

WAITING FOR THE FLOWERS: THE ROLE OF LIVING
COLLECTIONS IN TAXONOMIC RESEARCH AT THE ROYAL
BOTANIC GARDEN EDINBURGH

George Argent¹

ABSTRACT

Since the Royal Botanic Garden Edinburgh (RBGE) was established in 1670 as a collection of medicinal plants, taxonomy has been at its heart. Even before the publication of Linnaeus's *Species Plantarum* it was important to establish the correct identity of medicinal plants for use by the doctors of the day. Over the years the location and focus of the Garden have evolved to serve many and varied functions. Taxonomy, however, has continued to play a key role in preserving the special nature of RBGE as a 'botanic garden'. From the earliest years exotic plants were introduced to the Garden, giving it an international flavour, and this has continued with staff today collaborating with many different gardens and botanical institutions around the world. For over 300 years living plants have been brought to the Garden, grown to maturity and described. Many of the early novelties came from North America and China, especially gymnosperms and rhododendrons. Today, much of our effort is focused on plants from areas that are botanically rich but poorly known, such as the Malesian region, and on families Begoniaceae, Gesneriaceae, Ericaceae and Zingiberaceae. The expertise and ingenuity of the horticultural staff have been essential in cultivating unknown species and bringing them into flower so that they can be scientifically described. This has been aided by an enlightened policy of including horticulturists on collecting expeditions so that their knowledge can be used to bring plants back in good health but also to better understand the natural conditions in which they grow so that the plants can be grown to perfection in Edinburgh.

Since 1670, when the Royal Botanic Garden Edinburgh (RBGE) was established, its staff have been involved in the growing and naming of exotic plants. What sets a botanic garden apart from any other garden is that the plants are named. This was ruefully brought home to me on a visit to the Mendocino Botanical Garden near Fort Bragg on the US Pacific coast, when the then manager said the mistake they had made was to call it a botanical garden. People thus expected the plants to be labelled, which – if the labels are to be accurate – requires much more work than just growing them. The garden was first created to grow medicinal plants and as such it would always be important to have the correct names on them if they were to prove useful and have predictable and reproducible results.

RBGE has come a long way in the nearly 350 years since it was founded and its nearly 200 years on the present site. Introductions from around the world have played a vital role in building its reputation and importance. In the early 19th century it took

1. George Argent is a Research Associate at the Royal Botanic Garden Edinburgh.
Address: 20A Inverleith Row, Edinburgh, EH3 5LR.
Email: GArgent@rbge.org.uk

