

Kew Scientist

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NEWS FROM THE LIVING COLLECTIONS, THE HERBARIUM AND THE LABORATORIES AT KEW & WAKEHURST PLACE



A. Marshall / RBG Kew



S. Hopper

Above: The black kangaroo paw, *Macropidia fuliginosa*. Its phylogenetic and generic status in the Haemodoraceae was clarified by collaborative research involving Steve Hopper with Mike Fay and Mark Chase at Kew.

Left: Steve Hopper on a visit to Kew in July 2006.

KEW'S NEW DIRECTOR

On 19 May 2006, the Trustees of the Royal Botanic Gardens, Kew, announced the appointment of Professor Stephen D. Hopper as the next Director. Steve Hopper assumes the Directorship in October, taking over from Professor Sir Peter Crane who leaves Kew after seven years to become the John and Marion Sullivan University Professor at the University of Chicago.

Steve Hopper, previously Foundation Professor of Plant Conservation Biology at the University of Western Australia, has an international reputation in plant science and conservation. His research experience includes evolutionary, systematic and conservation studies on Australian plants, evolution of Mediterranean-climate plants, pollination ecology and a collaborative international programme on granite outcrop floras. He is the author of more than 200 publications, including eight books, and is currently developing and testing a new hypothesis about the evolution and conservation of biodiversity on the world's oldest landscapes. Steve is a passionate

conservation biologist and has been engaged in practical plant conservation for almost 30 years. For seven years he was Director of King's Park & Botanic Garden in Perth, followed by five years as CEO of the Botanic Gardens & Parks Authority, a Western Australian Government body run, like Kew, by an independent board.

Steve has a proven track record in attracting funding to the organisations for which he works, and he successfully managed stakeholder relationships through a period of change and development at King's Park & Botanic Garden. This experience, together with his strong background in science and plant conservation, will be invaluable at Kew. He said, "I am delighted to accept the post at Kew. With its worldwide profile, important national and local presence, and rich diversity of botanical and mycological programmes, Kew is superbly placed to speak for, inspire and demonstrate best practice in plant conservation – the basis of life on earth and one of the world's greatest challenges."

Lord Selborne, Chairman of the Kew Trustees, said, "We are fortunate to have found in Stephen Hopper an unusual combination of excellence in plant science research and conservation, coupled with in-depth experience of managing a large and complex visitor attraction. We look forward to working with Professor Hopper in the years ahead and especially the planning leading up to Kew's 250th anniversary celebrations in 2009."

In July 2006, Peter Crane and Steve Hopper visited the Secretary of State for Defra, David Miliband. As the outgoing and incoming Directors of Kew they made a detailed presentation of Kew's role and value, emphasising the need to support both Kew's science work that addresses a changing environment and the visitor side of Kew that engages public understanding.

Kew
PLANTS PEOPLE
POSSIBILITIES



GardenAfrica Show Garden, designed by Alan Capper (Kent Design) and Ross Allan Designs, RHS Chelsea Flower Show 2006

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NEWS

Minister's Warning

On 12 September 2006, Ian Pearson (UK Climate Change & Environment Minister, Defra), speaking from Kew's dry garden, warned that UK gardeners would have to adapt to warmer and drier weather by planting drought-tolerant species and that plant pest and disease attacks are likely to become more severe. Kew's Director, Peter Crane, highlighted the current pest damage to horse chestnut trees (see p8) and said that Kew's 2007 Summer Festival would be dedicated to the Mediterranean area, focusing on plants that thrive in coastal areas with low water supplies.

Kunming Declaration

Hugh Pritchard has been elected to the Conservation Committee of the Association for Tropical Biology and Conservation (ATBC). At the ATBC annual meeting in Kunming, China, in July 2006, the committee issued the Kunming Declaration on 'The critical need for forest conservation and strategic research in tropical Asia'.

Malaysian MoU

His Excellency Dato' Seri Azmi bin Khalid (Minister of Natural Resources & Environment, Malaysia) visited Kew on 19 May 2006. On this occasion, Dato' Dr Abdul Razak Mohd Ali (Director-General, Forest Research Institute of Malaysia; FRIM) signed a Memorandum of Understanding (MoU) between FRIM and Kew to enhance the longstanding scientific cooperation between the institutes.

The Director-General of FRIM (right) and Kew's Director (left) signing the MoU, overseen by the Malaysian Minister of Natural Resources & Environment (centre).



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AWARDS

Chelsea Medal

A show garden representing GardenAfrica's partnership project with Kew won a Silver-Gilt Medal at the RHS Chelsea Flower Show (23-27 May 2006). The garden was produced to increase public awareness of the project that is developing horticultural facilities in Africa to help local communities manage their botanical resources sustainably. The Chelsea garden provided an overview of the plant species being used for food and traditional medicines. The work in South Africa has been funded as part of a Darwin Initiative project.

Alpine House Award

Kew's new Davies Alpine House won a Royal Institute of British Architects award for buildings that 'have high architectural standards and make a substantial contribution to the local environment'. The award was accepted by architects Wilkinson Eyre at a ceremony on 22 June 2006.

