

Oxford Plant Systematics



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

OPS 12

March 2005

THE VIRTUAL FIELD HERBARIUM

The virtual field herbarium
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Refine your search	Selected terms
Name ACANTHACEAE (19) AGAVACEAE (1) ANACARDIACEAE (26) ANNONACEAE (24) APOCYNACEAE (13) AQUIFOLIACEAE (5) ARACEAE (5) ARALIACEAE (3) ASCLEPIADACEAE (2) More terms »	☒ Location: Caribbean
Species character Foliage (leafy branch) (2945) General (206) Habit (1508) Lamina (blade of leaf or leaflet) (3242) Spines thorns prickles on plant (108) Surface Texture (55) Woody stems (regardless of habit) (171)	Results 1478 images
Habitat Grenadian forest (798) Lowland, dry vegetation (446) Swampy places (13)	
Location Windward Is (1478)	
Image content Flowering & Fruiting (1012)	

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Editorial

Yesterday I organised a plant practical class for 100 first year biology undergraduate students. The task was to draw and compare the floral structure of a snowdrop and a hellebore. For the vast majority of students it was the first time in their lives that they had examined the anatomy of any flower and had explained to them what the parts were. This despite all of them having 'A' level biology. I argued that the flower, along with microbes and leaves, were one of the most important structures in all biology. Today, I gave my first ever lab talk in a molecular biology context as I've recently started a small project to understand the genes involved in making the daffodil flower. Several people commented that it was useful to see some plants during the short talk. Next week, I and colleagues will take a number of third year students to Portugal for two weeks to study the form and function of Mediterranean plants. In an educational environment increasingly dominated by molecular biology, student interest in whole-organism botany/biology remains healthy and will flourish given the opportunity and the odd enthusiastic lecturer. Once again this year OPS reflects a wide range of systematic botany including virtual field herbaria, monographic research and re-arrangement of the family beds at the botanic garden to better reflect phylogenetic relationships. I would draw your attention to three particular items in this year's newsletter. First, congratulations to Alex Wortley for winning the Irene Manton prize for her D.Phil thesis on *Thomandersia*. Second, the article by John Wood on our Darwin funded project aimed at capacity building of herbaria in Bolivia. John is to be congratulated for making this project totally in keeping with aims of the Darwin initiative which *seeks to help safeguard the world's biodiversity by drawing on British strengths in this area to assist those countries that are rich in biodiversity but poor in financial resources*. With the help of Darwin funding John has achieved this by living and working in Bolivia for much of the time and then for several months each year bringing a number of Bolivians to Oxford for specific training. In terms of capacity building and training of personnel, the legacy of this project to Bolivian botany will be substantial.

The front cover features an image from the exciting new initiative of a virtual field herbarium developed in Oxford by William Hawthorne. This is a valiant attempt to grapple with problems associated with identifying plants using current technology.

Robert Scotland

*Typesetting and layout of this issue by
Serena Marner*



Professor Peter Raven at the re-opening ceremony of the Fielding-Druce Herbarium on 2 July 2004

News items

Fielding-Druce Herbarium officially re-opened

After completion of a major refurbishment of its facilities, the Fielding-Druce Herbarium was officially re-opened on 2 July 2004 by Professor Peter Raven, Director of the Missouri Botanical Garden. Preceding the re-opening of the herbarium, Professor Raven delivered the 25th Blackman Lecture to a capacity audience in Plant Sciences which he entitled "Plants, sustainability, and our common future". Following the lecture, Professor Raven was presented with the **Sibthorp Medal** by Professor Chris Leaver, Head of the Department of Plant Sciences. The Sibthorp Medal is awarded by the Department for excellence in Plant Sciences.

Prizes

Congratulations to Dr Alex Wortley who has just been awarded the **Irene Manton Prize** by The Linnean Society of London, for her thesis entitled *Systematics of Thomandersia* (see page 4). The Irene Manton Prize is awarded for the best thesis in botany examined for a doctorate of philosophy during a single academic year (September to August). It is open to candidates whose research has been carried out whilst registered at any institution in the United Kingdom. This honour for Alex comes hot on the heels of her being awarded the **Brian Styles Memorial Prize** from the Department of Plant Sciences. The prize, in memory of the late Brian Styles, is presented for outstanding theses in the field of tropical or subtropical plant taxonomy.

Student progress

Ruth Eastwood (D.Phil., third year). The systematics of Andean lupins and the origin of *Lupinus mutabilis* Sweet. Supervised by Dr Colin Hughes (Oxford) and Dr Julie Hawkins (University of Reading). BBSRC studentship.

The Andean region of South America was one of a handful of independent sites of early crop and animal domestication and the origins of agriculture. The pulse *Lupinus mutabilis* is one of the "Lost Crops of the Incas", a set of indigenous food plants domesticated in the Andes. In common with other Andean domesticates little is known about the origin of *L. mutabilis* in terms of likely progenitors and where, when and how it was domesticated. Seeds of *L. mutabilis* have been found in Nazca tombs and the species is thought to be depicted on Tiwanaku pottery thus suggesting a pre-Incan domestication. The aim of my D.Phil. is to investigate the origins of domestication of *L. mutabilis* and the taxonomy of its putative close relatives.

In order to do this I am using a gene tree based approach to identify the close relatives of *L. mutabilis*. Throughout this year I have increased taxon sampling of non-Andean lupins by growing, extracting DNA and sequencing nrITS and nDNA GPAT from a range of Brazilian and North American species. This has shown for the first time the phylogenetic position of a number of Brazilian taxa. To date the ITS, GPAT and nDNA LEGCYC1A gene trees are highly congruent but all show low levels of resolution among Andean taxa. Lack of resolution in this part of the *Lupinus* phylogeny stems directly from low molecular variation. Current molecular

work is focusing on the development of a more rapidly evolving nuclear region in an attempt to gain resolution between Andean *Lupinus*.

Our lack of understanding of *L. mutabilis* is compounded by taxonomic problems caused by poor species delimitation and a surfeit of names. To address this I am undertaking specimen-based work to delimit *L. mutabilis* and its putative close relatives, in order to assemble a new taxonomic account of this group. Morphological studies based on herbarium specimens and field observations have led me to the hypothesis that *L. semperflorens* and *L. eanophyllus* are putative progenitors of *L. mutabilis*. These two species have similar distributions in the Province of Loja in Southern Ecuador and North-Central Peru. This suggests a possible origin of domestication for *L. mutabilis* in this part of the Andes where there is a rich history of sophisticated early civilizations.

During the year I visited herbaria at the British Museum, Cambridge and Kew, attended and presented seminars at The UK Legume Workshop in Reading and the Young Systematists Forum at the Natural History Museum and contributed to a joint paper entitled 'Andean *Lupinus* – Barneby's Augean Stable' at the BSA Botany 2004 meeting in Utah, USA. I also spent two months in the field in Ecuador and Peru (see fieldwork report on page 5).

Timothy Waters (D.Phil., fourth year). Systematics of *Agathis* Salisb. Supervised by Stephen Harris (Oxford) and Aljos Farjon (RBG Kew). NERC studentship.

Agathis is a genus of tropical conifers found in lowland and montane forest, and occasionally in scrublands, throughout much of Malesia and in the southwest Pacific islands. My doctoral work has been focused on issues of species delimitation in the group, especially those of the southwest Pacific, and on the wider issues surrounding both the conceptual justifications and the operational utility of different approaches to the recognition of species.

Molecular data from samples collected in 2003 has been disappointing as DNA extraction has continued to prove extremely challenging, but morphological data provide clear support for a taxonomic revision which has been prepared. This reduces the number of species recognized in New Caledonia in view of the variation within taxa previously regarded as separate, which appear to be ontogenetic phases of the same taxon. Furthermore, parallel investigations using datasets developed for the study of *Quercus* population genetics, in the context of accepted morphological taxonomies for that group, is providing insights into the both the relationship between morphological entities and molecular variation, and the strengths and weaknesses of different

proposed methods of species discovery designed for molecular data.

Conceptual approaches have focused on understanding species, and their traditional taxonomic treatment, as horizontal entities (sensu Stamos 2002), and on the possibilities of reconciling a synchronic approach to the species category with the view of species taxa as homeostatic property cluster kinds developed and popularized by Richard Boyd and others.

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Stamos, D. N. (2002). Species, languages, and the horizontal/vertical distinction. *Biology and Philosophy* **17**: 171-198.

Abstract of Systematic thesis submitted in 2004:

The following D.Phil. thesis was submitted and successfully defended in 2004:

Systematics of *Thomandersia* Baill.
Alexandra H. Wortley
Wadham College, April 2004

This thesis addresses three aspects of the systematics of *Thomandersia*. Firstly, a taxonomic account of *Thomandersia* is provided. Secondly, the anatomy of *Thomandersia* is described. Finally, the phylogenetic position of *Thomandersia* in Lamiales is investigated and the potential of morphological and molecular datasets to resolve relationships in Lamiales is assessed.

Six species of *Thomandersia* are recognised, based upon previous taxonomic treatments, an assessment of variability within the genus, and a rationale for describing infrageneric taxa. An improved key to species, species descriptions, distribution maps and illustrations are presented.