- PARROTTA, J.A. & FRANCIS, J.K. (1993). *Pouteria multiflora* (A.DC.) Eyma. Jacana, Bully-tree. Sapotaceae. Sapodilla family. Technical report, USDA Forest Service, International Institute of Tropical Forestry. Available online: <https://www.fs.usda.gov/treearch/pubs/30354> (accessed 29 January 2018).
- PENNINGTON, T.D. (1991). *The Genera of Sapotaceae*. Royal Botanic Gardens, Kew.
- PURNOMO, D.W., MAGANDHI, M., KUSWANTORO, F., RISNA, R.A. & WITONO, J.R. (2015). *Pengelolaan Koleksi Kebun Raya dalam Kerangka Strategi Konservasi Tumbuhan Indonesia*. *Buletin Kebun Raya*, 18(2): 111–124.
- RAKOW, D.A. & LEE, S.A. (2011). *Public Garden Management*. John Wiley & Sons, Hoboken, NJ.
- SOERIANEGARA, I. & LEMMENS, R.H.M.J. (eds) (1994). Plant Resources of South-East Asia, No. 5(1). *Timber Trees: Major Commercial Timbers*. Backhuys Publishers, Leiden.
- SOSEF, M.S.M., WONG, L.T. & PRAWIROHATMODJO, S. (eds) (1998). Plant Resources of South-East Asia, No. 5(3). *Timber Trees: Lesser-known Timbers*. Backhuys Publishers, Leiden.
- TRUONG, M.H., TRAN, D.H., NGUYEN, T.H., HAI, H.H., TUNG, T.D., LE-TAM, V.T., NGOC-TAM, B. & ELLIS, R.H. (2006). Seed development, maturation and storage behavior of *Mimusops elengi* L. *New Forests*, 32: 9–19.
- VARGHESE, B., NAITHANI, R., DULLOO, M.E. & NAITHANI, S.C. (2002). Seed storage behaviour in *Madhuca indica* J.F. Gmel. *Seed Science & Technology*, 30: 107–117.
- WIDJAJA, E.A., RAHAYUNINGSIH, Y., RAHAJOE, J.S., UBADILLAH, R., MARYANTO, I., WALUJO, E.B. & SEMIADI, G. (2014). *Kekinian Keanekaragaman Hayati Indonesia 2014*. LIPI Press, Jakarta.
- WIDJAYA, A.H. (2015). Viabilitas Benih Campolay (*Pouteria campechiana* (Kunth) Baehni) Pada Berbagai Bobot Dan Lama Penyimpanan Benih. Unpublished undergraduate thesis, Pakuan University, Bogor.
- WIKRAMANAYAKE, E., DINERSTEIN, E., LOUCKS, C.J. *et al.* (2002). *Terrestrial Ecoregions of the Indo-Pacific: A Conservation Assessment*. Island Press, Washington, DC.
- WILKIE, P. (2011). Towards an account of Sapotaceae for *Flora Malesiana*. *Gardens' Bulletin Singapore* 63(1 & 2): 145–153.

a keen interest in David Douglas's introductions of conifers and shrubs from North America; this was followed at the turn of the 20th century by the immense collections from China by Ernest Wilson, George Forrest and Frank Kingdon-Ward. At this time botany and horticulture were very closely associated, and David Douglas and Ernest Wilson started professional life as apprentice gardeners. The Edinburgh Garden became famous for the rapid description of some hundreds of newly introduced species of rhododendrons, many of them described from living plants in Scottish gardens. So the precedent was set very early on to introduce exotic plants, describe them and exhibit them to the public.

The first official expeditions to the Malesian region were those of B.L. Burtt, who set the precedent of combining botanists with horticulturists and took with him Patrick (Paddy) Woods, a horticulturist by training who would later transfer to the herbarium staff at RBGE. Paddy then continued collecting in New Guinea on his own. Mr Burtt soon afterwards took Adam Martin, a student gardener, with him to Sarawak. These were early days for the modern collection of living material, although at least they were transported by air rather than on ships, which meant they would arrive home in days rather than weeks. Paddy's material, however, did not always get the treatment it deserved. One parcel arrived on a Friday to be opened by the horticultural staff, upon which the specimens were laid out on the potting shed bench and then left uncovered for the weekend. Paddy's wife Pauline fortunately arrived and rescued the situation, but this was a salutary lesson in how not to treat plants and one which made it all the more important to send horticulturists on collecting expeditions. Those horticulturists return with the realisation that collections are made only after considerable physical effort and taking great care to transport the plants in good condition to the point of dispatch or directly back to Edinburgh. Our current horticultural staff have the same opportunities as the scientists to take leave and apply for funding to travel abroad, and they are consummate in their care of newly acquired plants.