Book and Paper Awards

The Stebbins Award for 2005 from the International Association for Plant Taxonomy was given to Doug and Pam Soltis (Univ. of Florida), Peter Endress (Univ. of Zürich) and Mark Chase (Kew) for their book *Phylogeny and Evolution of Angiosperms*. The medal is for 'an outstanding article or book on plant systematics and/or plant evolution' during that year. *Legumes of the World*, an illustrated encyclopaedia of legumes edited by Gwilym Lewis, Brian Schrire, Barbara MacKinder and Mike Lock and published by Kew in 2005, has won the Council on Botanical and Horticultural Libraries 2006 Annual Literature Award in the Technical Interest Category. At the Annual British Ecological Society Meeting in September 2006, Matthew Daws was awarded the Haldane Prize for the best paper by a young author in *Functional Ecology*. The study (*Func. Ecol.* 19: 874; 2005) investigated correlated evolution between seed traits associated with seed desiccation-sensitivity in Neotropical tree species.

ON THE WEB

Herbarium Catalogue

A web interface for Kew's catalogue of herbarium specimens was launched in June 2006. This currently contains records for nearly 200,000 specimens and covers Kew's spirit collection and 126,000 dried specimens, including over 60,000 types. Over 46,000 of these records, mostly types, are linked to high resolution specimen images.

Although the Herbarium Catalogue currently covers only c. 3% of Kew's herbarium collections, the coverage does focus on areas of Kew's research interest. All of Kew's African type data are now entered, most with associated images, and monocots are also well represented due to digitisation within the Monocot Types Project, supported by the Global Biodiversity Information Facility (GBIF). Details of additional digitisation projects are provided on the website.

By giving remote access to Kew's holdings, the Herbarium Catalogue will not only aid taxonomists but it will also interest the wider biological community, such as individuals investigating the history of botanical exploration. The number of records available increases daily as digitisation efforts continue.

www.kew.org/herbcat



Specimen image of *Stapelia gettleffii* (Apocynaceae) from Kew's Herbarium Catalogue.

Rubiaceae Checklist

The World Rubiaceae Checklist Project, funded by GBIF within the Electronic Catalogue of Names of Known Organisms (ECAT) programme, started in February 2005. The checklist is now available through the Kew website. It includes 13,183 accepted species and 611 accepted genera, with access to 36,385 names in total.

www.kew.org.uk/wcps/rubiaceae

Arum Key

An interactive key to the genus *Arum* forms the first installation of the NERC-funded Creating a Taxonomic e-Science (CATE) project. This collaboration between Kew, the Natural History Museum and Imperial College London is developing ways to present a web-based, consensus taxonomy for exemplar plant and animal groups.

www.cate-project.org

NEW PROJECT FUNDING

Successful funding applications this year will result in Kew scientists leading four new Darwin Initiative projects and hosting three Marie Curie Fellowships, as well as undertaking research on pesticidal plants and cryopreservation.

Marie Curie Fellowships

The European Commission's Marie Curie Fellowships allow researchers to broaden their experience in another laboratory. Kew will host three new Fellows.

Irina Belyaeva (Botanical Garden of Russian Academy of Science) will work with Petra Hoffmann on the project 'World classification and phylogeny of Salicaceae s.s.'. Morphological analysis will be used to characterise all 620 species (and hybrids) of *Salix* and *Populus*, the two genera of Salicaceae s.s. Molecular phylogenetic analysis using plastid and nuclear genetic markers will also be used to evaluate phylogenetic relationships within the genera.

Ovidiu Paun (University of Vienna) will study allotetraploids in the genus *Dactylophiza* (Orchidaceae) with Mark Chase. They will examine changes in patterns of expression in the hybrids relative to their parents using AFLP analyses of expressed RNA.

Paul Rymer (Oxford University) will work with Vincent Savolainen on the role of pollination biology and evolutionary ecology in rapid speciation in biodiversity hotspots, especially those in southern Africa. They will evaluate the hypothesis that the variety of floral traits is largely the result of adaptation to attract particular pollinators.

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Cryo-Network

Long-term data have now confirmed that longevity of living specimens is extended in cryopreservation compared to conventional genebanking. However, there is still a need to improve the efficiency and robustness of cryopreservation protocols for under-utilised crops and wild relatives that reproduce vegetatively or have non-orthodox seeds. To facilitate such developments the European Union has approved a three-year 'COST' action (European Cooperation in the Field of Scientific and Technical Research) that brings together 64 plant cryopreservation experts from 50 research institutes in 20 countries. Hugh Pritchard is the UK co-ordinator.

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Darwin Initiative Projects

Kew staff are leading four projects in Round 14 of the UK Government's Darwin Initiative, a programme that aims to promote biodiversity conservation and sustainable use of resources around the world. Projects are collaborative, particularly with stakeholder countries for which training elements are an essential part.

