CHANGING TO APG II – THEORY PUT INTO PRACTICE

Janette Latta[1]

ABSTRACT

In the summer of 2006, the Science Division at the Royal Botanic Garden Edinburgh made the decision to change the classification system used in their collections of pressed and preserved plants from the modified Bentham and Hooker system to that published by the Angiosperm Phylogeny Group (APG). As a result of that decision the Horticulture Division also decided to change its records and plant labels to the APG system. This paper describes the effect this had on the work of staff in both the Science and Horticulture Divisions as their collections had to be reorganized and relabelled to show the new family orders.

INTRODUCTION

For over 100 years the Herbarium of the Royal Botanic Garden Edinburgh (RBGE) had been organized according to the classification system of George Bentham and Joseph Hooker, with some modifications made over time. In summer 2006, staff in the Science Division held a full day seminar to discuss proposals to reclassify the Herbarium Collections according to the APG II system (wikipedia.org accessed 2 April 2008). It was felt that, as the institution was in the process of having an extension added to the Herbarium to add extra storage space, this was an opportune time, and possibly the only practical time, to effect the change. After the seminar a vote was held and the proposal was adopted.

Work began to put this large, time-consuming and historically significant process in place in autumn 2006, with the database work being commenced from January 2007. While database work in the genera and family tables was undertaken prior to the move, final work on the names table was delayed at the request of the Horticulture Division so that there would be no effect on the forthcoming *Catalogue of Plants* (Rae, 2006) published late in December 2006. The change in the Preserved (Herbarium) Collections had a knock on effect for the Living Collection as the two collections are held on a common database with common taxonomic relationships. It is considered a beneficial arrangement that the two collections are closely linked so that taxonomic changes are reflected in real time in the Living Collections database.

WHAT IS APG?

The Angiosperm Phylogeny Group or 'APG' is a group of international systematic botanists. These botanists from six different institutions worldwide collaborated to create

[1]Janette Latta is a Senior Horticulturist in the Outdoor Living Collections at the Royal Botanic Garden Edinburgh where she is responsible for plant records and plant labels.
Address: Royal Botanic Garden Edinburgh, 20A Inverleith Row, Edinburgh EH3 5LR.
Email: j.latta@rbge.ac.uk

a consensus view of the taxonomy of flowering plants (see box on Angiosperm Phylogeny Group, p. 149). The basis for the new taxonomic order is a combination of traditional taxonomic methods based on morphological characteristics and new information discovered through molecular systematics (see Wikipedia, http://en/wikipedia.org).

The Group produced an initial paper in 1998, now known as APG I (wikipedia.org accessed 2 April 2008). This paper was based on the work of 29 scientists (see information box on members of APG, p. 149), a much more collaborative effort than had ever taken place before and one which represented a major shift to using molecular data as a basis of taxonomic classifications. This was followed in 2003 by a revision known as APG II, which was the version adopted in 2006 by RBGE.

HOW IS MOLECULAR WORK USED?

How do taxonomists decide where a specific genus belongs in the order of things?

In fact they use varying amounts of DNA data, from a single gene to whole genomes. The APG II classification is primarily based on three genes in the plant DNA, but is also influenced by additional analyses using other genes. Using the results of this analysis the plants are arranged in a diagram that looks a bit like a family tree, called a 'cladogram' or phylogenetic tree (see Wikipedia, http://en/wikipedia.org). Fig. 1 below shows a simplified example showing three genera.

