plant scientists, photographers and members of the public. Small groups then visited the Herbaria where I exhibited my book and some of the key objects I had used within my research were on display. This included specimens Rosemary had collected, along with her illustrations of the critically endangered *Medusagyne oppositifolia* Baker (the jellyfish tree) alongside her book.

It was a real privilege to work in the Herbaria and I feel as though I have only just begun to unravel these stories. I very much look forward to being able to continue my research in the Herbaria in future.

The book and my talk can be viewed on my website: www.capturedbygem.co.uk

Gem Toes-Crichton
Academic Administrator (Graduates)





Images right: pages from the book 'INTERSTICES - Hidden Histories of Women in Botany' showing two case-studies, that of Elizabeth Blackwell and Rosemary Wise.
All images © Gem Toes-Crichton

News from the Herbaria

Fielding-Druce (OXF) and Daubeny (FHO)

This report covers the 2019 calendar year. Once again, the numbers of people visiting the Herbaria increased, this time by 19% compared to 2018. Increases were associated with group tours of the collections, particularly those tailored to specific themes. Individual research visits remained almost the same as 2018. From the curatorial perspective there was much activity within the Herbaria on digitisation and databasing of specimens, see below, and in the processing of new accessions.

Visitors

We recorded 414 visits to the Herbaria during 2019. This comprised 357 people in 16 groups and 69 researcher visits.

Several new groups made visits. In January 2019, a group of researchers from across the University with interests in discussing the origin, use, and future of the copper plates made for Robert Morison's work, *Plantarum historiae universalis Oxoniensis* (1680, 1699) visited. The copper plates of plant illustrations survive, together with records of the books' publication by Oxford University Press and plant specimens associated with the publication. During their visit, the 12 participants had the opportunity to see the original copper plates, Morison's published work, early-modern books from which images were copied, proof plates and herbarium specimens associated with the work. This was the first time such materials had ever been displayed together.

First-year biology undergraduates were introduced to the Herbaria and Sherardian Library of Plant Taxonomy in February. In March, four students studying to be medical herbalists and their tutor visited the Herbaria. This was followed by a visit from Graduate Library and Archive Trainees interested in the links among library manuscripts, rare books and preserved plant specimens, over the past four centuries. More recent material shown included a first edition of Charles Darwin's *On the origin of species* (1859), together with a letter from Darwin to a former Curator of the Herbaria, George Claridge Druce. Modern published monographs and papers, alongside related herbarium specimens, illustrated current research within the Department and showed the collections' importance for identifying plants, and investigating their distribution, classification and evolution.

A more unusual group was approximately 60 delegates from a one-day conference entitled 'Histories, theories, and uses of waste paper in Early Modern England'. They were shown a range of specimens from the pre-Linnaean herbaria of William Sherard, Robert Morison, Jacob Bobart the Younger, Charles Du Bois and Johann Dillenius - to illustrate: (i) reuse of drying papers as manuscript bindings; (ii) mounting of early modern specimens on contemporary printing proofs; (iii) use of eighteenth-century wallpaper to support herbarium sheets; (iv) use of printed documents and letter scraps as fragment and seed packets; and (v) the use of letter fragments as mounting straps.

In June researchers and administrative staff from the Department of Statistics visited the Herbaria. The focus of their tour was historical specimens in the context of modern plant sciences research, collection biases and the recovery of time series data from such collections.

Dr Sarah Simblet from the Ruskin School of Fine Art visited again with her students attending a summer school course on botanical drawing; the focus was Ferdinand Bauer's paintings and John Sibthorp's materials used to produce the magnificent *Flora Graeca* (1806-1840).

In September, Biology (class of 1989) and Oxford University alumni toured the collections where the focus was the role of collections in modern plant sciences and the linkages between specimens, books and manuscripts. Also in September, members of the Oxford Preservation Trust were shown botanical materials focused on Oxford and Oxford heritage, including items associated with the early history of the Botanic Garden, ground plans and designs for the glasshouses from the 1850's, and the opening and construction of the Plant Sciences Department in the early 1950s.

In November, students studying an M.Sc. in Environmental Impact Assessment and Management at Oxford Brookes University and Friends of Oxfordshire Museum visited the Herbaria. Undergraduate students from the Department of English were shown materials relevant to 'Eighteenth century literature and culture'. In December, delegates from a meeting of the Dendrological Society were introduced to the collections via the theme of 'herbaria and trees'.

Academic visitors included: Ozan Senturk, a doctoral student from the Royal Botanic Gardens Edinburgh, studied Mediterranean Fabaceae, especially specimens from Turkey; Dimitry German, from Heidelberg University and Altai State University, studied Brassicaceae, finding a rich collection of material from Altai; and Tiago Barbosa from São Paulo State University studied Brazilian Lauraceae. We were delighted to welcome Jim Bevan as a regular weekly visitor. Jim has a special interest in *Hieracium* (Asteraceae), and has set about redetermining the British holdings of the genus in the Druce Herbarium.