'Monitoring and managing biodiversity loss in SE Africa's montane ecosystems' (leader Paul Smith) will study five mountains (Namuli, Mabu, Chipirone, Cucutea and Inago) in north-central Mozambique. Mountains such as Namuli support known endemic plant and bird species whereas Mabu has perhaps 7000 ha of scientifically-unexplored intact moist forest.

'Habitat restoration and sustainable use of southern Peruvian dry forest' (leader William Milliken) is launched during the UN International Year of Deserts and Desertification. Peru's desert coast is undergoing rapid environmental deterioration. In the southwest only relics remain of the *Prosopis* (huarango) dry forests that have been essential to local livelihoods for 4,000 years. One aspect of the project is to evaluate the capacity for increased production of native forest products, such as *Prosopis* pod flour and syrup.

'Ex-situ conservation of the rare and threatened plants of Mauritius' (leader Steve Alton) will seed-bank 300 native species over three years, thus implementing Target 8 of the Global Strategy for Plant Conservation. Germination constraints of the rarest species



Relic riparian dry forest in southern Peru.

Pesticidal Plants

The Natural Resources Institute (University of Greenwich), Mzuzu University (Malawi), University of Zimbabwe and Kew have been awarded €700,000 to optimize the sustainable use of pesticidal plants in caesalpinoid woodlands of southern Africa. Plants with pesticidal properties provide poor African farmers with effective, low-cost pest control for crops, stored products and livestock, but their use can have health risks for users and consumers, and over-harvesting of some species threatens the diversity of local habitats. This project will study how these plants work, improve application, harvesting and cultivation techniques and provide health and safety guidelines. Markets developed for these plants in compliance with the Convention on Biological Diversity will promote the conservation of habitat diversity across the region and provide safe wealth-creating opportunities for farmers from their cultivation.

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The last known surviving plant of *Hyophorbe amaricaulis* in fruit in Curipipe Botanic Gardens, Mauritius. This 'Critically Endangered' Mauritian palm has been introduced into culture for the first time by Viswambaran Sarasan of Kew's Micropropagation Unit.

will also be studied to aid in their recovery programmes.

'Red List plants of Cameroon' (leader Martin Cheek) will provide a basis for conserving the threatened plants of Cameroon by assessing the conservation status of every species (c. 10,000). The results will be disseminated as a national Red Data book, conservation checklists for three protected areas, teaching packs and GIS-based maps, thus making the information available for national planning and education in secondary schools.

The Darwin project 'DNA banking, phylogeny and conservation of the South African flora' (leader Vincent Savolainen) has received a further two years extension funding. The project started in 2003 and has now banked DNA from over 4,000 species; it will continue working on integrating evolutionary history and phylogenetic measures of biodiversity into conservation planning. Together with the University of Cape Town, the project team has also just received top-up funding from the Royal Society's UK-South Africa Science Networks programme.

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Hotspots Summer School

Kew and Imperial College organised the first summer school for the nine PhD students working on an EU-funded project to study the World's biodiversity hotspots. Training was given by the Eden Project (photo), the Natural History Museum, the Institute of Zoology and the World Conservation Union, as well as the Millennium Seed Bank Project and Kew's Conventions and Policy Section.

© S. Rendell



Facilities at RBG Kew for research into plant and fungal diversity have been significantly enhanced by the addition of a major extension to the Jodrell Laboratory. Here we report some recent news from the new Wolfson Wing and related laboratory improvements

Wolfson Wing Opens

The Wolfson Wing was opened on 23 June 2006 by Lord May of Oxford. The ceremony culminated a week when over 500 people from the local and scientific communities toured the new facilities and attended presentations on scientific work.

The project, which was completed on time and close to budget in April 2006, increases the size of the building from 3,000 m² to 5,200 m². The new facility allows for expansion and modernisation of research laboratories, including conservation genetics, and greatly improves access to Kew's unparalleled mycology collections, now in one location with improved environmental control. New co-localisation of the mycology, palynology and economic botany groups with Kew's molecular systematics, anatomy and biological interactions teams provides improved integration and sharing of specialist equipment using advanced molecular, anatomical and chemical techniques to gain better understanding of plant and fungal diversity, relationships between organisms, and their uses.

Prof. Michael Bennett OBE, whose contract was extended for almost three years to oversee the scientific planning of the extension, retired in August 2006 after almost 19 years as Keeper of the Jodrell Laboratory, and 14 years as founder editor of *Kew Scientist*. Mike will continue plant genome research as a Kew Honorary Research Fellow based in the new wing.



Lord May (left) opening the Wolfson Wing, with Sir Peter Crane (centre) and Lord Selbourne (right).

New Keeper

Professor Mark Chase FRS, Head of Kew's Molecular Systematics Section, has been appointed the new Keeper of the Jodrell Laboratory. Mark is widely recognised in the field of molecular systematics and has contributed to over 340 publications. One of his current interests is the evolution of allopolyploids, hybrids containing multiple chromosome sets from different species.