Collecting plants from the wild has been described as the 'lifeblood' of a botanic garden. This gives an institution a first-hand insight into the situation of the floras of the world. Collectors come back with observations on the state of vegetation and potential threats to it, which are invaluable in conservation planning. Collecting in the wild provides new and different material exciting for science, aesthetic value and educational potential. Without the effort to collect new plants in new places the same tough plants, resilient to neglect and bugs, will be seen in garden after garden. New plants bring new challenges to cultivation techniques although some lessons have to be learned the hard way. One collection of banana seeds brought back was handed to the Garden staff for cultivation. On enquiring later as to whether they had germinated, I was told, "Oh no, we threw them out as when we placed them in water they all floated and so they were obviously unviable". In fact, the seeds belonged to a group of bananas which have oil rather than starch reserves in them and so they would always float regardless of viability. Other lessons have to be re-learned: Curator David Mitchell made some careful observations on environmental factors while collecting on

different expeditions. One of the surprising (to him) observations concerned the high temperature of natural rainfall in the tropics compared with the cold water we were using to water plants in the greenhouses. This, of course, was well known to Victorian hothouse gardeners who kept tanks of water inside the hothouses so that the water could acclimatise to the ambient temperature before it was used. Garden supervisor Ian Sinclair observed with surprise the growing conditions of Ericaceae in the montane forests, where surface soil as we know it in Britain was virtually non-existent. Here, roots were exploring under the protection of dense bryophytes and even the terrestrials were growing into the loose framework of tree roots and bryophytes which was lacunose with air-filled cavities. As this was a far cry from the mineral soils and dense peaty compost we were then using, Ian devised a completely new compost for our tropical Ericaceae.

Accuracy of plant names and records of their provenance have always been a high priority. Our records system goes back to at least 1850, with batch records even earlier, the old entries in collecting books and card indexes. An electronic system was instituted by the Scottish Office in 1969, one of the earliest for a major botanic garden. We now have the great benefit of Kerry S. Walter, Director of BG-BASE (UK) Ltd, as an in-house data retrieval system. This sophisticated computer system means we have some of the best-kept plant records of any botanical garden in the world, a most important link between horticulture and science.

The Royal Geographical Society/Sarawak Forestry Department 1977/78 expedition to what is now the Mulu National Park was for me a landmark expedition. I travelled with Ross Kerby, then a Garden Supervisor and a great plantsman. He paid particular attention to collecting Zingiberaceae, which at that time Rosemary Smith, Principal Scientific Officer at RBGE, was taking a special interest in. A considerable collection of living material was brought back from this expedition and several of the specimens were described from the living collections which grew in Edinburgh, such as *Zingiber albiflorum* R.M.Sm., *Hedychium muluense* R.M.Sm. (Fig. 1) and *Boesenbergia kerbyi* R.M.Sm., which was named after Ross for his diligent care of these living plants. This expedition also produced the first of the Malesian rhododendrons to be described from Edinburgh: *Rhododendron yongii* Argent, named after the then director of forests in Sarawak. Although this species had been collected earlier it had been confused with *R. rugosum* H.Low ex Hook.f. and only recognised for what it was from the field and garden observations.

Another notable plant which came into cultivation at Edinburgh from this expedition was the orchid *Paphiopedilum sanderianum* (Rchb.f.) Stein (Fig. 2). This extraordinary species had been lost to science and cultivation for nearly 100 years, the early collections having died out and the locality of the species, typically for Victorian collectors, having been kept secret so that no one knew where to look for it until it was re-found first by Ivan Nielson and almost simultaneously by the Edinburgh group. It was flowered for the first time in the 20th century in Edinburgh in 1980 and from this collection the plant was painted and figured in *Curtis's Botanical Magazine*. More



Fig. 1 *Hedychium muluense* R.M.Sm. One of the Zingiberaceae collected by Ross Kerby on the Mulu expedition and grown to flowering at RBGE. Photo: Lynsey Wilson.

importantly it became clear that there was considerable commercial demand, and devious enquiries were soon made as to the exact locality of such an exciting plant. It was realised that the wild populations would be under threat and with the permission of the Malaysian authorities *P. sanderianum* seed (collected from the plants grown in Edinburgh) was successfully micro-propagated and the resulting plantlets made commercially available, thus removing any excuse for illegal collectors to strip plants from the wild.