Loan material

Two loans were sent for special exhibitions during the year. Six historic specimens, three from the Morisonian Herbarium and three from the Herbarium of Charles Du Bois, relating to 'Horto Comptoniano', were lent to Fulham Palace, London. They formed part of an exhibition entitled 'Discovering the Bishop of London's Palace at Fulham' running from May 2019 through 2020. Another specimen from the Sherardian Herbarium of the orchid *Goodyera repens* (L.) R.Br. was lent to Magdalen College Library for an exhibition on a theme relating to John Goodyer (1592-1664); John Goodyer bequeathed his botanical library to Magdalen College. This exhibition ran from June to August 2019.

115 other specimens were sent out on loan to researchers within the UK for taxonomic studies. Further requests were received for images of specific specimens from Argentina, Australia, Brazil, Czech Republic, India, Italy, South Africa, Spain as well as the UK. 234 specimens were received as incoming loans for research by Alex Sumadijaya and John Wood. Over 300 specimens, returned to OXF and FHO, were checked in through the Herbaria database, which was transferred across to the new version of BRAHMS – BRAHMS8, before being returned to the collections.

New accessions

A total of 3,570 specimens were recorded as new accessions for the year. The largest set of material, 2,485 databased specimen records, was the personal herbarium of Jim Bevan. This excellently curated and labelled, primarily British collection, which includes many *Hieracium* specimens, has been determined by specialists, so adds greatly to the records in the Druce Herbarium. 124 miscellaneous specimens of Convolvulaceae, collected by John Wood and his associates mainly from Bolivia, were added to OXF. 836 new specimens were accessed to FHO consisting mostly of miscellaneous African duplicates.

Serena K. Marner
Assistant Curator

Oxford University Herbaria Digitisation Project

Workflow and progress report

The Herbaria Digitisation project is halfway through its initially funded period of two years. Within this time project technicians Alistair Orr, Kate Loven, and formerly Martina Boatfield, have managed to digitise about half of the material in the selected regions of North and South America and Africa from the Fielding-Druce Herbarium. This is around 28,000 (22,000 of which are transcribed onto the BRAHMS collections management system) of the estimated 145,000 total specimens. This adds to the 77,000 imaged and transcribed by Stephen Harris and Serena Marner from other areas of

the collection making a combined total of approximately 105,000.

The transcription of specimen images is a naturally slower process than the image capture since we must decipher some very old hastily handwritten notes, often very faded and in Latin. To expedite the process, we make use of some convenient features developed by the BRAHMS team for this process which allow for quick reference to commonly used entries in each data field. We have also collectively decided to focus on limited fields so that records can be grouped by collector and then the batch completed later. The rate of production is variable depending on the complexity and legibility of the material, but we aim for around 300 records per day.

The imaging process has developed through trialling different methods and has evolved to be very efficient and accurate. Specimens are fetched from the Herbarium and brought to the digitisation area using a temporary physical tagging system to ensure they are returned to the correct locations. The specimens are then given a unique adhesive barcode which becomes the image filename and identifier to link them with transcription data on the BRAHMS collections management system. For the image capture we use Capture One; a powerful, industry-standard software package and a carefully designed user preset which means there is no need to change camera settings between shots and the postproduction is uniform. To take the images, the specimens are placed in a frame designed in-house with an integrated scale bar, which eliminates the need for composing each shot and ensures the specimens are square in the image. The software is controlled by a custom-macro coded in-house using Autohotkey, which automates much of the process with a few keystrokes and takes a white balance reading from the white frame, so that each image is colour accurate. With these measures we can produce around 600 images per day.

Alistair Orr
Digitisation Technician

Unlocking the history of plants

Working in the Herbaria is an interesting transition from my former role working in a lab or the greenhouse. When I sit down in front of the computer, I see each day as a journey, a sense of connection with history of the men and women who dedicated their lives with passion to collecting plants. Each day I learn something, whether it be a place in the Americas or Africa, a plant from its native origin that might be familiar from our own gardens or a Latin name or phrase we use in our modern language. The Herbaria have all the information there, quietly waiting for the cupboards to be opened, so it is a great privilege that I am able to be part of sharing the Fielding collection online.

***Kate Loven**, Digitisation Technician*



A digitised specimen of *Lobelia polyphylla* Hook. & Arn. from OXF collected by Christopher Sandeman in Chile in 1939.
© Oxford University Herbaria

First rules for the Fielding Herbarium

The Fielding Herbarium is one of the core collections of Oxford University Herbaria. The collection was amassed by Henry Borron Fielding (1805-51), the wealthy son of the head of a successful Lancashire calico-printing company. In 1835, German physician Ernst Gottlieb Stuedel (1783-1856) sold Fielding a large collection of European herbarium specimens, which led to Fielding purchasing entire herbaria from collectors around Europe. He augmented these activities by subscribing to botanical fieldwork in Africa, Americas, Asia and Australia, where he provided financial support for collectors in return for specimens, and by purchasing their herbarium specimens at auction (Jackson and Kell, 2004; Clokie, 1964: 44-48). After 15 years, Fielding owned one of the best private herbaria in nineteenth-century Europe. In Britain, only the personal herbarium of his friend William Jackson Hooker (1785-1865), Director of the Royal Botanic Garden Kew, whose collection founded the herbarium at Kew, was more comprehensive (Jackson and Kell, 2004; Desmond, 1998).