NEW SCIENCE FACILITIES AT KEW

The new Wolfson Wing of the Jodrell Laboratory

Mycology Move

The move of Mycology to the new Wolfson Wing was completed in June 2006 after seven months of planning and preparation. It was an immense undertaking, involving the wholesale relocation of the Mycology library and over 800,000 herbarium collections. The new wing provides greatly expanded and extended laboratory, herbarium and library facilities and will help secure the long-term future of Mycology at Kew. It has strengthened Mycology's link with the Jodrell's molecular programmes, with immediate benefits for some bar-coding and other DNA-based projects, and for the first time in many years it has brought all the herbarium collections together under one roof making them more readily accessible for research. The purpose-built herbarium facilities are monitored for temperature and humidity and have expansion room for many years ahead. They also provide ample work space for research visitors who, following the official opening of the Wolfson Wing, can now again be fully accommodated and welcomed at Kew.

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New Mycology herbarium

Biotechnology Evening

Over 70 biology teachers from the London area came to the new Wolfson Wing on 19 July 2006 to participate in an evening of lectures, tours, demonstrations and information about biotechnology. The aim was to provide teachers with ideas on how to present plant science to schoolchildren in dynamic ways. The spacious atrium of the Wolfson Wing provided an attractive location for the practical demonstrations, some of which were performed by science and education staff at Kew and Wakehurst Place. Among the many stands, participants were shown how to extract DNA from strawberries, test for botrytis in raspberries using a diagnostic immunoassay kit, micropropagate plants using simple equipment, separate photosynthetic pigments, and undertake a seed research project with the Millennium Seed Bank Project. The evening was organised by Sue Hunt, Kew's Education Officer based at Wakehurst Place.

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Laura Kelly (left) and Rhian Smith (second from right) demonstrating the polymerase chain reaction and gel electrophoresis at the biotechnology evening.

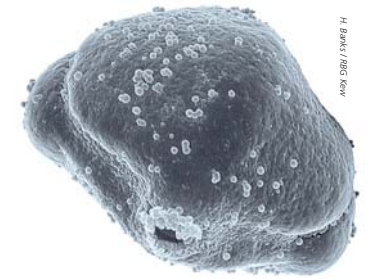
Chromosome Painting

Cytogenetics laboratories adjacent to the Wolfson Wing have undergone major refurbishment. Chromosome painting is one speciality of the laboratory, and for the first time this technique has been used to reconstruct the evolution of chromosome complements in a plant group. Martin Lysak and colleagues at the Institute of Plant Genetics and Crop Plant Research, Gatersleben (Germany), and the Allan Wilson Centre for Molecular Ecology and Evolution, Massey University (New Zealand), have reconstructed karyotype evolution in the model plant *Arabidopsis thaliana* (thale cress) and other Brassicaceae species. They show that karyotypes share a high level of chromosome homoeology, descended from a putative ancestral karyotype with eight chromosome pairs (n=8), and that different ancestral chromosomes were involved in karyotype reshuffling towards lower chromosome numbers (n=5-7) in the extant species. *Proceedings of the National Academy of Sciences USA* (2006) 103: 5224

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Unique Pollen

Pollen research is now carried out in the new integrated micromorphology laboratory in the Wolfson Wing. Comparative pollen morphology is one of a broad range of research disciplines currently being used to evaluate the systematic relationships of the monotypic legume genus *Duparquetia*, a liana native to tropical West Africa. This interesting species possesses unusual orchid-like flowers, and molecular sequence data have suggested that it represents one of the more isolated legume species. Examination of *Duparquetia* pollen by light, electron and confocal microscopy has shown some unique features (the grains are asymmetrical with one encircling latitudinal ectoaperture and two endoapertures), but its development fits broadly with that of other members of the family. In general, pollen morphology is



SEM pollen of *Duparquetia orchidaceae*

relatively stable in more derived legumes compared with a higher level of plasticity in early-divergent species. *Annals of Botany* 98, 107 (2006).

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Plant Uses Past and Present

The first floor of the Wolfson Wing provides offices for staff in the Centre of Economy Botany (CEB), previously housed in the Banks Building. This move enables CEB to work more closely with the Biological Interactions Section as part of the Sustainable Uses of Plants Group. The group has recently received a grant from the Wellcome Trust to study the historical material of *Cinchona* held in the Economic Botany Collections.

Another project in CEB is Ethnomedica. This project, in which Kew is a collaborator, aims to document the traditional uses of plants in the UK. The Heritage Festival at Kew this summer provided the ideal forum in which to gather more information from the public on their current or remembered uses of UK plants via a kiosk in the grounds of the newly refurbished Kew Palace. To date over 3,000 records have been obtained, and they provide an interesting overview of the diversity of plants used in Britain to treat common ailments.

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Oenanthe crocata

Oenanthe Poisoning

Better housing of Kew's chemical analysis instrumentation is provided in the expanded Jodrell Laboratory. Recently, liquid chromatography-mass spectrometry (LC-MS) was used to investigate the death of a pony suspected to have eaten *Oenanthe crocata* (hemlock water dropwort). The work resulted in improvements to current methods for detecting the toxic compounds from *Oenanthe*. These compounds were found in an extract of the pony's stomach contents. *Journal of Chromatography B* 838, 63 (2006).