A preliminary analysis of molecular sequence data suggests that previous, morphology-based classifications of *Thomandersia* in Acanthaceae do not reflect phylogenetic relationships. The floral and wood anatomy of *Thomandersia* are re-examined in this light and discussed in the context of Lamiales. Unique characters of *Thomandersia* include a particularly large calycine nectary, expanded placentas, irregular corolla aestivation, and spherical, scaly seeds. *Thomandersia* is found to share anatomical features with all other Lamiales investigated. Detailed anatomical studies of retinacula, a character shared with Acanthaceae, and extrafloral nectarines, which may be homologous to nectarines in other Lamiales, are presented. The majority of anatomical characters are homoplastically-distributed in Lamiales and

therefore of little use for diagnosing monophyletic groups.

Morphological and molecular phylogenetic investigations support the resurrection of Thomandersiaceae, a family of isolated phylogenetic position with a large number of molecular and morphological autapomorphies. At the same time, the investigations highlight problems in resolving interfamilial relationships in Lamiales. The ultimate aim of phylogenetic analysis in Lamiales is an accurately-resolved tree with strongly supported relationships between all taxa. Morphological characters are of limited use in achieving this goal: when a large morphological matrix is combined with molecular data only small, poorly supported increases in resolution are achieved. The increasing availability of molecular sequence data is expected to make it possible, in the near future, to resolve an accurate, supported phylogeny of Lamiales and elucidate the sister group relationships of isolated taxa such as Thomandersiaceae.

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Expeditions and visits

Bolivia – in January, **Colin Hughes** joined staff of the Darwin Initiative funded project investigating plant endemism in the central valleys of Bolivia to run a training course on Legume Systematics and Identification in Cochabamba. This was followed by a short field visit to the Rio Grande valley system in the Depts of Cochabamba and Santa Cruz.

Bolivia – **Rosemary Wise** visited Bolivia twice in 2004 supported by the Darwin funded project. She ran two week-long courses on the techniques of botanical illustration in Cochabamba and Sucre and spent a further four weeks painting typical plants of the Andean Valleys which will be assembled into educational posters.

Brasil – two visits, in February and November were made by **Colin Hughes** to Brasil to collect material of *Lupinus* in collaboration with Dr Maria-Teresa Schifino-Wittmann and Dr Silvia Miotto from the Universidade Federal do Rio Grande do Sul, UFRGS, in Porto Alegre and Dr Chris Fagg from the Universidade da Brasilia. The main focus of fieldwork was to assemble material of the unifoliolate species of *Lupinus*. Material of six unifoliolate and 10 digitate leaved species was collected in Goias, Minas Gerais, Rio Grande do Sul and Santa Catarina. Work is underway to incorporate these species into on-going *Lupinus* sequencing efforts.

Peru – in June, **Colin Hughes** joined **Ruth Eastwood** and Ruth Clark (K) to work with Aniceto Daza from the Universidad Agraria, La Molina in Lima in central and northern Peru, to collect *Lupinus* and other legumes,

focusing on the Depts of La Libertad, Cajamarca, Piura, Huancayo and Lima.

USA – in August, **Colin Hughes** attended the Botanical Society of America, Botany 2004 meeting at Snowbird, Utah. An invited paper entitled *Andean Lupinus – Barneby's Augean Stable*, written jointly with **Ruth Eastwood**, was presented at a Symposium commemorating Rupert Barneby's Legume legacy. After the meeting Colin visited CAS and UC to study material of *Lupinus*.

USA – **Robert Scotland** gave invited talks at the Botanical Society of America 2004 meeting in Utah and at the Field Museum in Chicago in August.

Field trip report

A successful and enjoyable fieldtrip was carried out in the Andes of Peru and Ecuador during June and July 2004. In Peru I travelled with Colin Hughes, Ruth Clark from Kew and Aniceto Daza from MOL, Lima. The team in Ecuador consisted of Tim Budden, Luis Lopez and myself. The primary aim was to expand the geographic,

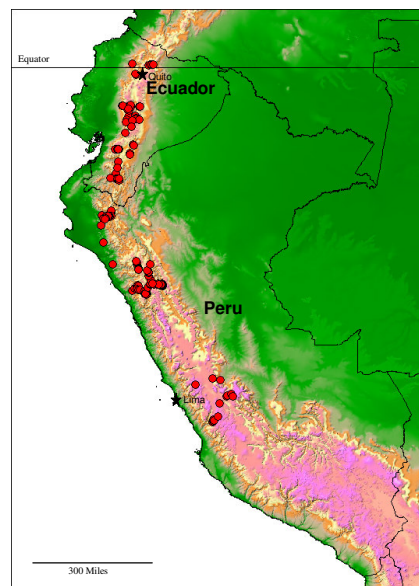


Fig. 1. Map of collections

morphological and taxonomic sampling of Andean lupins concentrating especially on *L. mutabilis* and its putative close relatives, but we also collected other interesting legumes. 195 collections were assembled from locations across the central Andes (Fig. 1). Along side herbarium specimens associated material included silica-dried leaf material for DNA extraction, seed where available, nodules, photographs and associated documentation. In addition, vital field observations of characters not available from herbarium specimens (flower colour, habit, habitat, etc.). Material has been

documented using the botanical database BRAHMS and is now being used in DNA sequencing and morphological work.



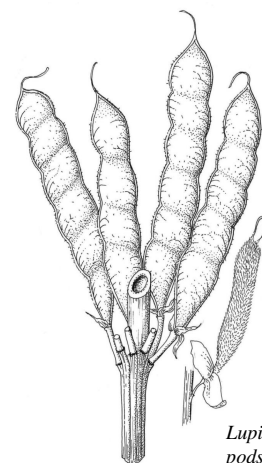
Fig. 2 Field of *Lupinus mutabilis* near Santiago de Chuco, Peru (RJE56).

This was my first trip to South America and the impressions and experiences I have come away with include:

- Images of the vast and seemingly endless Andes,
- The intensively cultivated and densely inhabited nature of the Andes,
- The grim desolate coastal desert,
- Eating *L. mutabilis* seeds and guinea pig,
- Seeing first hand the importance of *L. mutabilis* as a crop in Andean South America.

Fieldwork was carried out in collaboration with MOL herbarium in Lima, Peru and QCNE herbarium in Quito, Ecuador. Fieldwork grants were received from the BBSRC and the Genetics Society.

Ruth Eastwood



Lupinus mutabilis
pods

Four new legumes in forty- eight hours

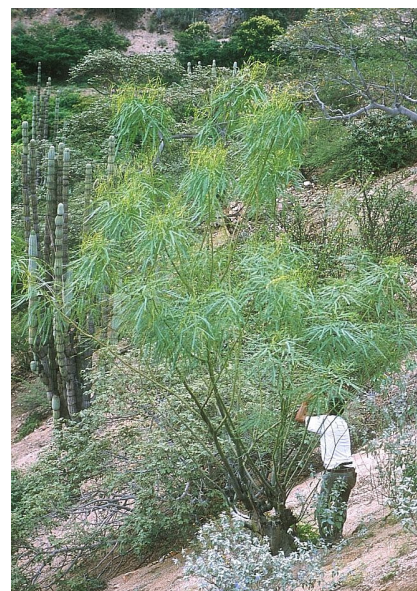
Discovering new plant species in the field is often as much down to serendipity as careful planning, and thus often an unexpected surprise when it happens. When we set out from the small town of Celendín in the northern Peruvian Department of Cajamarca in May 2001, our objective for the day was to travel east to the mountains around Leimebamba in the neighbouring Department of Amazonas. We hoped to collect a range of *Lupinus* species so were keen to spend as much time as possible higher up in lupin territory. However, in order to get there we first had to cross the gargantuan cleft carved by the Rio Marañón through the northern Peruvian Andes – I had heard that it was a long day to Leimebamba and that the road could be difficult, and I was expecting a day of driving with little collecting. As we crested the ridge to the east of Celendín, the sheer depth of the valley became apparent as we peered down to the distant Rio Marañón just visible some 3000m below us. The river crossing is at 1000m while the Andean ranges to east and west are over 4000m – the mountains across in Amazonas appeared closer than the river below. It was an exciting descent through a series of progressively drier vegetation types from cold shrubby grassland or puna at the top through mid elevation mesic forest into seasonally dry tropical thorn scrub forest at the bottom near the river – the influence of a strong rain shadow from the high mountains to the east protecting the valley from the Amazonian moisture. Here in the depths of the valley overshadowed by the unbroken Andean ranges on either side, surrounded by loose rocky bluffs and unconsolidated scree,