Orchids have not figured greatly in RBGE but Paddy Woods' collection and revision of *Dendrobium* section *Oxyglossum* resulted in several new introductions and two new species. What is often undervalued about the reduction of names in the group from 111 species to 28 is that many of these reductions are the result of observations of living plants. In its heyday, soon after I arrived in Edinburgh, this was a remarkable collection that in addition to being displayed in the greenhouses was often taken on display beyond Edinburgh, the flowers being not only very attractive but extremely long lasting. They were a great flagship advertisement for the Edinburgh Garden as no one else had a collection to match them.

Zingiberaceae became one of the main focus families for scientific research, and the living collection has been of paramount importance. The rhizomes travel



Fig. 2 *Paphiopedalum sandermanum* (Rchb.f.) Stein. The first flowering of this species in the 20th century at RBGE. Painting by Rodella Purves. Reproduced courtesy of the artist.

relatively easily from the country of origin to Edinburgh. Although they can be large, unwieldy plants in the greenhouses, growing and flowering them in cultivation has yielded a wealth of significant observations. New species and even a new genus, *Distichochlamys* and *D. citrea* M.F.Newman, were described from a Vietnamese collection grown here and in Singapore Botanic Gardens (Fig. 3). Early on, the related

Costaceae were cultivated, demonstrating that the same individuals could produce both basal and terminal inflorescences. This character was previously thought to be a universal difference between species and used in keys to separate them. Studying Zingiberaceae in the greenhouses can be considered a luxury. The complex inflorescences and floral structures make careful examination of critical importance, which is not easy on hurried visits to remote areas in tropical heat often amid biting insects and leeches.

The Ericales project began in 1972 and its aim was to work mostly on rhododendrons but to include an interest in many of the SE Asian genera. *Diplycosia*, although not a showy genus, has provided materials for several new species from the cultivated collections. A valuable consequence of growing novel plants in botanic gardens is that artist portraits can be created from fresh specimens and from the comfort of indoors, and so the extraordinary *Discocalyx* was painted for *Curtis's Botanical Magazine*. *Vaccinium*, less showy than *Rhododendron* but nevertheless with some horticulturally worthy plants, provided several new species such as *V. utteridgei* Argent, which was grown from seed

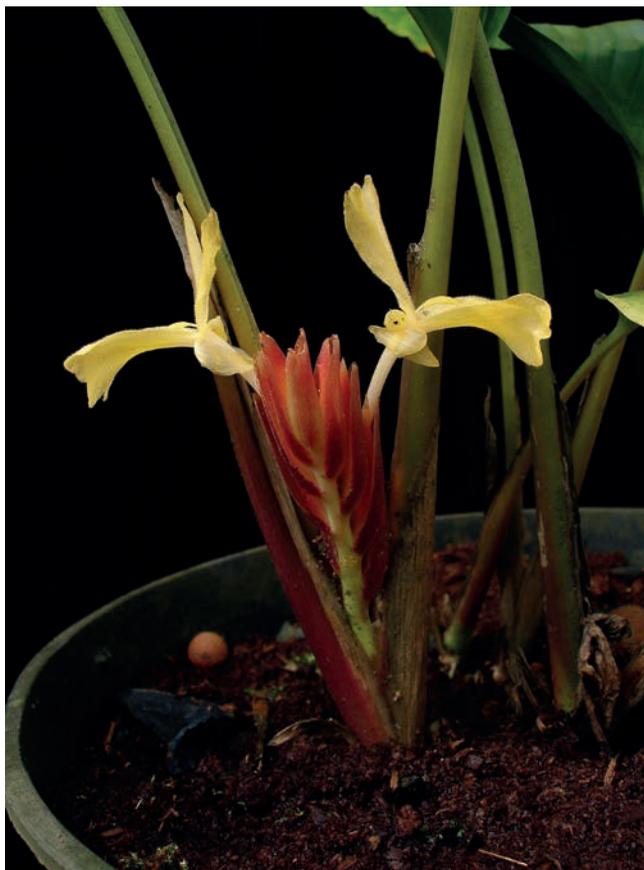


Fig. 3 *Distichochlamys citrea* M.F.Newman, described from a Vietnamese collection grown at RBGE and in Singapore Botanic Gardens. Photo: Jana Leong-Škorničková.