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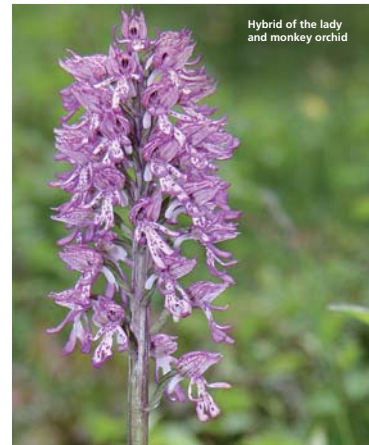
Genetics of a Lady x Monkey Hybrid

A new conservation genetics laboratory has been built adjacent to the existing molecular systematics laboratory as part of the improvements to the Jodrell research facilities.

This year, conservation genetics staff have investigated a hybrid between *Orchis purpurea* (lady orchid) and *Orchis simia* (monkey orchid) that was recorded for the first time in the UK at one of the Berks, Bucks and Oxon Wildlife Trust's nature reserves. Genetic analysis using plastid microsatellites and amplified fragment length polymorphisms proved the plants were hybrids.

On the basis of morphology, Richard Bateman of the Natural History Museum thought that *O. purpurea* was the female parent, and this was confirmed by the genetic analyses. Because both species are threatened in the UK, concerns were raised about the management of the population, but Kew staff advised the Trust to allow nature to take its course. Hybrids between these two species and their close relative *Orchis militaris* are relatively common elsewhere in Europe where they co-occur, and hybridization appears to be part of the natural process.

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Hybrid of the lady and monkey orchid

BOOKS & SPECIAL ISSUES

Fairy Lakes on Mount Jaya.

The Flora of Mount Jaya

New Guinea is one of the most poorly collected tropical areas in the world, but over the past eight years Kew has been studying the upland flora of Mount Jaya, the highest peak in South East Asia at 4884 m. The Mount Jaya area is on the southern coast of Indonesian New Guinea and is well known as being part of the Freeport mining area - one of the world's largest copper mines. A Rio Tinto funded project, with Freepport's support, undertook five expeditions to the area, collecting from sea level to the permanent glaciers that cap Mount Jaya.

A Guide to the Alpine and Subalpine Flora of Mount Jaya (by J. Johns, P.J. Edwards, T.M.A. Utteridge & H.C.F. Hopkins; Kew Publishing; ISBN 1 84246 057 9; £85) has now been published. The book gives concise descriptions of the 705 species of flowering plants, ferns and gymnosperms found growing above 2,800 m. Notes on their ecology, distribution and conservation status are also provided.

This comprehensive record of the high elevation flora of Mount Jaya will be an indispensable resource for everyone with an interest in the ecological management of New Guinea and, in particular, the Lorentz World Heritage Area adjacent to Mount Jaya.

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Kew books can be ordered from www.kewbooks.com

Conventions CD

A new CD-Rom *Biodiversity Conventions for Botanists* contains a copy of all the recent CITES plant checklists published by Kew and copies of the *CITES User's Guide* series. The latter covers a general training guide on *CITES and Plants* as well as specialist guides to succulents and slipper orchids. The CD-Rom also includes a copy of the updated version of *CBD for Botanists*. All of the titles are in English, French and Spanish.

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Palms of New Guinea

The *Field Guide to the Palms of New Guinea* (by W. Baker and J. Dransfield; Kew Publishing; ISBN 1 84246 138 9; £20) is an innovative identification aid that describes and illustrates all 31 genera of palms and many of the most important palm species that occur in New Guinea. The book has been completed as part of the UK Darwin Initiative-supported Papuan Plant Diversity Project, a collaboration between Kew, Universitas Negeri Papua (Indonesia) and the Papua New Guinea Forest Research Institute, and is published in both English and Indonesian language versions. It has been designed for anyone who is interested in the palms of New Guinea regardless of their experience or botanical expertise, but will be of particular interest to those who encounter palms regularly in the field, such as students, foresters, field botanists, ethnobotanists, ecologists and conservationists. The field guide is a precursor to a more extensive account of the palms of New Guinea that is currently in preparation.

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Savannas and Dry Forests

Neotropical Savannas and Seasonally Dry Forests - Plant Diversity, Biogeography, and Conservation (Eds. R.T. Pennington, G.P. Lewis & J.A. Ratter; Systematics Association / CRC Press; ISBN 0 8493 2987 6, \$119.95) was published in April 2006. The book is the result of a plant diversity symposium that formed part of a conference on tropical savannas and seasonally dry forests held at the Royal Botanic Garden Edinburgh in September 2003 and sponsored by the Systematics Association. Fifty leading scientists, representing a variety of disciplines and nations, contributed to the 20 chapters in the book, which presents the first overall synthesis of patterns of plant diversity in the species-rich savannas and seasonally dry forests of the Neotropics. The chapters range from local plant inventories to the detailing of modern techniques of molecular biogeographic analysis and emphasise conservation issues.