Seasonally dry thorn scrub above the Rio Marañón near the Balsas crossing

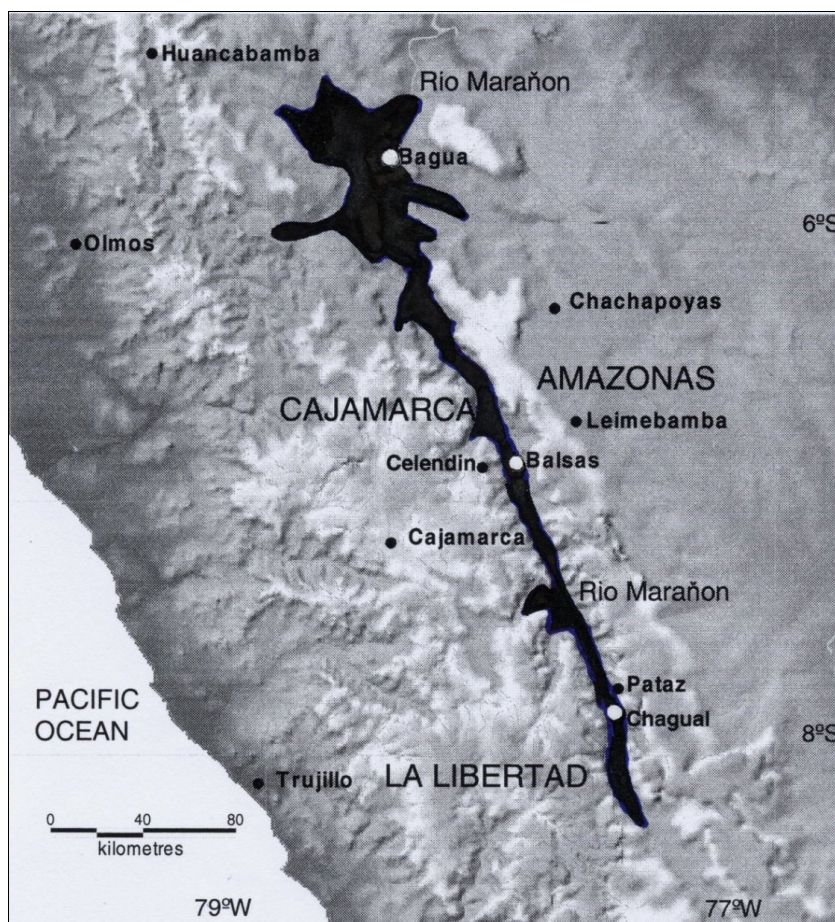
and listening to the dull roar of the sediment-laden Marañón river grinding its way down to the Amazon basin, the opposing forces of recent mountain uplift and massive erosion are nowhere more raw, stark and palpable.

The dry thorn scrub is dominated by *Erioteca*, *Ruprechtia*, *Loxopterygium*, *Capparis* and numerous woody legume genera. However, by early June, with the seasonal rains come and gone much of the vegetation was leafless, few species were flowering and we made few collections. As we started to climb back up from the bridge near the village of Balsas I spotted what looked like *Parkinsonia aculeata* trees scattered by the road. Given the occurrence of *P. praecox* alongside, I thought I might find the very interesting spontaneous hybrid species *P. xcarterae*, so we stopped to take a closer look. Clearly this was not *P. aculeata* after all. Although it had the same characteristic green bark, long pendulous pinnae and small leaflets, it lacked the stipular spines and spinescent leaf rachis of that species and the leaf rachis was long with 3-4 pairs of pinnae – vegetatively quite different from *P. aculeata*. None of the trees were in flower, but it was clearly a distinct species of *Parkinsonia*. I knew immediately it was new.



Aniceto Daza collecting *Parkinsonia peruviana* in the Marañón Valley

It has now been described as *P. peruviana* (Hughes et al. 2003).



Distribution of seasonally dry tropical forest in the upper Marañón Valley in northern Peru

This chance taste of Marañon novelty had whetted our appetites for a longer visit. Nearly a year later we returned to the Marañon, this time a month earlier hoping to find the new *Parkinsonia* in flower, and aiming to collect more extensively in the valley. This time we were not passing through en route to Leimebamba, we were aiming for the dry thorn scrub forest itself. Our luck was in. Not only was the *Parkinsonia* flowering, but also many more species than the previous year, including three other legumes that have since proved to be new taxa. In the space of just two days we collected four new legume taxa: *Parkinsonia peruviana*, a new dalbergioid legume tree since described as a new genus called *Maraniona* (Hughes et al., 2004), and two new species of *Caesalpinia* (Lewis et al. in prep.), alongside a suite of other interesting narrowly restricted endemics. The upper Marañon was turning out to be a rich gold mine of fascinating new legumes.

The most interesting of these was a small tree, again growing by the road. The blood red sap, yellow Papilionoid flowers and apically-winged samaroid fruits suggested placement in the *Pterocarpus* group of the Dalbergioid legumes. This was confirmed by analysis of *matK/itrnK* sequence data. In that analysis it was placed as sister to *Tipuana*, but without bootstrap support. However, it was clearly distinct from *Tipuana*, and indeed from all other genera in that group, meriting recognition as a new genus and, as a Marañon endemic, we named it *Maraniona* (Hughes et al., 2004).



Maraniona lavinii

Maraniona is known only from this part of the upper Marañon valley. *Parkinsonia peruviana* is known from here and a second locality 100km higher up the Marañon around Chagual in the Department of La Libertad. One of the new *Caesalpinias* is also highly restricted to slopes above Balsas, while the other occurs more widely also

down around Bagua. However one chooses to assess conservation value, it is clear that the upper Marañon contains a significant number of globally rare plant species. Taking just the legumes, with at least four species and one monotypic genus known only from the vicinity of Balsas, this represents an important and previously little documented hotspot of globally rare taxa. Furthermore, there will undoubtedly be more to find. The valley remains poorly explored and under-collected. Many stretches between the few roads and bridges are largely inaccessible. Our own visits amounting to little more than 5 days collecting, all around the same time of year, have merely scratched the surface.

It is not unusual to find more than one congeneric endemic within the confines of the upper Marañon valley. For example in the genus *Mimosa*, *M. ctenodes* is narrowly restricted around Balsas, a second, probably closely related Marañon endemic, *M. pectinatipinna*, occurs around 130km north around Bagua, and a third, *M. incarum* occurs in the upper part of the valley in Depts. Cajamarca and La Libertad. Similarly the Balsas endemic *Coursetia cajamarcana* has an endemic sister species, *C. maraniona*, lower down also in the Bagua region. The two new species of *Caesalpinia* provide another example. This pattern is repeated in other plant families. For example, *Ruprechtia* (Polygonaceae) has *R. aperta* in the Bagua – Jaén lower Marañon region and its sister species *R. albida* restricted to the Pataz – Chagual area in La Libertad (Pendry, 2004). Similarly, *Matucana* (Cactaceae) has seven endemics scattered along the upper Marañon trench (Bregman, 1996). It has long been known that the interAndean dry valleys harbour important hotspots of plant endemism. However, the diversity and complex distribution patterns of the upper Marañon endemics are only now becoming fully apparent.

The fact that two recently described fossil fruits, *Tipuana ecuatoriana* (Burnham, 1995) and *Loxopterygium laplayense* (Burnham and Barranco, 2004) from Miocene deposits from nearby southern Ecuadorean interAndean dry forest zones are a very close match to extant Andean species, suggests a period of remarkable morphological and evolutionary stasis over the last 10 million years in these dry Andean forests. This corresponds to the period of major mountain uplift in this part of the Andes, during which presumably previously more contiguous dry forest became progressively fragmented and isolated in areas such as the Marañon valley. It appears that this combination of dry forest stasis over the last 10 million years, vicariant interAndean valley isolation due to mountain uplift and the narrow configuration of the 250km-long seasonally dry tropical forest trench in the upper Marañon

has been conducive to diversification of the repeated pairs, or even clusters of sister endemics that grow there today.



Caesalpinia sp. nov., upper Marañon, near Balsas

Research on legume systematics is supported by a Royal Society University Research Fellowship. Fieldwork in the Andes was partly funded by the Stanley Smith (UK) Horticultural Trust. Thanks are due to Aniceto Daza-Yomona, from the Universidad Agraria La Molina in Lima, who has been on all three visits to the Marañon Valley in the last 4 years.

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Colin Hughes

The Oxford-Bolivia Darwin Project

In 2002 the Department of Plant Sciences received financial support from the Darwin Initiative to manage a project to investigate plant endemism in the central Andean valleys of Bolivia in collaboration with four Bolivian institutions headed by the Herbario Nacional de Bolivia in La Paz. The project is multifaceted and involves various kinds of research including field work but one of its most important aims is the training of Bolivian staff in our partner institutions.

Training is provided in many areas. These include basic skills in plant collecting and identification, in data entry and processing using the botanical database BRAHMS under the guidance of Denis Filer, in the use of digital cameras and in botanical illustration. However, it is hoped that all these new skills come together to promote competence in plant taxonomy and systematics and as part of this objective six Bolivian botanists will come to Oxford to work on specific projects related to plant systematics. The first three were in Oxford in June to September 2004 and represented three of our four partner institutions in Bolivia. The second group of three is programmed to come to Oxford in June 2005.

Plant taxonomy in Bolivia has only a recent and rather chequered history. The first and, to date, much the most eminent Bolivian plant taxonomist was Martin Cardenas who was active over almost 50 years from the 1920s until his death in 1973. He collected and published extensively particularly in Cactaceae and Amaryllidaceae and had wide international contacts in many countries including the United Kingdom and the United States (Candia, 1999). However, he left no legacy. His herbarium was sold by his family to Corrientes in Argentina and none of his students were active in plant taxonomy after his death. In the 1980s there was a revival of botanical investigation led by Stephan Beck in La Paz and stimulated by the interest of outside institutions notably the Missouri Botanical Garden, which has seen the development of four herbaria (La Paz, Cochabamba, Santa Cruz and Sucre) and the establishment of groups of enthusiastic field workers associated with each. However, the amount of taxonomic research has been very limited and only a handful of Bolivian botanists have published papers of a taxonomic nature involving new species before the start of the Darwin project in 2002. In a country such as Bolivia which is home to high levels of plant diversity, the promotion of taxonomic or systematic research is a pressing need if national conservation programmes are to be



Participants in a Darwin training workshop on legume systematics and identification held in January 2004 in Cochabamba. Back row from left: Moises Mendoza, Santa Cruz; Margoth Atahuachi, Cochabamba; Teresa Ortuño, La Paz; Julia Gutierrez, Sucre; Dani Vidal, Santa Cruz; Front row from left: Hibert Huaylla, Sucre; Magaly Mercado, Cochabamba; Pablo Duchén, La Paz.

successful. We hope the Darwin project will help towards this goal.