as all the plants collected in the wild were fruiting and without flowers. Undoubtedly *Vireya* rhododendrons have had the biggest impact with their beautiful, showy, often powerfully scented flowers. They have proved important horticultural and educational plants, often flowering in the depths of our gloomy winter and showing a great range of pollination syndromes. Paul Smith, sometime Garden Supervisor, participated in several notable expeditions to collect living plants. He demonstrated his dedication with the introduction of *Rhododendron flavoviride* J.J.Sm. (Fig. 4) to cultivation by climbing a 10 m tree of this species, searching for old fruits and, on finding a single old capsule, carefully retrieving six seeds which were germinated back in Edinburgh. He also pioneered the technique of taking cuttings of seedlings when they were only a few millimetres high and showing how they established and grew much faster than when left on their original roots.

After the Mulu expedition in Sarawak, field work continued in Sabah in collaboration with Kinabalu Park. This resulted in new species being described and in some of the Malaysian staff coming to Edinburgh for training in the growing and managing of *ex situ* collections. A full-colour guide to the rhododendrons of Sabah was published in Sabah as a result of this work (Argent *et al.*, 1988). We were also involved with the Danum Valley Project on which *Boesenbergia aurantiaca* R.M.Sm. was collected, which was flowered and described in the glasshouses in Edinburgh.

A series of expeditions to the Philippines, many involving Garden staff, produced a significant number of both new introductions and new species. A visit to Mt



Fig. 4 *Rhododendron flavoviride* J.J.Sm. From seed collected by Paul Smith in Indonesia and flowered for the first time in cultivation at RBGE. Photo: George Argent.

Mantalingajan on the island of Palawan had the aim of re-collecting *Rhododendron acrophilum* Merr. & Quisumb. This was in fact collected by chance from a sterile plant on a fallen tree and the species was properly described for the first time after it was flowered in Edinburgh. It was collected together with *R. madulidii* Argent, although the latter, with its gorgeous white or pink flushed flowers, was seen and collected on the mountain. Visits to the isolated peaks of Cleopatra Needle and Thumb Peak enabled the collection of *R. mendumiae* Argent (Fig. 5), *R. reynosoi* Argent and *R. palawanense* (Argent) Craven, and the rediscovery of *R. edanoi* Merr. & Quisumb., all collected sterile and grown on in Edinburgh to flowering, where they could be properly and carefully described. These records and those of other new species have added significant impact to the now active conservation movement on Palawan. The rare endemic *R. taxifolium* Merr. from Mt Pulag, Luzon was also introduced to cultivation and distributed to botanic gardens around the world with the permission of the National Museum in Manila. This bizarre-looking but attractive rhododendron serves as a wonderful example



Fig. 5 *Rhododendron mendumiae* Argent, a rare endemic of Palawan, flowered in Edinburgh from a collection of sterile material. Photo: Lynsey Wilson.

of a species 'on the brink'. All the Philippine species mentioned occur in very limited areas of mossy forest which are extremely vulnerable to El Niño droughts. The mossy forests on Cleopatra Needle and Thumb Peak probably amount to less than a hectare between them. One severe drought followed by a lightning strike could easily destroy the habitat for these rare endemic plants.