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Cyrtostachys loriae below Mt Jaya, New Guinea.

Palm Proceedings

A special issue of the *Botanical Journal of the Linnean Society* (vol. 151 part 1, May 2006) guest edited by Bill Baker (Kew) and Scott Zona (Fairchild Tropical Botanic Garden) was published in May 2006. The issue contains the proceedings of the International Palm Symposium, held at Kew and the Linnean Society in April 2005, and includes papers on structural biology, phylogeny, fossils, ecology and conservation; five of these papers were co-authored by Kew palm specialists.

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Stunning Seeds

Seeds - Time Capsules of Life, by artist Rob Kessler and Kew seed morphologist Wolfgang Stuppy, is a new popular science book. It gives a highly readable account of the natural history of seeds that is accompanied by stunning imagery of some of the most spectacular examples of seeds and fruits. Published by Papadakis Publisher in collaboration with Kew; ISBN 1901092666 (hb); £35.

Contact: Dr Wolfgang Stuppy (w.stuppy@kew.org)



Minaria campanuliflora (reproduced with permission from *Taxon*)

New Genus

Alessandro Rapini (Universidade Estadual de Feira de Santana, Brazil, and a former Kew Latin America Research Fellow) and his colleagues Tatiana Konno (Universidade Federal de Juiz de Fora, Minas Gerais, Brazil), Dave Goyder and Mark Chase (Kew) have been studying relationships among Neotropical Asclepiadoideae (Apocynaceae) for the past several years. They found that a clade of shrubby species with minute leaves that had been classified as *Ditassa* is not at all closely related to the type species of that genus, so they have proposed this group as a new genus *Minaria*. All 19 species are known to occur in the state of Minas Gerais, Brazil, hence the name, but two species extend as far as eastern Bolivia and adjacent Argentina. Fourteen species are endemic to the Espinhaço Mountains, many with extremely narrow ranges in cerrado (savanna-like) and campos rupestres (rocky fields) vegetation. Five species have been known only since 2000. *Taxon* 55, 421 (2006).

Contact: Prof. Mark Chase (m.chase@kew.org)

Brazilian PhDs

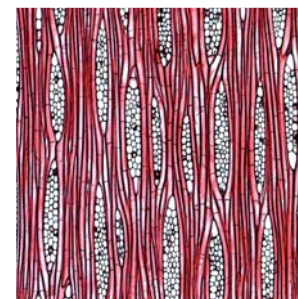
The first three PhD theses produced through Kew's collaboration with the Universidade Estadual de Feira de Santana (UEFS) in Bahia, Brazil, were completed and successfully defended in August 2006. Ivanilza Moreira de Andrade performed 'Morphometric and genetic studies on populations of two species of Araceae from forest areas in Brazil, especially in Ceará.' Lázaro Benedito da Silva studied the 'Structural variation in the wood of four caatinga species from northeast Brazil and their potential for sustainable development.' Roy Funch undertook an 'Evaluation of the extent of the Chapada Diamantina National Park (Bahia, Brazil) by means of vegetation analysis.'

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Mahogany 'Out-of-Africa'

Using information on fossils and extant diversity/endemism in the mahogany family, Meliaceae, Alexandra Muellner and colleagues at Kew and Vienna performed a global biogeographic study with a phylogenetic tree based on plastid data for all subfamilies, tribes and nearly all genera of the family. They found that Meliaceae are of African (western Gondwanan) origin and that long-distance dispersal played an important role in the distribution of extant mahogany biota. The direction of dispersal was most likely an 'out-of-Africa' scenario with important dispersal routes across Eurasia and between Eurasia and North America (provided by Beringia and the North Atlantic land bridge) and North America and South America (via island chains and/or direct land connections). Populations in North America, Europe and East Asia were presumably eliminated as tropical climates disappeared from these areas during the Miocene. Extensive Meliaceae fossils demonstrate that the entry of frost-sensitive angiosperms into southern continents from the North Temperate zones must be considered as an important means of dispersal for groups with modern Pantropical distributions. *Molecular Phylogenetics and Evolution* 40, 336 (2006)

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Swietenia macrophylla (Meliaceae), TLC wood

Wood Anniversary

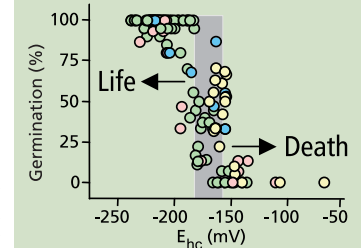
Steven Jansen organised a one-day symposium to celebrate the International Association of Wood Anatomists (IAWA) 75th anniversary at the Botanical Society of America centenary meeting in Chico, California, in August 2006. Steven spoke on the structure and function of bordered pits, and Peter Gasson spoke about institutional wood collections, their value in today's world, and the need for a national wood collection in the UK. Other speakers reviewed the breadth of wood science of interest to IAWA members. The IAWA website is run by Steven Jansen at Kew (www.iawa-website.org).