The three Bolivian botanists who came to Oxford in 2004 had all selected groups or topics for study well in advance of their arrival. Margoth Atahuachi from Cochabamba came to study *Mimosa*, a genus of around 43 species in Bolivia, under the supervision of Colin Hughes. Moises Mendoza from Santa Cruz came to study *Eryngium* (Umbelliferae), a genus of around 16 species in Bolivia under the supervision of Mark Watson from Edinburgh Botanic Garden, while Teresa Ortuño from La Paz came to study *Gomphrena* (Amaranthaceae) under the guidance of Thomas Borsch of the Nees Institute for Systematic Botany in Bonn, with whom she had been collaborating since 2002.

In order to facilitate the research, specimens were borrowed in advance from many institutions in different countries from the United States and Argentina to France and Sweden. The project paid for frequent visits to Kew and the Natural History Museum in London as well as for less frequent visits to Bonn and Edinburgh to consult specimens, make use of library facilities and seek the advice and help of different botanists.

Valuable information and images came by e-mail from many correspondents including Arno Wurz in Germany, Eve Emshwiller of

the Field Museum and from Paris. We are grateful for the help we received from all these individuals and institutions and this emphasizes just how important international collaboration is for successful taxonomic research, something that I hope our Bolivian colleagues have learnt as part of their training at Oxford.

The first challenge facing Margoth Atahuachi was to grapple with the large and complex monograph of *Mimosa* (Barneby, 1991) in order to review all the species recognised from Bolivia. *Mimosa* in Bolivia comprises mostly shrubs and undershrubs from dry to moderately moist areas totalling 43 in all with some of considerable ecological importance. Amongst the material collected by the project and received from different herbaria were eight new records for Bolivia and two new species, one collected as part of our Darwin Project and one from the Serrania de Huanchaca in eastern Bolivia. These two species were described and illustrated and the resulting paper has been submitted to *Brittonia* for publication. Margoth has also prepared a key to all the species of *Mimosa* in Bolivia, which after further trial and final editing should be submitted for publication in the first half of 2005. As part of her subsequent field work with our project good material of a new species of *Acacia* from the Rio Grande basin has been collected and I

hope she will go on to describe this and extend her expertise more widely amongst the legumes, which is one of the most important plant families in Bolivia, especially in the dry valleys where the Darwin project is focussed.



One of the new species of *Mimosa* described by Margoth Atahuachi as part of her training in Oxford.

Moises Mendoza worked towards preparing a revision of *Eryngium* in Bolivia. The literature on this genus is old and modern publications relate mainly to floristic accounts in neighbouring countries rather than revisions. Although some species are prominent in Bolivia and indicate degraded soils, the genus is both neglected and complex. Moises was able to recognise approximately 16 species, of which at least four are new, all endemic and all collected within our Darwin Project area and mostly as part of the project. In addition there may be additional new species within section *ebracteata* Wolff. There are certainly two species from this section in Bolivia (one a very rarely collected plant from the Tarija area) but material collected from near Sucre and Potosi may represent two additional endemic species. Moises was able to do anatomical studies of fruits in Edinburgh, but it was agreed it would be best to postpone completion of his revision until the end of the rainy season in Bolivia in March 2005 to allow further study of section *ebracteata*. It is planned that he will be able to submit his revision of the genus to *Candollea* in the spring of 2005. Moises hopes to move on to study *Hydrocotyle* in Bolivia, another complex genus in the Umbelliferae, which is very diverse in Bolivia.

Teresa Ortuño worked on the genus *Gomphrena*. This is a diverse and complex

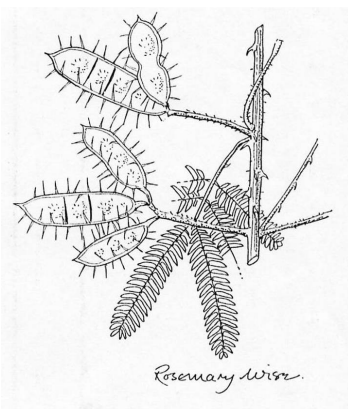
genus of dry areas of Bolivia. There are several new species from the project area. Teresa worked on the description of *Gomphrena stellata*, from the Rio Grande basin collected as part of the Darwin project activities. Her paper has been submitted to Kew Bulletin for publication. She also did SEM work with Robert Scotland concentrating on variation in pollen, leaf trichomes and tepal form. She is working with Thomas Borsch to produce a paper on the taxonomy and phylogeny of the *Gomphrena perennis/fuscipellita* clade making use of data related to variation in pollen morphology, leaf indumentum, and tepal form as an aid to species delimitation. She also looked at variation in *Gomphrena perennis*, a frequent species of the Bolivian Andean valleys. Fortunately the Linnean type of this species, hitherto ignored by all workers in this genus, is based on a specimen in Dillenius' herbarium at Oxford and illustrated in Hortus Elthamensis.

All three Bolivian botanists have learned new skills and techniques, have gained familiarity with taxonomic procedures including how to access herbarium and library resources in the wider botanical world. Crucially they have gained confidence in actual publication of taxonomic papers. We hope that all they will continue studying the systematics of the families they have chosen and that the Darwin Project will have played a significant role in promoting the study of plant taxonomy and systematics by Bolivians.

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John Wood



Continuing research on *Aglaia*

Caroline Pannell is a regular visitor to the Daubeny Herbarium, working on regional flora accounts of *Aglaia* (Meliaceae), seed-dispersal of woody tropical plants by vertebrates and collaborating in molecular and phytochemical investigations of the genus. In February and March 2004, she spent three and a half weeks with Alexandra Muellner and Gill Challen on a Kew-funded expedition to Brunei. The primary aim was to collect fresh material of *Aglaia* for DNA extraction as part of Dr Muellner's post-doctoral studies at the Jodrell Laboratory, RBG, Kew. Caroline also made a general collection of woody species with vertebrate-dispersed fruits. The group was the guest of the Brunei Forestry Department and was based at their herbarium (BRUN), where Mr Joffre Ali Ahmad and Mrs Halimah Morni arranged the itinerary and support. BRUN staff took them to the species-rich tropical rain forest of Ulu Temburong National Park, to peat swamp forests, heath forest on white sand with *Araucaria borneensis*, Andulau Forest Reserve and to the summit of Bukit Teraja, near the border with Sarawak. Dr Pannell found 22 of the 30 species of *Aglaia* known to occur in Brunei, which represents a contribution of nearly 20% of the entire genus to Dr Muellner's systematic molecular survey of *Aglaia*. This is a continuation of Alexandra's doctoral studies, which were based on collections of *Aglaia* made in Thailand, Fiji and Australia by Professor Harald Greger of her home institution, the Institute of Botany in Vienna (WU). Since 1997, Caroline has identified the *Aglaia* collections of Professor Greger for his phytochemical studies with Dr Brigitte Brem and their successful search for bioactive compounds in the genus. Building on her account of *Aglaia* for the Tree Flora of Sabah and Sarawak, which involved recognition of some new taxa, Dr Pannell brought the naming of the BRUN holdings of *Aglaia* up to date and documented all the specimens there in preparation for writing an account for the Field Guide to the Forest Trees of Brunei Darussalam. This is being prepared by Dr Kamariah Abu Salim of the University of Brunei Darussalam (UBD) and Professor Peter Ashton of Kew and Harvard. Along with her companions, she wishes to acknowledge her gratitude to the Ministry for Industry and Primary Resources, Brunei Darussalam, for permission to carry out their research in Brunei and for their generous provision of accommodation, field assistants and transport, to all the staff of the Brunei Forest Department and to UBD for providing additional accommodation, river-transport and field guides at the Kuala Belalong Field Studies Centre in Ulu Temburong National Park.

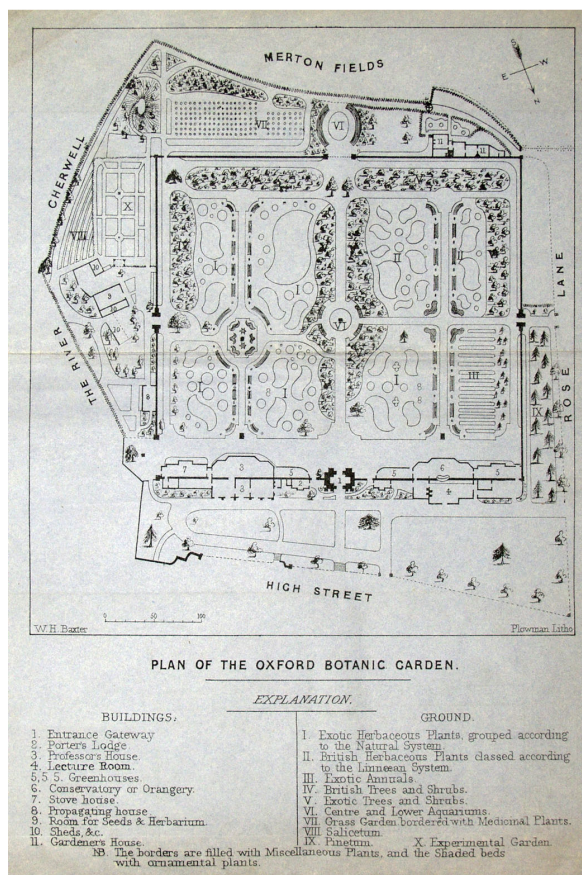
Classification and phylogeny at the Oxford Botanic Garden

The formal teaching of plant science at the University of Oxford dates from the founding of the *physic garden* in 1621. The mission of the Garden was, and still is, “to promote learning and glorify the works of God”. Although the teaching of herbal medicine was the original core subject, botany soon rose to prominence and observations made in the Garden by Millington were included into Nehemiah Grew’s lecture on plant reproduction.