B.L. Burtt described a prodigious number of Gesneriaceae. Several were cultivated from his Bornean expeditions, the living plants providing valuable morphological, anatomical and cytological evidence. Mr Burtt worked closely with the horticultural staff and valued their skill, professionalism and often their observations. Encouraged by Mr Burtt, Paddy Woods took on the genus *Aeschynanthus* (lipstick plants) and described the remarkable *A. chrysanthus* P.Woods (Fig. 6) from the plant cultivated at Edinburgh, although this had originally been collected in Sumatra by a horticultural student from Kew, Andrew Patterson. The study of *Aeschynanthus* passed to Mary Mendum (née Bates), who travelled on several expeditions to the Philippines and with the horticulturist Steve Scott to Sulawesi. Mary published new species from Cleopatra Needle and Thumb Peak and, jointly with Steve, *A. citrinus* Mendum & S.M.Scott from the living



Fig. 6 *Aeschynanthus chrysanthus*
P.Woods, flowering at RBGE. Painting by
Mary Mendum (née Bates). Reproduced with
the kind permission of Josephine Dewhurst.

plants collected in Sulawesi and grown on in Edinburgh. One of the most remarkable of Mary's introductions was *Cyrtandra cleopatrae* H.J. Atkins & Cronk. The living plant arrived semi-rotten after its long journey. Steve Scott, horticulturist then in charge of the Gesneriaceae, resurrected it from a leaf cutting, using one of the few pieces of healthy tissue, a fine example of the considerable trouble the horticultural staff take with new introductions from the wild.

Studies in *Begonia* are relatively new to RBGE, but Mark Hughes has taken up the challenge of this enormous genus. He has had valuable collaboration with Malesian scientists, especially Pak Wisnu Ardi. Several new species have been described from cultivated material collected from the wild: *Begonia macintyreana* M. Hughes from Sulawesi, a Steve Scott collection; *B. cleopatrae* Coyle, an endemic from Cleopatra Needle in Palawan (Fig. 7); *B. karangputihensis* Girm., named after the white coral limestone which was being rapidly excavated in Sumatra, threatening this species and others with extinction in the wild; and the recently collected *B. yapenensis* M. Hughes from Yapen Island off the north coast of Indonesian New Guinea, collected and grown by Sadie Barber, Andy Ensoll and Louise Galloway. *Begonia* not only has great display and educational value but its enormous diversity gives valuable information on botanical diversity that is potentially of value in conservation planning.

Good relations and collaboration between scientists and horticulturists has been a long-standing hallmark of RBGE and has been essential in its role as a successful international garden. The European Garden Flora project undertaken at RBGE started in 1976



Fig. 7 *Begonia cleopatrae* Coyle. A species described from living material at RBGE collected on Cleopatra Needle, Palawan, Philippines. Photo: Ching-I Peng, Academia Sinica.

and enhanced the collaboration between horticulture and science with active collaboration encouraged at high level between the then curator Dick Shaw and the deputy keeper James Cullen. This approach continued with David Rae as director; David fully appreciated the integrated role that horticulture and science played in the reputation of the Garden. This enlightened approach resulted in the establishment of the journal *Sibbaldia* and a range of exciting garden projects. The good relations between horticulture and science have enabled the description of many new species, cytological observations and now DNA analyses that are allowing new insights into relationships between plants at all levels. RNA is also becoming increasingly important and, unlike DNA, can only be extracted from living plants of which botanic gardens are an important repository.

We are acutely aware of the privilege of working in Malesian countries. We have not sought to commercialise plant introductions but have insisted that our interest is scientific, aesthetic and educational. We aim to share our discoveries with host countries and try to actively promote the transfer of scientific information. We had a policy long before it became formal in most countries that holotype specimens, even when described from material cultivated in Edinburgh, would be returned as a priority to the country of origin. We have always expressed our willingness to repatriate living plants to the country of origin when requested. In 2004, we took *Rhododendron* material back to Indonesia to be grown in the Cibodas Botanical Garden. Scientific and horticultural staff participated in a workshop on growing, processing and recording plants in botanical gardens and were rewarded with over 60 enthusiastic participants. Gabriel Sinot and Ansou Gunsalam came to work at RBGE from Sabah, Malaysia for several months, taking the skills they learned back to the botanic gardens on Kinabalu. Pak Wiguna Rahman from Cibodas and Pak Wisnu Ardi from Kebun Raya Bogor have been valuable horticultural counterparts, sharing their knowledge with us. Peter Wilkie has set up the Sapotaceae project, coordinated from Edinburgh but with worldwide links. He offers advice and is keen to glean information from the trees growing at the Forest Research Institute Malaysia, Bogor and other tropical botanic gardens, to which end he has been working closely with Prima Hutabarat from Kebun Raya, Bogor. Peter also hosted a very successful 'Malaysia Trail' at RBGE in 2012 which was sponsored by the Malaysian Minister of Tourism, the Hon. Dato' Sri Dr Ng Yen Yen, who realised what a valuable 'shop window' RBGE is for Malaysia.