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Death Defined in Plants

The elucidation of factors that contribute to cell viability loss is compromised by the lack of a universal measure that quantifies 'stress'. Using seeds to study stress response, scientists at Wakehurst Place have shown that a substantial increase in the half-cell reduction potential of glutathione, a major cellular antioxidant and redox buffer, results in viability loss. Ilse Kranner and co-workers propose that an increase in this potential to the 'death zone' of -180 to -160 mV initiates programmed cell death, and they show that DNA is cleaved into inter-nucleosomal fragments in the final or 'execution phase' of programmed cell death. An analysis of data representative of 13 plant and fungal orders confirmed that plant stress generally becomes lethal when the glutathione half-cell reduction potential exceeds -160 mV. This parameter is therefore a universal marker of plant cell viability and can be used to predict whether a seed will germinate or die. *Free Radicals in Biology and Medicine* 40, 2155 (2006).

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Viability (% germination) of seeds is lost at a glutathione half-cell reduction potential (E_{hc}) of -180 to -160 mV. Colours indicate data for four species (reproduced from *Free Radicals in Biology and Medicine* with permission from Elsevier).

Gene Expression in Dormant Seeds

Historically, physiological dormancy of seeds has been investigated widely without knowing which genes are involved. A comprehensive study has now been conducted using microarrays to study gene expression in seeds that are either dormant or germinating. Two sets of genes were identified with 779 genes being expressed more strongly in germinating seeds and 442 genes being expressed more strongly in dormant seeds. These gene sets revealed that dormant seeds have greatly reduced gene expression associated with protein synthesis, compared to germinating seeds, and are further characterised by greater expression of stress-related genes. Furthermore, the data support a role for a balance of the plant hormones abscisic acid and gibberellic acid in dormancy and germination. The results were also applied to dormancy cycling and may explain how seasonal regulation of seed dormancy in the soil is regulated. *The Plant Journal* 46, 805-822 (2006)

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Grasses of China

The account of the grasses for the *Flora of China* was published in June 2006 and is the culmination of five years work on this important family. At nearly 750 pages, it is the largest part published so far, covering all 1,795 species known from China. Of these, 534 species are bamboos (80% of which are endemic) making the volume the first comprehensive English account of this horticulturally important but taxonomically difficult group.

The *Flora of China* is a large international project, with family accounts being written by Chinese and western co-authors. Three Kew botanists collaborated on the grass volume. Sylvia Phillips contributed most of the herbaceous genera, working with Prof. Chen Shouliang (Nanjing University), and was generously supported for the first three years of the project by the Kadoorie Foundation and Parkview International. Chris Stapleton contributed the bamboos with Prof. Li Dezhu (Kunming Institute of Botany, CAS), and most of the volume was edited by Mike Gilbert. An accompanying illustration volume will be prepared over the coming months

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Cameraria damage on horse chestnut leaf

Horse Chestnut Attack

Since 2002 an increasing number of horse chestnut trees in Britain has been attacked by a leaf-mining moth *Cameraria ohridella*. At Kew the majority of *Aesculus hippocastanum* trees and some related species have been badly attacked. This year the moths have multiplied rapidly with six generations already and little evidence of loss via parasitoids. The Sir Jeremiah Colman Gift Trust has provided funds to enable Kew to study how the moth selects the horse chestnut tree. This winter it is planned to remove more of the litter from under the trees to see if this will decrease numbers next spring.

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Miscanthus lutarioriparius

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Flora of China Vol 22 Poaceae; Science Press (Beijing) & Missouri Botanical Garden Press (St. Louis), ISBN 1 930723 50 4; USD140. The *Flora of China* can also be accessed online at <http://flora.huh.harvard.edu/china>

MoU aids 2010 Target

A Memorandum of Understanding signed in Curitiba, Brazil, on 27 March 2006 brings together the CBD Secretariat and eight major biodiversity research institutes, including Kew. Under the agreement, the institutes will help developing countries meet the 2010 target through training in scientific, technical and policy skills in biodiversity conservation. Capacity building activities will cover issues such as the GSPC and access and benefit sharing.

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UK Plant Diversity

In April a conference at Kew organised by the Joint Nature Conservation Committee (JNCC), Plantlife International and Kew assessed progress against the 16 targets of Plant Diversity Challenge – the official UK response to the GSPC. More than 100 delegates heard that much progress had been made against some targets, notably those that could be met by botanists alone, but there was still much to be done if the goals are to be met by 2010. The role of amateurs was identified as a major contribution to successes so far, including the recent *Checklist of the British & Irish Basidiomycota*. Papers from the conference can be found at www.plantlife.org.uk

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M. Hamilton

TOWARDS THE 2010 TARGET

The 2010 Biodiversity Target to reduce biodiversity loss declared by the Convention on Biological Diversity (CBD), and the specific targets of the Global Strategy for Plant Conservation (GSPC) adopted by the CBD, provide a framework for Kew's work in biodiversity and conservation.



Workshop participants in the shadow of Montserrat's active volcano.