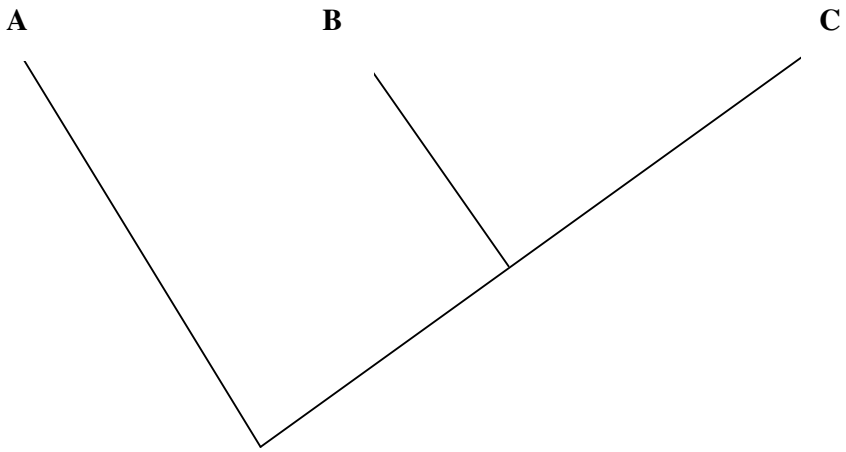

Fig. 1 A simplified cladogram.

Fig. 2 shows that the point of common ancestry between samples B and C is marked, and it can be said that B and C are more closely related to each other than either of them is to sample A (as they share a common ancestor).

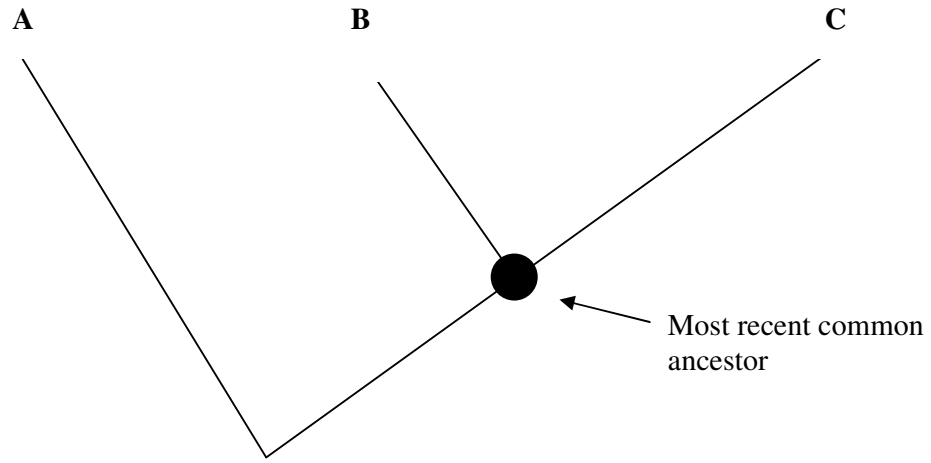

Fig. 2 Cladogram showing point of ancestry. B and C are more closely related to each other than either of them is to A.

In Fig. 3, each of the two cladograms drawn are essentially the same, as the common ancestry determines the relationship between the samples rather than the order of the samples in the diagram. B and C are more closely related to each other than either of them is to A.

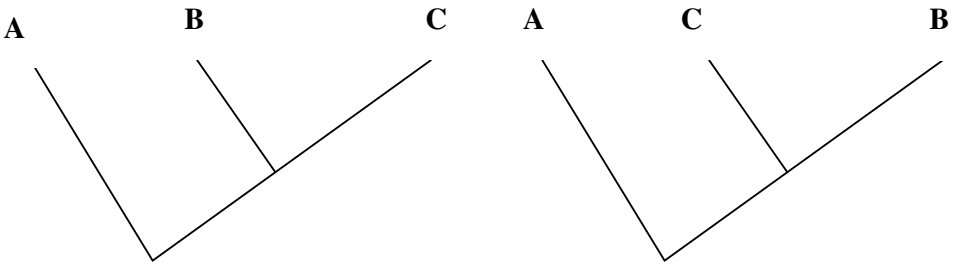

Fig. 3 Two cladograms producing an identical rule.

In Fig. 4, samples D and E were historically in the same family, 'the green family', while A, B, C and F were in 'the red family'; but the cladogram tells us that F evolved from within 'the green family' and it is therefore more closely related to D and E than it is to the rest of 'the red family'. For this reason, systematists would recommend moving it into 'the green family'.