Foreign travel provides field observations, and allows important links to people abroad, sometimes at a surprisingly high level. Scientists collaborate mostly with other scientists, with whom they can share ideas and achieve mutual scientific stimulation. Not least, however, is the collaboration with local villagers who invariably share their own field knowledge freely and are often surprised at the interest and delight shown at what to them is commonplace in their local area.

CONCLUSION

Describing new species is not by any means the only aim of botanists, although this tends to be an easy measure for politicians to understand and so is important in

influencing decision making for conservation or development projects. The ‘add ons’, however, can be just as significant as the new names. Growing plants side by side is sometimes very illuminating in distinguishing genetic from environmental responses. Cytological observations are much easier from cultivated plants that can be stimulated to grow and watched daily for the precise moment to collect root tips or flower buds. Similarly, many other observations can be made on pollination syndromes, changing disposition of floral parts, and aspects of scent and even heat production from floral parts, none of which can be made so easily in the wild. Scanning electron microscopy has become standard for examining structures such as the scales on rhododendrons and with our modern equipment extremely delicate subjects from the living material in the Garden can be examined with the low-vacuum variable-pressure facility. The herbarium has been extensively enriched with cultivated specimens harvested from the living collections and many dried specimens have been sent back to the countries of origin in addition to the types. Tony Conlon has been particularly active in carefully preparing herbarium specimens from the living collections. He patiently cultivated a none-too-attractive *Vaccinium* for 12 years, convinced that it was undoubtedly a new species, only to be ultimately rewarded by a few uninspiring flowers that were quickly determined to be of a common and widespread species.

Botanic gardens provide an attractive environment for people to enjoy themselves, subtly engage people’s attention, help to link people with their environment and stimulate interest in the plant world (Fig. 8). Horticulturists can foster this interest and encourage the next generation of taxonomists. As scientists we enjoy working with horticulturists,



Fig. 8 Schoolchildren having fun at Kebun Raya (Bogor Botanic Gardens), Indonesia. Photo: George Argent.

are keen that we mutually learn from each other and fully appreciate the contribution that they make. If science is to move forwards it requires goodwill partnerships. The partnership I have experienced in Edinburgh between horticulture and science over 40 years has been near exemplary and I feel privileged to have been part of it. The *Flora Malesiana* project has always sought partnership between the countries involved and its continued success will depend on mutual cooperation and understanding.

ACKNOWLEDGEMENTS

This material is based on valuable information from all the Edinburgh horticulturists who have participated in expeditions to SE Asia: Sadie Barber, Tony Conlon, Andy Ensoll, Louise Galloway, Ross Kerby, Adam Martin, David Mitchell, Steve Scott, Ian Sinclair, Paul Smith and Patrick Woods.

I am indebted for illustrative material provided by RBGE library archive, Sadie Barber, Frieda Christie, Tony Conlon, Louise Galloway, Mark Hughes, Jana Leong-Škorničková, Peter Wilkie and Patrick Woods.

REFERENCES

- ARGENT, G., LAMB, A., PHILLIPPS, A. & COLLENETTE, S. (1988). *Rhododendrons of Sabah*. Sabah National Parks Publication, No. 8. Kota Kinabalu, Sabah.