As soon as Jacob Bobart, the first *Horti Praefectus*, started to collect plants he was faced with the problem of how to arrange them. With the exception of a hopelessly inadequate greenhouse, all the plants had to be grown in the same conditions – there was no rock garden or water garden for example. It is believed that the plants were grouped by genera and this is how they were listed in the 1648 catalogue. There is no evidence that this changed until the 1850s when Charles Daubeny decided not only to change the specific epithet of the Garden from *physic* to *botanic* but also to adopt the Linnaean system for the collection of British species. These plants were neatly arranged in long, narrow rectangular borders. The rest of the hardy collection was grown in informal beds scattered through the Garden.

In 1884 work began to extend the use of long, narrow, rectangular borders to house all species not just the natives. At the same time the Linnaean system was scrapped in favour of that of Bentham & Hooker. This four year programme was directed by Isaac Balfour before he moved to RBG Kew. This meant that there was an area of monocots and a much larger area of dicots. Although Balfour believed that the arrangement proposed by Bentham & Hooker was essentially correct he made a few ‘improvements of his own’.

During the 1980s the arrangement of the monocot families became increasingly untenable with the disintegration of the Liliaceae *s.l.* and the decision was made in the middle of the 1990s that one of the new classifications had to be adopted. Just in the nick of time the Angiosperm Phylogeny Group came to the rescue with the publication of APG I. It was impossible for Bentham & Hooker (& Balfour) to be used when undergraduates were being taught using APG I. The Garden was the first to adopt the APG classification in its entirety though many other botanic gardens have followed suit. The rearrangement required very careful planning in order to minimise the disturbance to plants; in effect it was a precise game of botanical chess. As soon as the new plan had been drawn up APG II hit the shelves & the minor changes were incorporated. About 50% of the plants had



Charles Daubeny's plan of the Oxford Botanic Garden, 1850

to be moved enabling us to move the terminally dull knotweeds away from their position near the entrance and to replace them with the much more attractive Brassicaceae *et al.*. One group that had to be moved into a new group were the basal angiosperms that have been such a thorn in taxonomy's side since John Ray's proposal of the monocot/dicot split.

For some of our visitors the rearrangement has been of little importance because the primary design of the Garden has remained the same. This is not surprising because in botanic gardens form follows function and the function had not altered. For many visitors, and especially the members of *The Friends*, this work has been fascinating. Through the summer of 2004 we ran a sold-out course for amateur gardeners looking at the *New Order*. This surprised those who believe that no-one really cares about plant taxonomy and even if they did it would be impossible to explain APG II to the layperson. Firstly, visitors do want to learn how plants are classified, often to improve their ability to identify plants. Now that we have a ruthlessly phylogenetic classification we are able to remove the *gestalt* element that it so infuriating for a beginner. Secondly, with a living collection such as this where people of courses can pick flowers, fruit etc. and pull it apart it is very

straightforward to explain why *X* is related to *Y*.

This was brought home conclusively recently when I was accosted by two visitors who wanted to know to where we had moved the paeonies. I showed them and they then demanded to know why. They had some basic knowledge but it stopped at the monocot/dicot split and a few families. They were fascinated by the fact that the dicots had been superseded by the eudicots and that the rejects had been placed at the base of the evolutionary tree. After an impromptu 15 minute tutorial the inevitable final question was “where can I learn more about this?”. The only suggestion that I could make was Judd

et al. Plant Systematics: A Phylogenetic Approach (1999). Fine though this book is, what we really need is a third remake of the 1968 classic *An introduction to plant taxonomy* by Charles Jeffrey.

Timothy Walker

Director

University of Oxford Botanic Garden



University of Oxford Botanic Garden: present day family beds in frost

The Oxford University Herbarium database

Oxford University Herbaria contain some 800,000 specimens, is the fourth oldest herbarium in the world (established 1621) and incorporates the third largest wood collection in the UK. The Herbaria have been enriched by collections from William Sherard (1659-1728), Henry Fielding (1805-1851), George Druce (1850-1932) and the former Forestry Herbarium. The Herbaria also have Full Registration with Museums, Libraries and Archives Council. At its most straightforward, Oxford University Herbaria are one of the most important botanical collections in any UK university and provide an unparalleled resource for botanical, horticultural and historical research. The Herbaria comprise nationally and internationally important collections of plants from Africa, Europe, South and Central America, South East Asia and Australasia and contains more than 25,000 Type specimens. Oxford University Herbaria are a means of plant identification based on access to named specimens and associated data, a biological database, an archive of botanical diversity in time and space and a resource for research, teaching and public access.

Access to the vast amounts of data contained in Oxford University Herbaria is a fundamental issue. This is important for research, public use of the Herbaria and efficient management. Oxford University Herbaria are arranged in a manner that may not be the most convenient for a particular user, e.g., historians may want all collections made by a particular person or a geographer may want to know all of the species that occur in a particular region, although the collections are arranged taxonomically. Such access issues can be effectively resolved by ensuring that information on specimens in the Herbaria is available through on-line databases. Furthermore, a central database to the Herbaria will help 'future-proof' the collection, make its management more efficient and raise its overall profile. For example, with an effective database in place, changes in staff will result in minimum disruption to the knowledge of the collection.

Oxford University Herbaria has started creating a central database and digitising the collection using BRAHMS. Furthermore, BRAHMS on-line is being used to ensure that collection data are made available outside of Oxford (<http://herbaria.plants.ox.ac.uk>). All of the information on a specimen label is being included in the database, although not all of it may be available on-line. The most recent identification recorded on the labels is being accepted as correct (although names are being up-dated), unless

the person who inputs the data has special knowledge of the group. It is important for the user of the database to be aware of this caveat – buyer beware! Digitisation is being done using a Nikon D100 camera and the images managed in BRAHMS using barcodes. For each image, two files are created. The original high resolution image is archived and a low resolution image is published to the web through BRAHMS on-line.

Given that the Herbaria contains at least 800,000 specimens, databasing will be a long process; at current rates, it is estimated that it will take 20 years! The initial investment of staff time is high but it is hoped that the return on this investment will come as more and more of the collection is available on-line. In the meantime, priorities have had to be set. Therefore, currently all incoming and outgoing specimens are routinely databased and all Type specimens are databased and digitised as they are located. Priority is also being given to those collections for which there have been traditional strengths in Oxford, e.g., Meliaceae and Ebenaceae, and groups of collections that are of interest to particular projects, e.g., specimens cited in *Flora Brasiliensis*, or collections made by the Bobarts in the mid-1600s from the nascent Botanic Garden.

The on-line database currently contains 53,000 records. In addition to the routine incorporation of material and of type species, the database contains all of the records from Oxford Xylarium, all of the mimosoid legumes in OXF, most South American Ebenaceae from FHO and all of the carpological and spirit collection from FHO.

Stephen A. Harris

Oxford's Virtual Field Herbarium - bringing tropical plant life to the internet

<http://herbarium.lital.si>

[See front page]

"Virtual herbaria", or web sites with data and images of herbarium specimens, are burgeoning on the internet: the number of hits for "Virtual herbarium" in Google increases every month. As a consequence, images of herbarium specimens are available for ever more species, for examination wherever you happen to be - providing you have an internet connection, of course. Many of the images available are of type specimens, so clearly this is a wonderful trend, particularly useful to

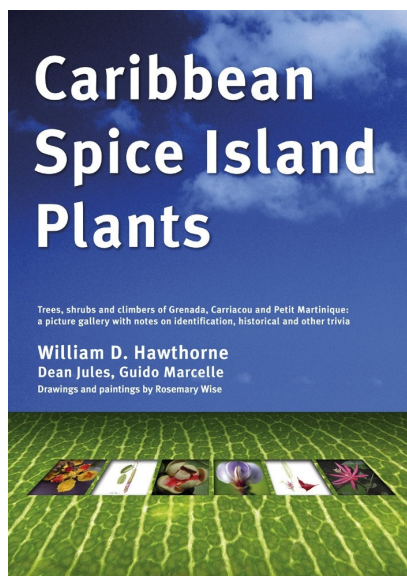
taxonomists in the tropics, even if the results are currently very patchy in quality and coverage. Images of living plants are also abundant, but mainly for cultivated plants and species of developed countries, and in this case there is a particular high risk of inaccurate identification.

At the same time, strands of the web are penetrating ever remoter regions, increasingly available to poor people in biodiverse countries, and certainly available to most botanists and others working in national plant-related institutions in the tropics, even if connection involves a trip to the local internet cafe. So, it seems something of an anachronism that so many dried, pressed plants are visible back in their home country, like repatriated ghosts, yet pictures with information of living tropical plants, fresh leaves and other parts (like the bark or slash) which are more use to field botanists, are far less often available.