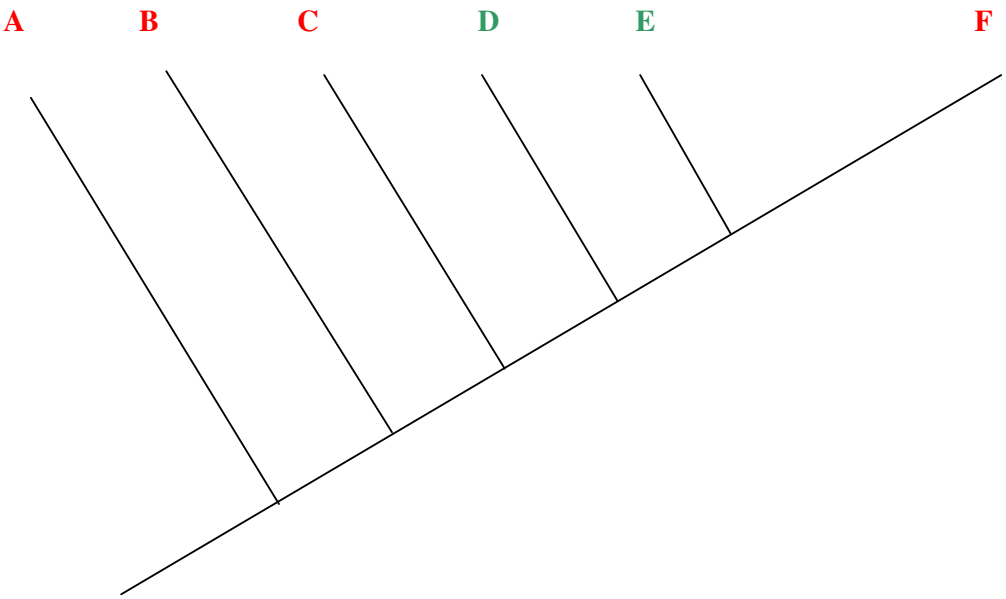

Fig. 4 A cladogram showing an example of a change to family relationships as a result of research.

This method produces an order to the flowering plant world that is more robust than anything that had gone before. "The primary aim of APG II was to create a classification which reflects angiosperms' common evolutionary history by grouping them according

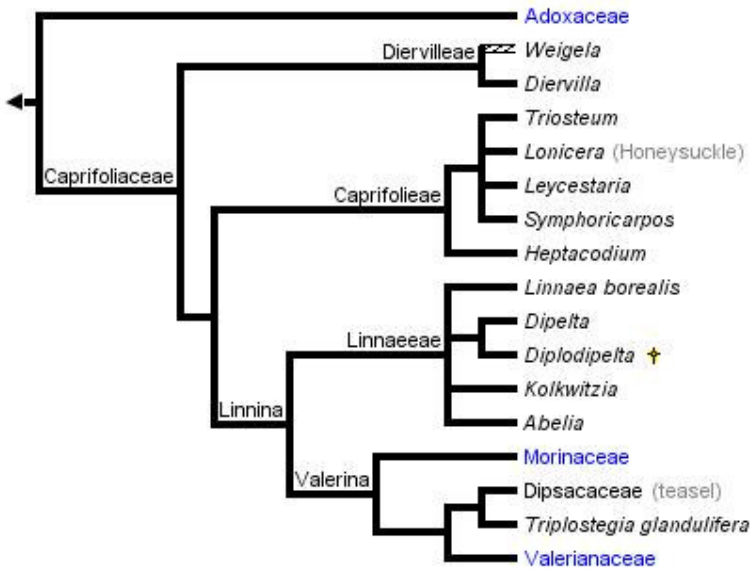

Fig. 5 Part of a real cladogram for family Caprifoliaceae (Bell, 2004).

to their shared ancestry. It is remarkable how closely the majority of traditional family concepts agree with the DNA evidence" (Pendry, 2008).

Fig. 5 shows a real example of a section of what was historically known as the family Caprifoliaceae. In this arrangement it shows how some of the genera have now been reclassified, to recognize what were previously divisions of a large family, as distinct families. The family of Caprifoliaceae has lost members to the new families of Adoxaceae, Diervillaceae and Linnaeaceae, while a smaller group of plants (*Triosteum* to *Heptacodium*) remain in Caprifoliaceae. The familiar genera of *Viburnum* and *Sambucus* are now held in the Adoxaceae family.