In 1852, Charles Daubeny (1795-1867), fifth Sherardian Professor of Botany and first Sibthorpian Professor of Rural Economy, convinced the university to accept an offer from Fielding's wife, Mary Maria (1804-95), that her husband's herbarium (c. 80,000 specimens) be housed in the Botanic Garden, together with an endowment (£900) to pay a subcurator (Harris, 2017a). On the strength of this donation, the university awarded her brother, Samuel Simpson (1802-81), an honorary MA (Jackson and Kell, 2004)!

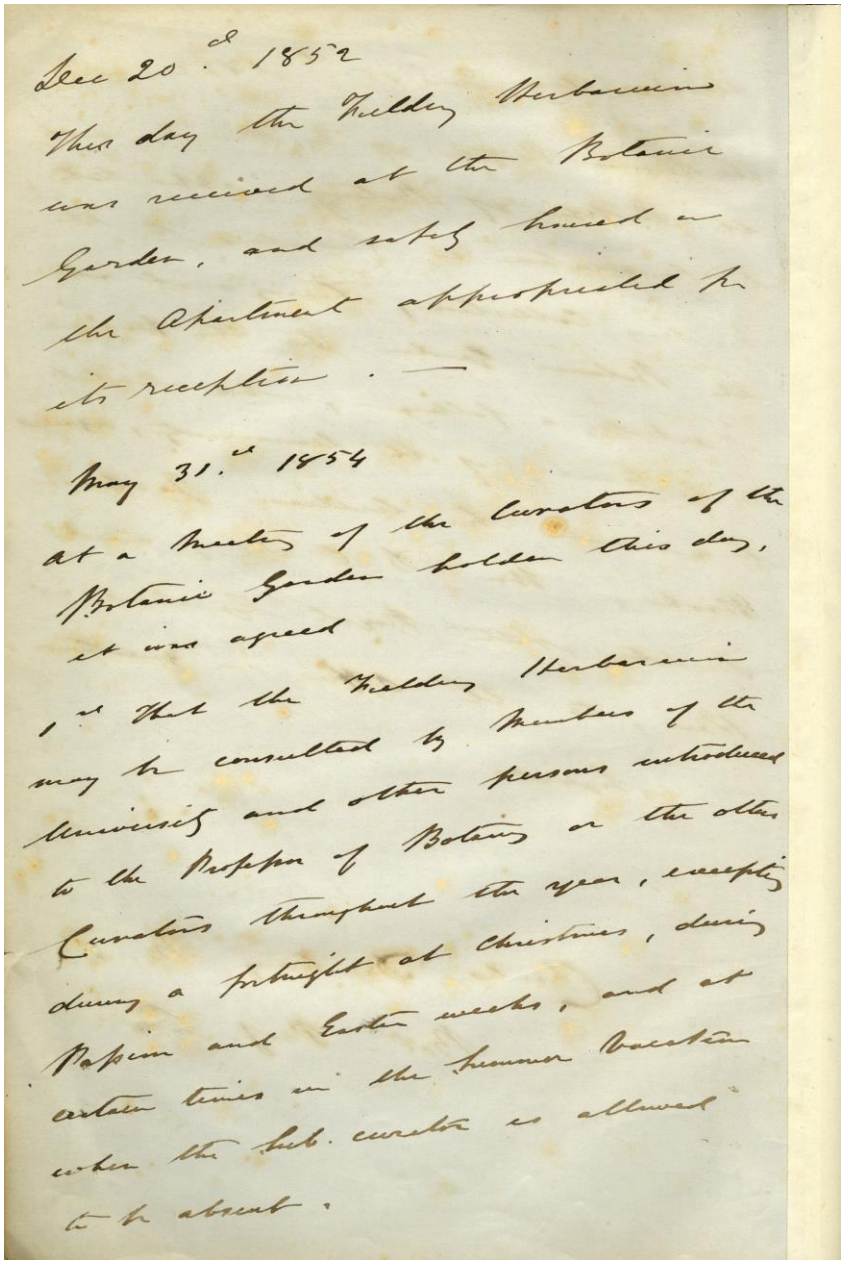
On 20th December 1852, the University officially took full responsibility for the Fielding Herbarium, where it was 'safely housed in the Apartment appropriated for its reception' at the Botanic Garden. With characteristic bravura that the task of cataloguing the diversity of the world's plants was near its end, Daubeny praised the completeness of Fielding's collection: 'So large a portion indeed of its [the world's] surface has been ransacked to supply the contents of these cabinets, that it would seem to be a much shorter task for me to enumerate the deficiencies, than to recount the contents of the Collection' (Daubeny, 1853: 5).