One of the products of the last DFID/FRP field guides project (R7367 - see past issues of OPS), which should start to redress this imbalance, and by which we hope the project's influence may have lasting benefit, is our prototype Virtual Field Herbarium (VFH), featuring images of living tropical plants. It is envisioned that the VFH will help aspiring field guide writers in the tropics identify their plants and make their own field guides, tailored to local needs. Although there is still vast scope for expansion and improvement, we hope that, as a first approximation, the VFH will even now provide inspiration for how future virtual field herbaria might evolve. At the time of writing we have a sample set of more than 2000 images from Mexico and Grenada, but are poised to add tens of thousands of images from around the tropics.

For the Grenadian species, the VFH is almost an interactive version of our book, (an ecotourist field guide also funded by DFID: Hawthorne *et al.* 2004 *"Caribbean Spice Island Plants: Trees shrubs and climbers of Grenada, Carriacou and Petit Martinique: a picture gallery with notes on identification, historical and other trivia"*). Users interested in Caribbean plants can find more images and information than are in the book, although for maximum efficiency in the forest, a printed field guide is still usually the most appropriate medium.

A main component of the VFH is an image display system, which can be thought of as a "successively filtered image gallery". The filters are all hierarchically structured (e.g. first select family – all images for that family are then available - then select genera and species within that family). Currently, filters cover taxonomic, geographic, and image characteristics and characteristics of the species. Users can select any filter or combination, as each selection successively reduces the options available via all other filters. The image gallery is linked to a



glossary of field guide jargon. The site also has an extensive bibliography of existing field guides for all parts of the tropics (selectable by country), and is about to be updated with more pages on 'how to write a field guide'. Many thousands more images are waiting off-stage to be imported; these are from Ghanaian forests (linked to another forthcoming guide, Hawthorne and Jong-kind 2005) and, through collaboration with the Ghana northern Savanna biodiversity project, savanna plants. But first we are upgrading some of the software based on our first 'draft'.

Classifying the images taxonomically and by character content is a major chore, as is writing something useful about each species, and linking the geographic data into a useful hierarchy. For maximum verifiability, most of the images are directly linked to herbarium specimens. In order to help handle this information, Denis Filer is modifying BRAHMS to automate export of classified images to the VFH, and to allow communication between BRAHMS' specimens database and commercial image cataloguing software. We intend that plot and raw check-list data will also be integrated through our plot database software TREMA. Without this sort of data handling tool, opportunities to capture existing slide libraries and other datasets linked to herbarium specimens slip away. We hope benevolent botanists seeking a wholesome use for their photo library will be encouraged to contribute to the VFH by the free cataloguing tools, even if they are not BRAHMS users already.

We are intending this year to import the image libraries of various enthusiastic colleagues, to include African *Acacias* and *Leucaenas* and other tropical legumes, which are also partly derived from projects funded by DFID over the last decade or three. The VFH in effect provides a platform for botanists to publish their

miscellaneous plant images in a way that is synergistic with others, and in a way that works to educate, to conserve, and even to promote rural livelihoods (by production of local field guide material). Contributors can choose whether or not to allow free local use of their images in this way in the tropics, but we intend that most images will be available for specified, forest- and people-friendly purposes as long as the creators' copyright and input is acknowledged.

Data Contributors or funders interested in supporting the future of the VFH should please contact William Hawthorne or Stephen Harris:

william.hawthorne@plants.ox.ac.uk or
stephen.harris@plants.ox.ac.uk

William Hawthorne

News from the Herbaria

Fielding-Druce (OXF)

We were delighted to welcome Professor Peter Raven to officially re-open the Fielding-Druce Herbarium on 2 July 2004 (see page 3) and enjoyed the day with many of our colleagues from other UK herbaria.

The up-dated facilities in OXF have provided a much more useful spreading-out space for specimens, and books, for sorting and display which has now been fully put to the test. All cupboards in the herbarium have been labelled with their contents so that specimens can be found easily and are now more accessible. Also the added cupboards for storage of specimens have proved their value providing an uncluttered environment in which to work.

During the last year the enormous task of databasing, including barcoding, the OXF collections began in earnest. Those specimens being sent out on loan have been treated as priority for this process and the databasing of type specimens in the collection is now well under way. Digital images of type specimens are also being prepared simultaneously and linked into the BRAHMS database by their barcodes. See article on page 11 for more information.

During the refurbishment programme unincorporated OXF material was sorted and some 800 specimens of British *Rubus* were presented to the Bolton Museum, which also includes the Bolton Biological Records Centre, where there is active interest in the genus. Part of a large collection of British plants, presented to OXF by Dr S.R.J. Woodell (1928 - 2004) on his retirement in 1988 from the Department of Plant Sciences as Lecturer in Ecology, was accessed, databased and incorporated during the summer.

An exciting development this year was that, as well as sending loans in the normal way, where more appropriate, we began sending a number of internet loans of images of specimens. An additional 73 images of herbarium sheets were sent on loan electronically, with the images being posted on our website for a limited period for those individuals or institutions who requested the material. We were very grateful to receive determinations from examinations of the images, whereupon the loans were cancelled as returned. This method of delivering 'loan' material as images will now offer improved access to the historical collections in OXF where conventional loans are not normally permitted.

Material returned from loan included 3 specimens from the 'Hortus Siccus' of Jacob Bobart (1641-1719) which had been sent out as a 'special' loan of historic material for exhibition. The 3 specimens of *Primula* had been on display in the exhibition entitled "Gregor Mendel: The Genius of Genetics" firstly at the Abbey of St Thomas in Brno (Czech Republic) and then in the Accademia Ligustica di Genova. About 12 % of other miscellaneous materials returned from loan were type specimens.

Visitors

Apart from a number of visits by individuals, 20 members of the local Rare Plants Group of the Ashmolean Natural History Society of Oxfordshire were the first group to be given a complete tour of the refurbished herbaria OXF and FHO in February 2004. In July, a group of 8 visitors came especially to view the John Sibthorp and Ferdinand Bauer collections in OXF and the *Flora* and *Fauna Graeca* drawings, plus a tour of Plant Sciences Library. In December, a guided tour of the herbaria was given to a group of students from the Department of Continuing Education, Oxford University, studying for a Diploma in Environmental Conservation.

Serena Marner

Daubeny (FHO)

The main priorities during the last few months have been to deal with as much of the backlog of material as possible and incorporate it into FHO, along with recent collections, and to make a start on databasing selected parts of the collection.

To that end, specimens sent to FHO from Z, collected by R. Schlechter in South Africa between 1892 and 1894, have been mounted and incorporated, as have substantial miscellaneous collections by F. White and others from Zambia, South Africa and Kenya.

Recent collections incorporated into FHO include: *Hemigraphis* (Acanthaceae) collected by Elizabeth Moylan in the Philippines and described in the paper entitled 'Taxonomic account of *Hemigraphis* Nees (Strobilanthinae-Acanthaceae) from the Philippines' (*Kew Bulletin* 57: 769-825. (2002)); *Dalea* (Fabaceae) collected by Colin Hughes in Mexico, Bolivia and Peru and Ruth Eastwood in Peru; the holotype of a new spontaneous hybrid, *Euphorbia x pasteurii* T. Walker, from the Oxford Botanic Garden (*The Plantsman* N.S.: 94-97. (June 2003)).

Specimens returned from loan presented the opportunity to re-organise and database the South American *Diospyros* (Ebenaceae) section of FHO. The specimens of Central and South American *Diospyros* still out on loan will be added to the database when they are returned.

All the above specimen data is available through BRAHMS on-line (BOL; <http://herbaria.plants.ox.ac.uk/bol/home/default.asp?section=home>).

A recent account by Caroline Pannell in *Kew Bulletin* (59: 87-94. (2004)) describes three new species, two new sub-species and five new combinations at the subspecific level in *Aglaia* Lour. (Meliaceae) in Borneo, which necessitated re-organisation of the *Aglaia* holdings in FHO. Holotypes of two of the new species and the two new subspecies are in FHO. It is planned that these data will be available via BOL within the next few months, as part of the planned stages of databasing the whole of the FHO Meliaceae collection.

Another priority is to database all the Type specimens in FHO and link each entry to a digital image of the specimen. A start has been made with a small number of families at the beginning of the alphabet and this information is now available through BOL.

Alison Strugnell

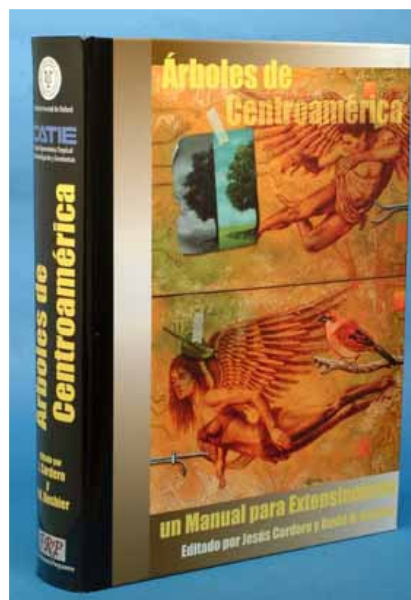
Trees of Central America – a sourcebook for extension workers

The diverse biological, environmental and cultural conditions of Central America require diverse approaches to sustainable farming. Diversification makes farmers less subject to cost rises, decreases in selling prices and adverse climatic effects. Trees are a vital component of such systems, but often only a limited range of species and management options are promoted.