EFFECT OF CHANGE ON COLLECTIONS MANAGEMENT

The decision to move to the new classification system was an important one, not least because it would begin a chain of events affecting both the dried specimens in the Herbarium and how they are filed, and the labelling of the plants in each of the four gardens that make up the RBGE Living Collection.

HERBARIUM – THE PRESERVED COLLECTIONS

Since the Herbarium at Edinburgh is not yet fully databased it is impossible to provide accurate information for the number of specimens involved. However, as the reclassification took place in tandem with the expansion of the cupboard space (and in fact was only possible because of the extra cupboard space), the real number of specimens that had to be moved was almost the entire collection – in the region of 3 million specimens. The work brought the total number of families represented in the Herbarium to 479.

Work needed

Although the families to be accepted and used were provided by the APG II paper, they had been listed alphabetically within their major groups rather than by relationships. A completely systematic sequence of the APG II families was written up well before any herbarium sheet was moved, based on a wide ranging review of the current state of knowledge (Haston *et al*., 2007). A detailed filing plan was then drawn up, based on the new classification system and the space used by each genus, so that, when a block of specimens was moved, their new position in the Herbarium had been calculated in advance and those specimens could therefore be moved directly to their new position. The empty cabinets left behind would then be filled by the genera destined for that space. The entire collection was moved in this way, piece by piece, until the colossal jigsaw fitted back together.

The main move took approximately nine weeks with a handful of lead members of staff and a legion of volunteers from the Science Division. This placed all of the genera in their new family groups but left the final sorting of specimens within the families

to be done, as well as the not insubstantial labelling task required to relabel all of the herbarium cabinets and specimen covers. This work is still ongoing and the main cost has been staff time rather than any materials or equipment.

THE GARDENS – THE LIVING COLLECTION

In the Living Collection there was a much smaller volume of work to be done with only those live plants which actually changed family needing to be relabelled. The size of the Collection as a whole is also much less (in the region of 55,000 living plant records), so the magnitude of the reclassification task was tiny in comparison to the preserved collection. However, it was still not a task to be taken lightly. The number of living plant records affected was 4,539 representing 2,351 accessions, 1,267 taxa, 199 genera and 65 families. The total number of labels ordered was just under 4,000 as some plants in back up areas were not given an engraved label.

A list of the genera represented in the Living Collection which changed family as a result of the reclassification is shown in Appendix I.

Work needed

Luckily, the plants themselves did not have to be moved, although this would have been the case if the Garden held them in traditional order beds, planted by family. Each plant held in the display areas of the Living Collection has an engraved plant label that shows the family along with the scientific name, accession number and a few other pieces of information. Each plant involved needed to be relabelled to show its new family name and so a sequence of events had to be followed as described below.

i) Update of the database to show the new family
   The database genera table had already been updated as a result of the work done in the Herbarium. This was because RBGE maintains a unified database for both the living and preserved collections. This has many advantages, one being that the classification system is updated for both collections as soon as any taxonomist updates the database for their work. The database used at RBGE is *BG-BASE*, a system used by many taxonomic institutions worldwide (see information box on *BG-BASE*, p. 149).

ii) Produce lists of the live plants affected
   Once the genera table had been updated a note of the genera affected was sent to the database administrator who compiled lists of living plants which had moved to a new family.

iii) Create label requests
   These lists were used as the basis of the label request records. Label size and type were determined partly by reference to earlier label requests and also by checking

with staff more familiar with particular garden areas to decide which label format would be most suitable. A full stocktake of all plants involved did not take place as there was a high degree of confidence in the accuracy of the plant records. This was because a large stocktake had been carried out in the previous winter. It was felt that the small proportion of errors would be justifiable on cost grounds compared to the time needed for a full stocktake.