In the archives of Oxford University Herbaria there is Daubeny's uncatalogued, handwritten record (transcribed below) of a meeting of the Curators of the Botanic Garden, which took place on Wednesday 31st May 1854. This is the earliest record of the rules put in place for the care of the Fielding Herbarium.

> *At a Meeting of the Curators of the Botanic Garden holden this day, it was agreed*
>
> *1st That the Fielding Herbarium may be consulted by Members of the University and other persons introduced to the Professor of Botany or the other Curators throughout the year, excepting during a fortnight at Christmas, during Passion and Easter weeks, and at certain times in the*

Summer Vacation when the Sub-Curator is allowed to be absent.
2. That the Sub-curator should be in attendance in general from 12 o'clock at noon till 5 during every week-day to give out and return to their places after examination the packets of specimens which parties consulting the Herbarium may desire to inspect.
3. That no portion of the Herbarium can be allowed to be removed from the premises for inspection.
4. That the duty of the Subcurator shall be to attend, as above stated during the hours already named, both in order to enable Students to consult the Herbarium, and also to arrange, preserve, and determine the plants which it at present contains, or which may be added to it from time to time.
5. That although the Fielding Herbarium will constitute the primary object of the Sub-curators attention, yet all[?] *the other Botanical Collections belonging to the Establishment shall also be placed under his charge.*
6. That the Sub-curator shall also make himself acquainted with the contents of the public Library belonging to the Establishment of the Botanic Garden, as far as to be able to refer, when appealed to, to any of the Works which persons admitted to the Herbarium may desire to consult, and to prepare a proper Catalogue for this purpose.
7. That the Sub-curator shall also be ready to comply with any other requirements of the Professor connected with the Science of Botany, and in particular that of providing the Specimens so necessa[ry] *for the illustration of his Lectures.*
8. That the Sub-Curator be allowed to be absent for a period not exceeding two months during the summer vacation, at times to be arranged between the Professor and himself, and that his attendance at the Botanic Garden will not be expected during Passion and Easter Weeks, or for a fortnight after Christmas day.
9. That Mr Maxwell Masters be confirmed in his appointment as Sub-Curator, and that his Salary for the year commencing on April 11th be paid at £20 from the Fielding Fund, augmented by a Gratuity of £30 from the Professor of Botany in consideration of his acting as his Demonstrator or Botanical Assistant.
10. That the Sub-curator be allowed for his Residence the two largest of the Rooms lately built over the Lecture room contiguous to the Botanic Garden, and in immediate proximity with the Herbarium.

[Signed by W.J. Hooker, J.A. Ogle and C. Daubeny]


Dec 20th 1852
This day the Fielding Herbarium was received at the Botanic Garden, and duly housed in the Apartment appropriated to its reception. —
May 31st 1854
At a Meeting of the Curators of the Botanic Garden holden this day, it was agreed
1st That the Fielding Herbarium may be consulted by Members of the University and other persons introduced to the Professor of Botany or the other Curators throughout the year, except during a fortnight at Christmas, during Passion and Easter weeks, and at certain times in the Summer Vacation when the Sub. curator is allowed to be absent.

Charles Daubeny's records of a meeting of the Curators of the Botanic Garden laying out the duties of the Fielding Curator. © Oxford University Herbaria

It is ironic that Hooker was one of the Curators. Despite his success as Professor of Botany in Glasgow, before his appointment to the Kew post in 1841, he was debarred from professorships in Oxford; he lacked an Oxbridge education (Desmond, 1998). On 14th June 1866, Joseph Dalton Hooker, who had succeeded his father as Director of Kew, was appointed William Hooker's replacement as a Curator of the Botanic Garden. James Adey Ogle (1792-1857) had been Regius Professor of Medicine in the University since 1851.

Maxwell Tylden Masters (1833-1907) resigned after about three years to teach botany at St. George's Hospital medical school before eventually taking on editorship of the *Gardeners' Chronicle* (Boulger and Stearn, 2004). In 1886, Selmar Schönland (1860-1940) arrived for a three-year stint as Fielding Curator, before emigrating to South Africa where he founded the botany department at Rhodes University and became a leading light in the Botanical Survey of South Africa (Lubke and Brink, 2004). The post remained vacant until the Oxford-based pharmacist and botanist George Claridge Druce (1850-1932) became honorary Curator in 1895; he remained in post until his death (Harris, 2007).

Today, the Fielding Herbarium is no longer at the Botanic Garden. It was given a new home in the Department of Plant Sciences in the early 1950s, together with the University's pre-nineteenth-century collections, the vast personal herbarium of Druce and the herbarium of the former Department of Forestry (Harris, 2017b). Together these collections are known as Oxford University Herbaria – a collection of approximately one million specimens.