From dusty library to dusty farm

There has been much research on native tree species of Central America. However, most

of the information remains in libraries and filing cabinets of universities and other institutions. For extensionists (promoters who help farmers to adopt new skills and production strategies) access to such information is limited both physically (due to location, time, cost) and because of the language and scientific style of writing. Compilation and presentation into a single book can offer easy access to this information. The Oxford Forestry Institute and CATIE (*Centro Agronómico Tropical de Investigación y Enseñanza*) have published a manual in Spanish covering the use of 199 indigenous Central American species within the context of farming systems, farmer constraints and preferences. The materials were developed and tested in co-operation with extension networks in Central America, with species selection based on farmer preferences from more than 100 surveys. The manual is aimed at extension services and rural development organisations involved in promotion of sustainable land use options in Central America. It provides details of which species appear best suited to which systems (e.g. small blocks, living fences, trees with perennial crops, natural regeneration).



Reaching the farmer

Writing and distributing a book is no guarantee of its use, and transfer of the information to farmers. The 1000 page book contains much technical information, but the style and language level make it accessible to the intended users. To ensure uptake, the book is distributed through a programme of free training courses within Central America. More than 1000 extensionists have been trained covering a mix of foresters, agroforesters, agronomists and extensionists from rural development agencies.

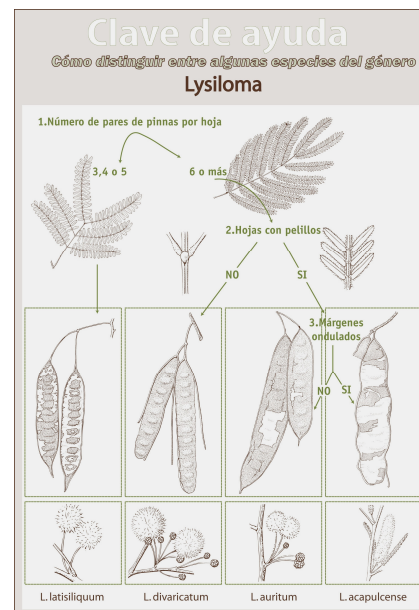
The educational level of extensionists and their access to IT varies enormously across the region. The project offers a variety of options for accessing information - retrieval directly from the book, an interactive CDROM with a searchable data base and images to facilitate production of extension materials, and a website. Further developments are a distance learning course through a CDROM and on-line tutorials. The book is available outside of Central America on the project's web page.

www.arbolesdecentroamerica.info

Taxonomy in action

The compilation of a book covering 199 native species aimed at extension workers throughout Central America raised a number of taxonomic and nomenclature issues.

The species descriptions concentrate on the products, and silvicultural aspects with only brief botanical descriptions. However where there was known to be difficulty in distinguishing between species within the same genus (e.g. *Leucaena*, *Lysiloma*, *Inga*, *Manilkara*, *Spondias*, *Tabebuia*) simple drawings of key features by Rosemary Wise are given to aid identification (see figure below). Terry Pennington provided the main taxonomic revision and advice, with additional inputs from Colin Hughes, Jose Linares and Clive Stace.



The description of the same species in different countries under different scientific names, along with the transfer of species between genera causes problems for non-taxonomists. The book contains a list of the most frequent scientific synonyms for each species, to help readers coping with problems encountered when searching for information on particular species. Although the latest accepted scientific name is generally used, occasionally a former one is used, when this is "universally" known

across the region, and the new one almost unknown, except to botanists.

Not being trained botanists, users said that they preferred to see the species descriptions sorted by common name, rather than by scientific name. This presented a problem as for some species the common name varies across Central America, not only by country, but also within countries, and with language. An example is *Gliricidia sepium*, one of the trees most valued by farmers. With many common names (e.g. *madero negro*, *madreado*, *madrecacao*, *mataratón*), choosing one name would bias the book towards one country and render species searching very difficult for people from other countries or with other native languages. Common names have therefore been made available in two ways: i) a list of all the common names available for each species, ii) an alphabetical list of all common names, with details of usage by country and region, to allow retrieval of their scientific name.

This listing also helps to distinguish species where common names are not exclusive to a single species. This is typically associated with names derived from morphological characteristics or wood properties which are common to several allopatric species, or several similar species within a genera (e.g. *Lysiloma* - quebracho). Typical of this problem are studies where common names are recorded in the field with no further checking of species by a botanist. Studies cite the common name given by local people and often equate it with a scientific name from the first available database. Thus, information may be attributed to the wrong species. This is essentially an irresolvable problem. However, for species where this is known to be an issue, the species descriptions give a warning as to the duplication of common names and which species may be confused.

David Boshier and Jesus Cordero

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BRAHMS online

BRAHMS databases, previously confined to your local workstation or network, can now be published online in full. The new BRAHMS online service is available on www.brahmonline.com with all the related BRAHMS documents and downloads.

Advantage online

The advantages of publishing research and herbarium databases online are substantial. Database developers can disseminate botanical information quickly and widely without additional printing costs. 'Reprinting' is replaced by push of the button electronic updating. Species checklists, monographs and entire herbarium curation systems can be published in part or in full together with scanned specimen and other plant images. As discussed below, databases can be published individually or in linked groups, the latter an ideal way to foster regional collaboration and data sharing – as well as providing curation benefits across the board.

With online functions to Select, Analyze, Sort, Report and Print data, the tools for flexible botanical database publishing are in place.

Your project – your homepage

Each published database or database group has its own homepage. By linking this to your chosen website address and developing the homepage with your own text and images, you can create and update a project homepage from within BRAHMS.

The screenshot shows the BRAHMS online interface. At the top, there's a navigation bar with links like 'Home', 'About', 'Advisory Group', 'Projects Summary', 'Training and Support', 'Registration', and 'Contact'. Below this, the main heading is 'The genus Leucaena'. A welcome message states: 'WELCOME TO THE BRAHMS ONLINE SEARCH ENGINE FOR THE GENUS LEUCAENA'. It mentions that the database group is now working with the following database: 'Leucaena'. A search bar is provided with a 'Search' button. Below the search bar, there's a list of databases: 'Leucaena', 'Leucaena (Leguminosae - mimosoidae)', 'Leucaena (Leguminosae - mimosoidae) is a small genus of 25 species of small to medium-sized Neotropical trees. Species of Leucaena have been the focus of both early indigenous domestication and modern crop breeding – as a fodder tree throughout the tropics and as a native food plant in Mexico. Previous taxonomic work on Leucaena culminated in two major publications – a Taxonomic Monograph of the genus (Hughes, C.E. 1999. *Synthetic Botany Monograph 55*), and a Genetic Resources Handbook (Hughes, C.E. 1998. *Tropical Forestry Paper 37*, Oxford Forestry Institute). Recent collaborative research on Leucaena in Oxford and New Mexico has focused on understanding hybrid and polyploid origins using molecular data.' A sidebar on the left lists various databases: 'The genus Leucaena', 'The genus Agathis', 'The genus ...', etc. The main content area also includes a list of species: 'Leucaena (Leguminosae - mimosoidae) is a small genus of 25 species of small to medium-sized Neotropical trees. Species of Leucaena have been the focus of both early indigenous domestication and modern crop breeding – as a fodder tree throughout the tropics and as a native food plant in Mexico. Previous taxonomic work on Leucaena culminated in two major publications – a Taxonomic Monograph of the genus (Hughes, C.E. 1999. *Synthetic Botany Monograph 55*), and a Genetic Resources Handbook (Hughes, C.E. 1998. *Tropical Forestry Paper 37*, Oxford Forestry Institute). Recent collaborative research on Leucaena in Oxford and New Mexico has focused on understanding hybrid and polyploid origins using molecular data.'

Leucaena was one of the first BRAHMS databases to go online (C.E. Hughes, Oxford). This comprehensive monograph database includes full nomenclature for all taxa, a comprehensive bibliography and data from c.3,000 specimens, most of these with mapping coordinates. Images, GenBank links, and morphological and DNA sequence data are currently being added.

The screenshot shows the Oxford University Herbaria online interface. At the top, there's a navigation bar with links like 'Home', 'About', 'Advisory Group', 'Projects Summary', 'Training and Support', 'Registration', and 'Contact'. Below this, the main heading is 'Oxford University Herbaria'. A welcome message states: 'WELCOME TO THE BRAHMS ONLINE SEARCH ENGINE FOR THE GENUS LEUCAENA'. It mentions that the database group is now working with the following database: 'Oxford (OXF) and OXF'. A search bar is provided with a 'Search' button. Below the search bar, there's a list of databases: 'Oxford (OXF) and OXF', 'Oxford (OXF) and OXF', etc. The main content area shows details about the 'Oxford University Herbaria' database, including its description and a list of species.

The Oxford University Herbaria online. Specimen data and images, literature, illustrations and manuscripts from OXF and FHO are gradually being incorporated into a central online system.

Publish from your workstation

Publishing a database online is a daunting prospect for most herbaria as much technical knowledge is required. One of the challenges in developing BRAHMS online has been to remove these hurdles so that projects with minimal resources and technical server knowledge can publish and update an online system easily. You don't even need your own server. In fact, all you do need is a BRAHMS database and internet access to be able to connect and publish.

The online publishing software (known as the BRAHMS online client) can be operated from within BRAHMS itself. It compresses the required database files on your local workstation, sends these to the secure Oxford server and either creates or updates your online database. The same program is used for homepage design. When you want to update your online system, simply repeat the process. The same option can be used to publish images linked to specimens and assuming these are registered in your database, these can be viewed online with the specimen and species information.