After labelling, records were updated for any anomalies encountered and as a result a minimal number of additional labels were ordered.

iv) Produce label orders for the engraving company (see information box on Engraving, p. 150)
The label requests were collated into eight separate label orders, based on family groups. The multiple orders made handling of completed orders more manageable and also meant that early orders could be processed further while others were still at the earlier stages.

v) Check and sort the engraved labels
Completed labels were checked for errors and omissions on delivery from the engraver. The error rate was very low, less than 10 out of almost 4,000.

At the same time as the labels were checked the relevant garden location was written on the back of each label using a Chinagraph Marker crayon. The labels were also sorted into each of the four gardens that make up RBGE and then into locations (or beds) within each garden.

vi) Prepare the labels and their deployment in the garden
Labels requiring stands were attached to those stands by rivets, screws or slide holders (see information box on label stands, p. 150, and Figs. 6–8), while those being hung on shrubs or trees had their wire attached. Labels for a garden area were collected together (see Fig. 10) and placed on or in front of each plant, with staff carefully double checking that they had the correct plant by comparing accession numbers and qualifiers on the old and new labels. Once the new labels had been attached or placed in the ground the old labels were brought in for disposal. Old labels on stands were collected together, as the stands can be removed from the labels for reuse. At present there is no way to recycle the old labels.

Once the Outdoor Collections at the Edinburgh site were fully changed, a team visited each of the three Regional Gardens for two or three days (see Figs. 9, 11, 13), working there alongside local staff to attach labels to stands, wire hanging labels, replacing labels in the gardens, and bringing in old labels for disposal. The relabelling of the Indoor Collection at Inverleith is still ongoing at the time of writing.

These visits were a highlight of the project for the label team, giving them an opportunity to work in tandem with the local staff at each garden (see Fig. 12).

Time and costs

The total person time taken for horticulture personnel was in the region of 600 hours, split into around 113 hours of data entry and label order preparation and checking, then over 480 hours of building and sorting the labels and finally replacing the old labels in the gardens. Label engraving costs totalled approximately £5,000 while label stands, rivets and wire were used from existing stock.

PROBLEMS ENCOUNTERED

It is always useful to look back at a project and see what could have been done differently and this project was no exception. A large investment of time and resources was devoted to managing the label changes, and any ways in which it could have been made easier for a future occasion would be very useful knowledge for the organization.

Accuracy of plant records

The work in the Living Collections depended very heavily on the plant records held in the institutional database, *BG-BASE*. The sorting of the affected plants into manageable lists, the determination of those that were alive and the location of these plants were all made easier by the existence and accuracy of these records. Of course, there were some inaccuracies but the vast majority of the plants were found where they should have been.

Knowledge of collections on the ground

Even with the database guiding the relabelling staff it was still essential for them to enlist the help of staff with local knowledge to help them decipher garden location maps to find the correct locations and to pinpoint the plants they were looking for. The help given by local teams at all four gardens was greatly appreciated and made the job much easier, faster and more enjoyable.

Gridding

Some of the garden areas visited have a simple ‘gridding’ system in place whereby the plants are listed in the order they are encountered in the bed and can be located with reference to the plants around them. However, in some areas, there was no such system and there was simply a list of the plants in that location.

The use of electronic mapping would have made finding the plants easier and potentially faster and this is something that RBGE is hoping to bring into practice in the future. However, the team effort that resulted from the use of local staff rather than a GPS unit was a pleasure to be involved in.

Weather!

Throughout the last phase where the labels were taken out into the gardens the project staff were extremely lucky with the weather. On one day they had to battle through heavy rain and wind and another day had to be rescheduled as the wind was strong enough to force the garden to close. However, in general they enjoyed dry weather, a few snow flurries and even some sunshine!

FUTURE CHANGES

No classification system is static and changes are inevitable. There will no doubt be changes to the current system but these would be put into place more gradually as the new relationships are agreed and published. There should not be any need for major changes such as have been seen in the change from Bentham and Hooker to APG II. There should also be a level of stability, as a system based on international collaboration should be less open to disputes. "It is expected that future changes will be limited to the few remaining species whose placement is still ambiguous" (Pendry, 2008).

INTERPRETATION

Visitors to the Garden's Living Collections need to be informed and educated about what they see. Visitors to the Herbarium are more likely to be from the scientific community and aware of the APG system. Visitors to the gardens, however, may not be aware that family names on the labels have changed or may not understand why.