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Stephen A. Harris
Curator of Oxford University Herbaria

Dillenius in Oxford

When you visit Oxford University Herbaria you see on the wall of the reading-room a fine portrait of Johann Jacob Dillenius (1684-1747) in which he holds a drawing of the Mexican plant *Sprekelia formosissima* (L.) Herb. described by him in 1732 (Figure 1).

After qualifying as a doctor at Giessen University, and publishing several botanical works, Dillenius went to London in 1721 at the invitation of William Sherard to arrange his herbarium. In 1724 he was elected Fellow of the Royal Society, and in 1734 became the first Sherardian Professor of Botany at Oxford, where he remained until his death.

Among the treasures of Oxford Herbaria are 26 specimens sent to Dillenius by Carl Linnaeus, who visited Oxford in 1736. Their first meeting took place in Oxford's Botanic



Figure 1: Portrait of Johann Jacob Dillenius
© Department of Plant Sciences

Figure 2

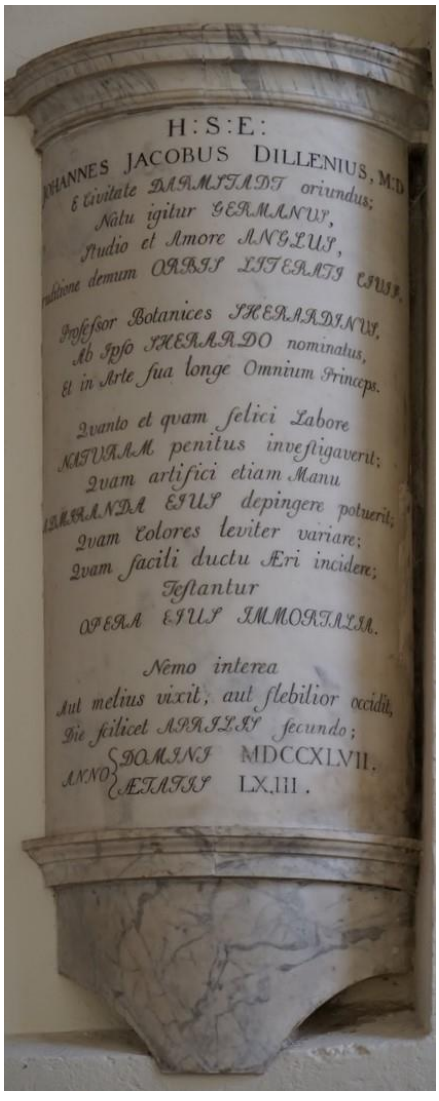


Figure 3

H:S:E
JOHANNES JACOBUS
DILLENIUS M:D
E civitate DARMSTADT
oriundus:
Natu igitur GERMANUS,
Studio et Amore ANGLUS,
Eruditione demum ORBIS
LITERATI CIVIS
Professor Botanices
Sherardinus,
Ab ipso Sherardo nominatus,
Et in Arte sua longe Omnium
Princeps.
Quanto et quam felici Labore
NATURAM penitus
investigaverit:
Quam artifice etiam Manu
ADMIRANDA EIUS depingere
potuerit:
Quam Colores leviter variare:
Quam facili ductu Æri incidere:
Testantur
OPERA EIUS IMMORTALIA.
Nemo interea
Aut melius vixit, aut flebilior
occidit
Die scilicet APRILIS secundo:
Anno Domini MDCCXLVII.
Aetatis LXIII.

Figure 2 reproduced by kind permission of the Principals and Fellows of St Edmund Hall

Garden where Dillenius, sceptical of Linnaeus' system of classification, remarked 'This is the young man who would confound the whole of botany'. But Dillenius was soon impressed by the visitor's botanical expertise, and Linnaeus later wrote 'There is nobody in England who understands or thinks about genera but Dillenius'. Their meeting led to a life-long friendship and exchanges of letters, publications, and herbarium specimens.

The life of Dillenius is commemorated in Oxford's Church of St Peter-in-the-East, now the Library of St Edmund Hall, by a splendid marble tablet (Figure 2) with a Latin eulogy (transcribed at Figure 3). In translation it says: "Here lies Johann Jacob Dillenius, Doctor of Medicine, who came from the city of Darmstadt. Thus by birth he was German, by study and affection English, and by scholarship a citizen of the world of letters. Chosen by Sherard himself as Sherardian Professor of Botany, he was an outstanding leader in his field. His immortal works bear witness to the success of his work in investigating nature in depth, his skill in depicting its wonders with subtle differences of colour, and his expertise in copper-engraving. At the same time, no-one led a better life, or was more mourned when he died, which was on the 2nd day of April 1747 A.D. at the age of 63"



Figure 4 © Bodleian Libraries, University of Oxford

Dillenius is also commemorated in the Radcliffe Science Library in Oxford on a set of wooden doors, designed in 1935 by Eric Gill, which include a panel (Figure 4) depicting 'J.J.D.' (Johann Jacob Dillenius).