The screenshot shows the BRAHMS online client software interface. The window is titled 'Browse 'The genus Agathis' | Edit 'Agathis' Database'. It shows a form for entering database information, including 'Database Title', 'Information URL', and 'Database Description'. Below the form, there's a section for 'Database Notes' and a 'Upload and Replace the Existing Database or Library' section. The 'Upload' section includes a progress bar with steps: 'Compressing Files', 'Sending Data', and 'Decompressing Files'. The progress bar shows the current status of the upload process.

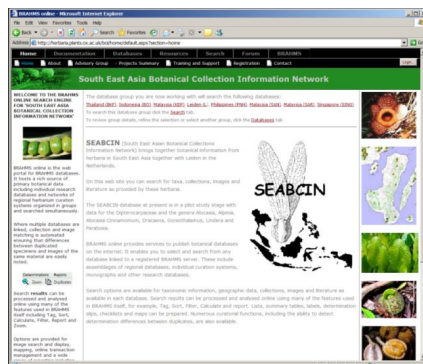
The BRAHMS online client software to publish and update online can be activated using a standard BRAHMS menu option.

Group power

The full potential of BRAHMS online is realized when databases are linked into online groups. A database group has a single home page and all linked databases are searched simultaneously. Database groups open up a host of options for regional collaboration, sharing data for curation purposes and any research that benefits from access to data from multiple herbaria.

Grouping can be carried out in different ways. For example, databases from related institutions can be linked into a single searchable group. Two examples currently online are the National Herbarium of the Netherlands (linking the Leiden, Utrecht and Wageningen herbaria) and the SEABCIN project mentioned below.

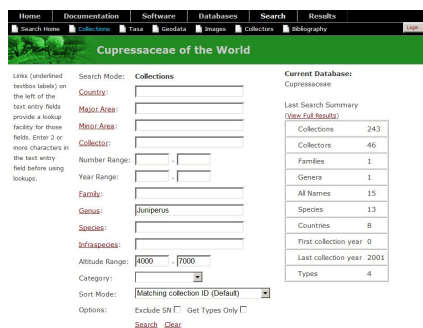
Another example is when a single institute has a series of separate databases, for example one for curation and various research databases – all of which could be linked into a group called ‘Our herbarium databases’.



The South East Asian Botanical Collections Information Network (SEABCIN) online accessible directly via www.seabcin.org. This online database group brings together data from Indonesia (Bogor), Malaysia (Keping, Sabah and Sarawak), Philippines (PNH), Singapore (SING), Thailand (BKF) and also Leiden in the Netherlands.

Online searches

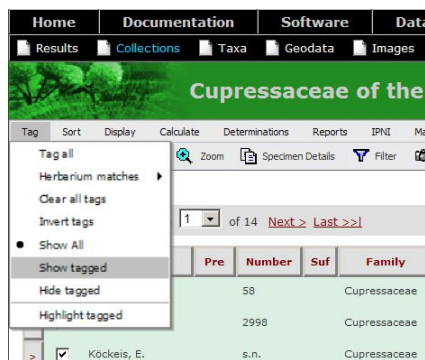
Queries can be made on collections, taxa, geographic data, literature and images. These data are all integrated online so that, for example, a search on collections not only creates a table of collection results – but also builds a separate results table for the taxa represented by those collections and any related images. Thus, after a collection search on all Cupressaceae from China, an online checklist of the relevant taxa is created on the fly.



A query made in ‘Cupressaceae of the World’ online (A. Faron, RBG Kew) for high altitude *Juniperus* collections. After each search, a results summary is displayed as above. Query results can be further processed on the Results page.

Processing query results

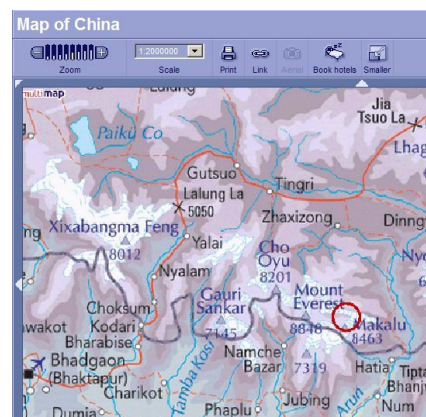
Search results can be processed into products for research and curation, similar to those available in BRAHMS itself. Many of the online toolbar and menu options will be familiar to BRAHMS users including options to Tag, Sort, Zoom, Filter, Map, Calculate and Report.



Record tagging options provide flexible record selection online.



Results are displayed in tables with processing tools. The database owner decides which columns are displayed by default. These can be adjusted when viewing results – although particular databases may have restrictions enforced.



Mapping the highest ever recorded *Juniperus* collection (*J. indica* var. *indica*) using the Multi-Map toolbar link. Map data can be restricted online to protect rare taxa. Further mapping and map analysis options are now being added to BRAHMS online.

Automated duplicate matching

Bringing together data from multiple herbaria opens up possibilities to look for discrepancies in the identification of collections duplicated to two or more herbaria. After an online query, specimens in the results table are auto-matched using the specimen number, the day, month and year of collection and an intelligent range of characters from the country and family names given. This results in almost 100% correct matching, avoiding problems caused by variation of spellings of collector names, irregular use of specimen number prefix and suffix fields and differences in the geographic data.

Tag	DB	Collector	Number	Species
☒	KEP	Kochummen, K.M.	85236	Hopea myrtifolia
☒	L	Kochummen, K.M.	85236	Hopea bracteata
☒	PNH	Kochummen, K.M.	85236	Hopea mengarawan
☒	SAN	Kochummen	85236	Hopea minima

In this not atypical example, a search on the genus *Hopea* has found and auto-matched duplicates of the collections Kochummen 85263 at the KEP, L, PNH and SAN herbaria with different determinations at each. The name of the identifier and the determination date can be viewed to help resolve differences. Differences in collector and geographic names are also picked up.

Images online

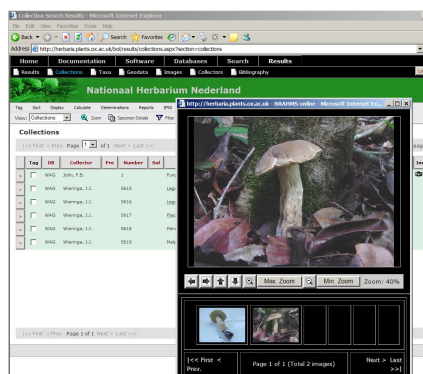
Many herbaria have started their digitization activities focusing on the type specimens, including type specimen images and these are ideal for online publication.



The Singapore Botanic Garden herbarium has a complete type specimen reference collection online with scanned images.

S/N	Family	Species	Country	Major	DO	HM	YY	MID	Imp
1	Leguminosae	Cratogeomys	Indonesia	Java	0	0	0	0	
2	Acanthaceae	Strobilanthus	Indonesia	Sulawesi	0	0	1005	0	
3	Araceae	Arisaema	Peninsular M.	Perak	14	10	1939	0	
4	Araceae	Allocaasia	Peninsular M.	Perak	0	0	0	0	
5	Leguminosae	Sindora	Indonesia	Java	29	5	1941	0	
6	Zingiberaceae	Bosmanthera	Peninsular M.	Sarawak	0	0	0	0	
7	Orchidaceae	Pleuropleura	Peninsular M.	Sarawak	0	3	1908	0	
8	Gesneriaceae	Ruellia	Peninsular M.	Johore	26	3	1906	0	
9	Gesneriaceae	Ruellia	Peninsular M.	Perak	0	8	1962	0	

A sample search result from the Singapore Herbarium online type collection. The Image icon is displayed when images are available. In this example, the IPNI menu has also been opened to check the current species.



This example from the National Herbarium of the Netherlands Wageningen database shows a collection with two linked images. Multiple images are displayed as thumbs with options to display and zoom the selected image

Restricting access

To protect vulnerable taxa and restrict data access for any other reason, a number of mechanisms can be deployed. The safest way to block access to your data is not to publish it in the first place. Sensitive records can be removed and it is also possible to select and publish 'sub-databases' derived from your main system. All online publishing and updating is strictly password protected and database administrators can apply further online restrictions, for example, defining the columns to view and whether downloads are permitted.

The coming year

During 2005, facilities to store databases on different servers are to be added. Mapping

tools are being extended and links between BRAHMS online and the Virtual Field Herbarium, as introduced in this edition of OPS, will be created. A link to the Global Biodiversity Data Facility (GBIF) will be completed early in 2005 – BRAHMS online database owners will have the option of becoming a GBIF data provider.

Denis Filer

The initial development of BRAHMS online was undertaken collaboratively with the Leiden herbarium in the Netherlands under the EU Asia IT&C funded project 'South East Asian Botanical Collections Information Network'. Further software development and support to prepare a range of databases including Inga, Leucaena and Pinus has been provided by the UK DFID Forestry Research programme.

Request for Aglaia specimen data

The Daubeny Herbarium has a large collection of Meliaceae, including *Aglaia*, the largest and most intractable genus in the family. Data from as many sources as possible including the FHO collections is now being compiled for BRAHMS online. If you or your herbarium has *Aglaia* data in electronic form and you are willing to contribute the data, please email to caroline.pannell@plants.ox.ac.uk.

Once the specimen data have been entered and correct determinations applied, it will be possible to submit a list of specimens and receive an automatically-generated list of determinations.

Exhibition at the Ashmolean Museum, Oxford Beaumont Street, Oxford OX1 2PH



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