Interpretation signs for each of the four gardens to explain to the visiting public what has happened are planned along with a description of where they can expect to see changes. This is further supported by an article in RBGE's quarterly *Botanics* magazine for spring 2008 (Pendry, 2008).

APPENDIX I

Genera represented in the Living Collection which changed family as a result of the move to APG II

Genus	Old family	New family
Acer	Aceraceae	Sapindaceae
Dipteronia	Aceraceae	Sapindaceae
Abelia	Caprifoliaceae	Linnaeaceae
Diervilla	Caprifoliaceae	Diervillaceae
Dipelta	Caprifoliaceae	Linnaeaceae
Kolkwitzia	Caprifoliaceae	Linnaeaceae
Linnaea	Caprifoliaceae	Linnaeaceae
Sambucus	Caprifoliaceae	Adoxaceae
Viburnum	Caprifoliaceae	Adoxaceae
Aesculus	Hippocastanaceae	Sapindaceae
Pseudobombax	Bombacaceae	Malvaceae
Pachira	Bombacaceae	Malvaceae
Ceiba	Bombacaceae	Malvaceae
Chorisia	Bombacaceae	Malvaceae
Bombax	Bombacaceae	Malvaceae
Adansonia	Bombacaceae	Malvaceae
Heritiera	Sterculiaceae	Malvaceae
Pterospermum	Sterculiaceae	Malvaceae
Theobroma	Sterculiaceae	Malvaceae
Fremontodendron	Sterculiaceae	Malvaceae
Abroma	Sterculiaceae	Malvaceae
Trochetiopsis	Sterculiaceae	Malvaceae
Ruizia	Sterculiaceae	Malvaceae
Herrania	Sterculiaceae	Malvaceae
Firmiana	Sterculiaceae	Malvaceae
Sterculia	Sterculiaceae	Malvaceae
Guazuma	Sterculiaceae	Malvaceae
Brachychiton	Sterculiaceae	Malvaceae
Tilia	Tiliaceae	Malvaceae

Genus	Old family	New family
Grewia	Tiliaceae	Malvaceae
Sparmannia	Tiliaceae	Malvaceae
Mollia	Tiliaceae	Malvaceae
Callicarpa	Verbenaceae	Labiatae
Caryopteris	Verbenaceae	Labiatae
Gmelina	Verbenaceae	Labiatae
Clerodendrum	Verbenaceae	Labiatae
Oxera	Verbenaceae	Labiatae
Vitex	Verbenaceae	Labiatae
Leea	Leeaceae	Vitaceae
Nothofagus	Fagaceae	Nothofagaceae
Francoa	Saxifragaceae	Francoaceae
Glaucidium	Glaucidiaceae	Ranunculaceae
Acorus	Adoxaceae	Acoraceae
Camassia	Hyacinthaceae	Agavaceae
Hosta	Hostaceae	Agavaceae
Chlorophytum	Anthericaceae	Agavaceae
Anthericum	Anthericaceae	Agavaceae
Leucocrinum	Anthericaceae	Agavaceae
Paradisea	Asphodelaceae	Agavaceae
Hastingsia	Hyacinthaceae	Agavaceae
Chlorogalum	Hyacinthaceae	Agavaceae
Alectorurus	Anthericaceae	Agavaceae
Aloe	Aloeaceae	Asphodelaceae
Gasteria	Aloeaceae	Asphodelaceae
Haworthia	Aloeaceae	Asphodelaceae
Lomatophyllum	Aloeaceae	Asphodelaceae
Uvularia	Convallariaceae	Colchicaceae
Disporum	Convallariaceae	Colchicaceae
Tacca	Taccaceae	Dioscoreaceae
Phormium	Phormiaceae	Hemerocallidaceae
Dianella	Phormiaceae	Hemerocallidaceae
Geitonoplesium	Philesiaceae	Hemerocallidaceae