Caribbean Regional GSPC Workshop

Funding from Defra's WSSD (World Summit on Sustainable Development) Implementation Fund enabled a Regional Workshop to be held in Montserrat to consider ways of implementing the GSPC in the Caribbean. Facilitators from Kew, JNCC, Botanic Gardens Conservation International and Seychelles Government brought experience in developing national and regional GSPC responses and implementation strategies, while sharing ideas and experiences were delegates from Antigua, Belize, Bermuda,

Cayman Islands, Dominica, Jamaica, Montserrat, St Kitts & Nevis, St Lucia and Trinidad & Tobago. Montserrat provided an appropriate location for evaluating GSPC targets since biodiversity there is under pressure both from an active volcano and re-development following the 1995 eruptions. A regional network has been established and delegates are developing their own national responses to the GSPC.

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By Melissa Wray In Kruger National Park

Science fiction is rapidly meeting science fact in the world of genetic research, and a team of scientists working in the Kruger National Park (KNP) are taking early steps in a process that will someday allow a person to take the tiniest scrap of a plant's leaf, drop it into a handheld machine and minutes later accurately identify what species of plant the leaf came from. No more scrutinising a plant in minute detail, wishing for flowers to emerge to help with identification, or confusion between two closely related species. The reality of this is closer than one might think.

Already scientists have developed a 'DNA barcoding' process for animal species, which allows a tiny scrap of animal skin or blood or any other suitable tissue to be put through a DNA sequencing machine and within a short time reveal whether it was a bird, bat, human, cow, polar bear or any other animal species that provided the tissue sample. The race is now on to develop a similar DNA barcode for all plant life – an ambitious task when you consider that there are some 300,000 different plant species on earth. Kruger is playing an important role in this race and is already a forerunner in that over the last several months more than 1,600 different specimens (around 600 different species) of plants in the park have donated a few leaves to science.

This represents the largest and most diverse sampling ever made for DNA barcoding purposes

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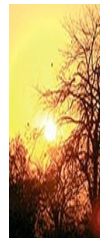
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in a protected area anywhere in the world. Under the supervision of Dr Michelle van der Bank from the University of Johannesburg and Dr Vincent Savolainen from the Royal Botanic Gardens at Kew in the United Kingdom, three postgraduate students have been conducting a complete inventory of Kruger's plant life. Out in the field, Olivier Maurin, Renaud Lahaye and Sylvia Duthoit have been diligently collecting plants according to a pre-determined sampling programme. They collect two types of specimens. Firstly, they collect approximately 30cm long branches/stems with leaves (and flowers and fruit if possible), which are dried out in plant presses or preserved some other way to act as herbarium specimens, in much the same way as early explorers collected the plant life outside of their home countries.

The second specimens that the barcoding team collects are fresh leaves, which are placed in a special silica gel which rapidly dries them out without harming the allimportant DNA inside. The samples are then taken back to the lab, with herbarium specimens being collected for Skukuza's herbarium as well as for Kew's herbarium. The leaves that have been dried in the silica gel are then treated and put into a machine that will sequence the DNA inside the leaf 's cells. Only a tiny amount - 0.3g - of leaf material is needed to provide enough raw material for the genetic sequencing machine to work on. The scientists are not trying to look at every single last scrap of DNA in each leaf. Rather they are looking for one or two genes that are found in all different kinds of plant life, but have a specific makeup that differs from species to species.

By knowing how the exact composition of these genes is different between the species, the scientists can then create a barcode that will allow for rapid identification of different species from samples of unknown origin. And this is where Kruger's rich plant life comes into play – within one national park, researchers have access to a rich variety of raw material to find out which gene is the best one to develop the barcode of plant life. Competition is stiff – there are scientists from 11 different institutions worldwide who are all in a race to be the first to produce a green barcode. Although it's unlikely that a handheld DNA scanner will be on the market anytime in the next few years to help people walking in the bush to settle disputes as to exactly which particular species of grass they are walking on or which exact tree an elephant has just snacked on, DNA barcoding has other uses.

In the search for suitable genes, scientists can also use the genetic material to find out which species are most closely related, and which species that look superficially alike are actually different and therefore in need of conservation. The technology also has implications for fighting eco-crimes – already barcoding can reveal if a hacked-up piece of bushmeat being sold in an open-air market is from an endangered species or is actually a bit of goat meat in disguise.

By barcoding plants, illegal trade in cycads could be more closely monitored by officials with no

botanical knowledge, along with other applications. And with bio-piracy on the increase around the world, conservationists need as many tools as they can get. While the computers and DNA sequencers crunch their way through the 1,600 specimens collected in Kruger and anticipate the next batch of samples to be collected next year as the project continues, taxonomists and botanists are looking at all the herbarium specimens collected in the old-fashioned plant presses.

Using good old-fashioned experience they are identifying all the individual species so that when the high technology spits out a gene sequence, they know exactly who it belongs to. After a hard day of eyestrain in the classification process, they are probably not sure whether to wish for the day that science fiction becomes science fact – because then their years of experience may be replaced by a little black box that anyone can operate.

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