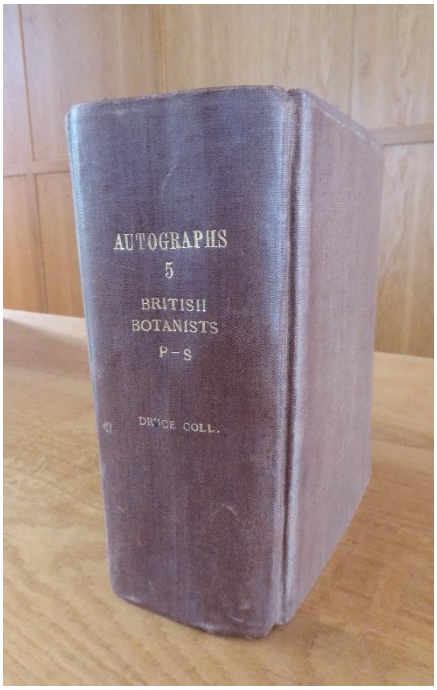
Graham Avery
Fellow of the Linnean Society

Druce Collection: autographs of British Botanists

There seems to be no end to the archival material left by George Claridge Druce (1850-1932) to the University of Oxford. Druce was one of the main benefactors to Oxford University Herbaria. In the past we have highlighted the Druce archive and Druce's Birthday Book (*OPS* 18: 15; *OPS* 16:10-12). There is another separate, and virtually unknown, collection of volumes entitled *Autographs of British Botanists A- Y*, which is described here.

The 'autographs' are not just signatures but exist in the form of letters, postcards, photographs and notes interleaved and arranged in six thickly bound volumes. They are preserved within the Fielding-Druce Herbarium. The items were organised and bound by George Claridge Druce, and consist of correspondence he received from individuals, plus other notes he assembled about them. An index of these items has recently been complied. Druce was an active field botanist from the 1870's until his death. He has been described as 'the most prominent British amateur botanist of the first three decades of the 20th century' (*OPS* 14: 12-13). He was an avid letter writer with a desire to be in contact with eminent members of the botanical community of his time, as well as other prominent people from the pharmaceutical, medical, scientific and wider natural history communities. He invited and encouraged many people to join the Botanical Exchange Club (forerunner to the present-day Botanical Society of Britain and Ireland), also the Ashmolean Natural History Society of Oxfordshire and the Northamptonshire Natural History Society, all these organizations he ran sometimes practically single-handed for many years. People's replies added to his collection; the more influential and eminent the person, the more Druce liked it! Druce's purpose it seems for compiling such an archive was to reflect not only his diverse and significant contacts, his networks of professional colleagues and friends, but to give a snapshot of individuals of note in the wider botanical world of late-nineteenth century and early-twentieth century Britain.

Within the six volumes there are 458 named individuals. The 'autograph' items are sorted mainly in alphabetical order by author surname. For just over one third of the collection, there is one letter per person, about one fifth of the collection is represented by two letters per person, with variable numbers of letters from the rest. The largest number of letters per person are from the following: 20 letters each from John Knox (1831-1914), Charles Carmichael Lacaita (1853-1933) and Professor Sydney Howard Vines (1849-1934); 11 letters each from Sir Joseph Dalton Hooker (1817-1911),



One of the volumes from the Druce 'Autograph' collection
© Oxford University Herbaria

Ernest David Marquand (1848-1918) and Edward Shearburn Marshall (1858-1919); plus 10 letters each from Sir Isaac Bayley Balfour (1853-1922), Sir David Prain (1857-1944) and Nathaniel Charles Rothschild (1877-1923). The entire collection includes 16 individuals with knighthoods and 25 professors. Somewhat surprisingly Druce includes himself as an entry.

Amongst the 'autograph' items are those from 35 women, considered by Druce as 'British Botanists' of the day. One might have expected they would have mostly been contributors to Druce's Herbarium, but only about a third come into that category. Druce very likely met a couple of these women at a meeting of the British Association for the Advancement of Science held in Oxford in 1926, in particular Gertrude Bacon (1874-1949) and Mabel Mary Cheveley Raynor (c. 1888-1948). Bacon not only had interests in botany, joining the Wild Flower Society in 1901, but she was an original member of the Astronomical Association. A keen interest in aeronautics led her to be the first woman to fly in an airship in 1898 and the first Englishwoman to fly in a biplane in 1909.