Genus	Old family	New family
Pasithea	Anthericaceae	Hemerocallidaceae
Cordyline	Agavaceae	Laxmanniaceae
Lomandra	Lomandraceae	Laxmanniaceae
Eustrephus	Philesiaceae	Laxmanniaceae
Arthropodium	Anthericaceae	Laxmanniaceae
Tricyrtis	Convallariaceae	Liliaceae
Scoliopus	Trilliaceae	Liliaceae
Streptopus	Convallariaceae	Liliaceae
Clintonia	Convallariaceae	Liliaceae
Luzuriaga	Philesiaceae	Luzuriagaceae
Trillium	Trilliaceae	Melanthiaceae
Paris	Trilliaceae	Melanthiaceae
Aletris	Melanthiaceae	Nartheciaceae
Liriope	Convallariaceae	Ruscaceae
Maianthemum	Convallariaceae	Ruscaceae
Ophiopogon	Convallariaceae	Ruscaceae
Disporopsis	Convallariaceae	Ruscaceae
Polygonatum	Convallariaceae	Ruscaceae
Convallaria	Convallariaceae	Ruscaceae
Smilacina	Convallariaceae	Ruscaceae
Rohdea	Convallariaceae	Ruscaceae
Dracaena	Dracaenaceae	Ruscaceae
Beaucarnea	Dracaenaceae	Ruscaceae
Calibanus	Dracaenaceae	Ruscaceae
Nolina	Dracaenaceae	Ruscaceae
Dasylirion	Dracaenaceae	Ruscaceae
Sansevieria	Dracaenaceae	Ruscaceae
Aspidistra	Convallariaceae	Ruscaceae
Peliosanthes	Convallariaceae	Ruscaceae
Reineckia	Convallariaceae	Ruscaceae
Theropogon	Convallariaceae	Ruscaceae
Tupistra	Convallariaceae	Ruscaceae
Speirantha	Convallariaceae	Ruscaceae

Genus	Old family	New family
Sparganium	Typhaceae	Sparganiaceae
Cyanastrum	Cyanastraceae	Tecophilaeaceae
Triteleia	Alliaceae	Themidaceae
Milla	Alliaceae	Themidaceae
Tofieldia	Melanthiaceae	Tofieldiaceae
Xeronema	Phormiaceae	Xeronemaceae
Wendtia	Geraniaceae	Ledocarpaceae
Meliosma	Meliosmaceae	Sabiaceae
Tapiscia	Staphyleaceae	Tapisciaceae
Corylus	Corylaceae	Betulaceae
Carpinus	Corylaceae	Betulaceae
Ostrya	Corylaceae	Betulaceae
Ostryopsis	Corylaceae	Betulaceae
Arceuthobium	Viscaceae	Santalaceae
Viscum	Viscaceae	Santalaceae
Celtis	Ulmaceae	Cannabaceae
Scleranthus	Illecebraceae	Caryophyllaceae
Paronychia	Illecebraceae	Caryophyllaceae
Brexia	Escalloniaceae	Celastraceae
Atriplex	Chenopodiaceae	Amaranthaceae
Chenopodium	Chenopodiaceae	Amaranthaceae
Sueda	Chenopodiaceae	Amaranthaceae
Alangium	Alangiaceae	Cornaceae
Carrierea	Flacourtiaceae	Salicaceae
Azara	Flacourtiaceae	Salicaceae
Berberidopsis	Flacourtiaceae	Berberidopsidaceae
Poliothyrsis	Flacourtiaceae	Salicaceae
Dovyalis	Flacourtiaceae	Salicaceae
Xylosma	Flacourtiaceae	Salicaceae
Idesia	Flacourtiaceae	Salicaceae
Camptotheca	Cornaceae	Nyssaceae
Curtisia	Cornaceae	Curtisiaceae
Davidia	Cornaceae	Nyssaceae