Druce had a strong desire to make discoveries of new plants within the British flora and record them. Some of his female correspondents did just that. Gertrude Bacon was with Druce's friend Lady Joanna Charlotte Davy (1865-1955), a botanical illustrator, when they were the first to find the sedge, *Carex microglochin* Wahlenb. in Britain. Druce would have been extremely interested in this, if not a bit jealous! Another of his correspondents, Eliza Standerwick Gregory (1840-1932), from whom seven letters are included, was the first to discover

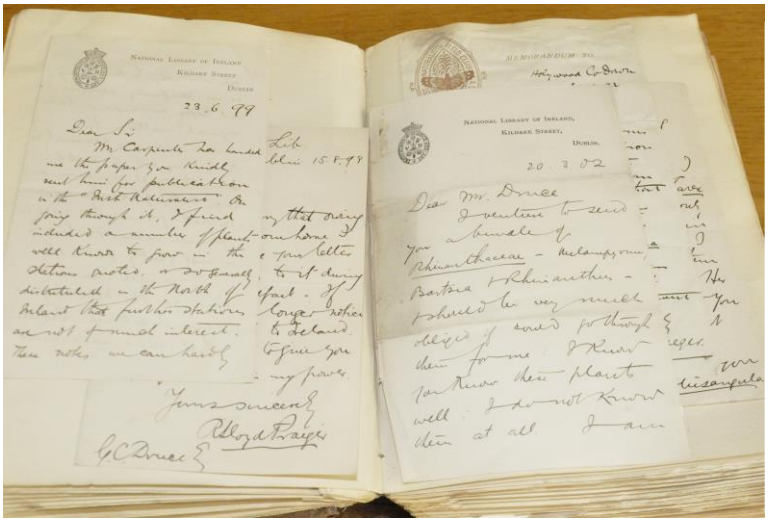
Fumaria occidentalis Pugsley in Cornwall. Eleanor Vachell (1879-1948), a Welsh botanist, had a similar ambition to Druce which was to see every British plant species in the wild. With the help of Druce, she was one of very few people to find the extremely rare Ghost Orchid, *Epipogium aphyllum* Sw. Vachell almost achieved her goal, reportedly finding just 13 short of 1,800 different British species during her life time.

Druce archived two letters and two postcards from Gulielma Lister (1860-1949) who was a world authority on slime moulds and had published a significant work on the taxonomy and nomenclature of Myxomycetes. Miss Lister was one of the first women to be elected as a Fellow of the Linnean Society of London in 1904. Another correspondent of Druce was Ida Margaret Hayward (1872-1949) who also became a Fellow of the Linnean Society in 1910. She studied alien plants, many whose seeds had been inadvertently transported in fleeces to the woolen mills in Galashiels on the Scottish borders from Australia, New Zealand and South America. In 1919 she published *The Adventive Flora of Tweedside* jointly with Druce. One of the first of three trustees of the Royal Horticultural Society gardens at Wisley, Ellen Ann Willmott (1858-1934) is also represented. Enjoying cultivating thousands of species and cultivars in her gardens, in which she employed up to 100 gardeners, she also helped finance plant-hunting expeditions. Eccentricity took hold as she aged and when visiting the gardens of others in the horticultural world, she surreptitiously planted seeds of the giant thistle *Eryngium giganteum* M.Bieb.; the plant has become known as Miss Willmott's ghost.

A great number of gentlemen represented in the archive were Fellows of the Royal Society. One such was the pioneering geneticist William Bateson (1861-1926), who introduced the word 'genetics' into biology. He was the founder of the Genetics Society which celebrated its centenary in 2019. From the medical profession is Sir (Edward) Farquhar Buzzard (1871-1945) who became the Regius Professor of Medicine at the University of Oxford in 1928. He went on to found a medical school at Oxford dedicated to clinical and laboratory research with the sponsorship of Lord Nuffield; now known as the Nuffield Department of Medicine. Similar to Druce, Edward Morell Holmes (1843-1930) started his working life as an apprentice to a pharmacist. He went on to lecture on materia medica and between 1872 and 1922 was curator of the Pharmaceutical Society's Materia Medica Museum in London. There are seven letters from Holmes to Druce as well as specimens of bryophytes and algae collected by him in the Druce Herbarium.

There are 12 letters from the Irish (although Scottish born) medic turned plant collector, Augustine Henry (1857-1930). He spent 20 years travelling in remote provinces in China with the aim of finding Chinese plants with medicinal uses, but turned his attention to collecting plants which might possibly survive cultivation in the British Isles. He collected a vast number of herbarium specimens sending them back to Kew, including 5,000 species new to science at the time. Later his interests turned again and he began a career in Forestry which led him to work in the newly established Forestry School at Oxford University in 1905. Another plant hunter of note was Reginald Farrer (1880-1920), who went on botanical expeditions to the Alps and the Italian Dolomites, and later to China, the Tibetan border, and Upper Burma. Six letters exist from Farrer, who was a student at Balliol College, graduating in 1902, and assisted with the rock garden which the Rev. H.J. Bidder had created in the grounds of St. John's College, Oxford. Farrer wrote many books on rock gardening and was responsible for many hardy plant introductions to British gardens. Perhaps an unexpected individual to be included in this archive is a wealthy lawyer, very avid gardener and collector of microscopes, Sir Frank Crisp (1843-1919). His claim to fame was that he built a very large neo-Gothic mansion near Henley with an extensive alpine garden modelled on the Alps. Built under the rock garden were caves, grottoes and connecting passages which he filled with gnomes. He had a keen sense of humour!

Druce also had contact with many British botanists working abroad. There are three letters and a telegram from Joseph Henry Maiden (1859-1925). From 1896 Maiden was government botanist and Director of the Botanic Gardens in New South Wales. He studied and published extensively on Australian plants, revising the genus *Eucalyptus* in particular and writing on the useful native plants. He is remembered for establishing the National Herbarium of New South Wales, Sydney, including a museum and library which opened in 1901. Another of Druce's contacts, based mostly in Singapore and in Malaysia, was Henry Nicholas Ridley (1855-1956) from whom there are four letters in the archive. He was responsible for a major industry in the Malay Peninsula; the cultivation and tapping of rubber, after discovering a method of tapping which did not cause lasting damage to the trees. He acquired the nickname 'Mad Ridley' for his obsession for this work. He also published a multi-volume work on the *Flora of the Malay Peninsula* and described about 4,000 new species.



Druce Collection: Autographs of British Botanists Volume 5: P-S

Pages showing letters from R.L. Praeger

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The founder of the South London Botanical Institute (1910), Allan Octavian Hume (1829-1912), wrote to Druce. He had worked in the Indian Civil Service and besides being a politician was interested in ornithology. He amassed a very large collection of Indian bird skins and eggs, now held in the Natural History Museum in London, but when he lost his manuscripts he turned his activities to the study of botany instead. There are also eight letters from, William Herbert St Quintin (1851-1933), a naturalist with a special interest in ornithology who was a founding member of the Avicultural Society. The Professor of Agricultural Botany at Reading University, John Percival (1863-1949), known for working on the taxonomy of wheat corresponded with Druce. Percival was asked to identify carbonized cereal grains from archaeological sites in Egypt and the Near East which led to the development of archaeobotanical studies at Reading.

There are letters from Directors of the Royal Botanic Gardens Kew including Sir Joseph Dalton Hooker and Sir David Prain; from Keepers of the Kew Herbarium and letters from Sir Isaac Bayley Balfour, the Keeper of the Royal Botanic Gardens Edinburgh, who had previously been the Sherardian Professor of Botany at Oxford, mentioned earlier. Many more interesting individuals are represented who all contributed much to our knowledge of botany.

The index of the 'Druce Collection: Autographs of British Botanists' recently compiled has been added to the Oxford University Herbaria website at https://herbaria.plants.ox.ac.uk/bol/Content/Projects/oxford/resources/Autograph_list_British_botanists.pdf

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A revelation in full colour

Stenostephanus Nees is a genus of Acanthaceae characteristic of neotropical cloud forest extending from southern Mexico along the Andes south to Bolivia with an isolated species in the Mata Atlantica forests of southern Brazil. Most species are rare and very restricted in their distribution with many local endemics, seven out of twelve species occurring in Peru and ten out of twelve in Bolivia being single country endemics. It is often difficult to refind plants, perhaps because some species are plietesial, and flower at irregular intervals.

Although John Wood knew the genus well in Bolivia and Colombia, he had worked entirely with dried herbarium specimens in the preparation of the account for Peru (Wood 2019). One of the new species described was characterised by conspicuous sub-rhomboid to obovate bracts and a dense inflorescence, the whole blackish in colour having been preserved using alcohol. This plant was given the name *Stenostephanus densiflorus* J.R.I Wood and was represented by 13 collections from moist hill forest on the eastern Andean slopes of central Peru in the area where Huánuco and Pasco meet with an outlying population in San Martín.

The new species was only published in mid-December so it was a very welcome but expected seasonal present on Boxing Day when an e-mail arrived from Rosa Villanueva-Espinoza with attached photographs of the new *Stenostephanus*. This showed a striking inflorescence with attractive deep-pinkish flowers. The correspondence that followed revealed that there were four additional collections from the same general area of Peru and an additional one from Junín bringing the total number of collections of this species to 18, suggesting a healthy population. Although Andean forest is generally under threat in Peru, it is reassuring that many of the collections were made in protected areas. Photographs and an updated map add value and colour to the original description and line drawing.

References

Daniel, T. (2006). Synchronous flowering and monocarpy suggest plietesial life history for neotropical *Stenostephanus chiapensis* (Acanthaceae). *Proceedings of the California Academy of Sciences* 57: 1011–1018.

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Map showing the distribution of *Stenostephanus densiflorus* J.R.I. Wood in Peru.





Stenostephanus densiflorus J.R.I Wood in Peru
Photos © Rosa Villanueva-Espinoza