Genus	Old family	New family
Nyssa	Cornaceae	Nyssaceae
Liquidambar	Hamamelidaceae	Altingiaceae
Altingia	Hamamelidaceae	Altingiaceae
Picramnia	Simaroubaceae	Picramniaceae
Harrisonia	Simaroubaceae	Rutaceae
Cleome	Capparaceae	Cleomaceae
Corokia	Escalloniaceae	Argophyllaceae
Itea	Escalloniaceae	Iteaceae
Carpodetus	Escalloniaceae	Rousseaceae
Desfontainia	Loganiaceae	Desfontainiaceae
Fagraea	Loganiaceae	Gentianaceae
Gelsemium	Loganiaceae	Gelsemiaceae
Eucryphia	Eucryphiaceae	Cunoniaceae
Citronella	Icacinaceae	Celastraceae
Villaresia	Icacinaceae	Cardiopteridaceae
Pennantia	Icacinaceae	Pennantiaceae
Nitraria	Zygophyllaceae	Nitrariaceae
Peganum	Zygophyllaceae	Nitrariaceae
Eurya	Theaceae	Pentaphylaceae
Visnea	Theaceae	Pentaphylaceae
Ternstroemia	Theaceae	Pentaphylaceae
Cleyera	Theaceae	Pentaphylaceae
Empetrum	Empetraceae	Ericaceae
Leucopogon	Epacridaceae	Ericaceae
Cyathodes	Epacridaceae	Ericaceae
Dracophyllum	Epacridaceae	Ericaceae
Epacris	Epacridaceae	Ericaceae
Prionotes	Epacridaceae	Ericaceae
Trochocarpa	Epacridaceae	Ericaceae
Richea	Epacridaceae	Ericaceae
Pentachondra	Epacridaceae	Ericaceae
Phacelia	Hydrophyllaceae	Boraginaceae
Romanzoffia	Hydrophyllaceae	Boraginaceae

Genus	Old family	New family
Maesa	Myrsinaceae	Maesaceae
Lysimachia	Primulaceae	Myrsinaceae
Cyclamen	Primulaceae	Myrsinaceae
Anagallis	Primulaceae	Myrsinaceae
Antirrhinum	Scrophulariaceae	Plantaginaceae
Asarina	Scrophulariaceae	Plantaginaceae
Bacopa	Scrophulariaceae	Plantaginaceae
Chionohebe	Scrophulariaceae	Plantaginaceae
Cymbalaria	Scrophulariaceae	Plantaginaceae
Digitalis	Scrophulariaceae	Plantaginaceae
Erinus	Scrophulariaceae	Plantaginaceae
Globularia	Globulariaceae	Plantaginaceae
Hebe	Scrophulariaceae	Plantaginaceae
Hemiphragma	Scrophulariaceae	Plantaginaceae
Isoplexis	Scrophulariaceae	Plantaginaceae
Keckiella	Scrophulariaceae	Plantaginaceae
Linaria	Scrophulariaceae	Plantaginaceae
Nothochelone	Scrophulariaceae	Plantaginaceae
Ourisia	Scrophulariaceae	Plantaginaceae
Paederota	Scrophulariaceae	Plantaginaceae
Parahebe	Scrophulariaceae	Plantaginaceae
Penstemon	Scrophulariaceae	Plantaginaceae
Russelia	Scrophulariaceae	Plantaginaceae
Sibthorpia	Scrophulariaceae	Plantaginaceae
Synthyris	Scrophulariaceae	Plantaginaceae
Tetranema	Scrophulariaceae	Plantaginaceae
Veronica	Scrophulariaceae	Plantaginaceae
Veronicastrum	Scrophulariaceae	Plantaginaceae
Wulfenia	Scrophulariaceae	Plantaginaceae
Buddleja	Buddlejaceae	Scrophulariaceae
Gomphostigma	Buddlejaceae	Scrophulariaceae
Myoporum	Myoporaceae	Scrophulariaceae
Mazus	Scrophulariaceae	Phyrmaceae

Genus	Old family	New family
Mimulus	Scrophulariaceae	Phyrmaceae
Bowkeria	Scrophulariaceae	Stilbaceae
Halleria	Scrophulariaceae	Stilbaceae
Lathraea	Scrophulariaceae	Orobanchaceae
Orobanche	Scrophulariaceae	Orobanchaceae
Pedicularis	Scrophulariaceae	Orobanchaceae
Rhinanthus	Scrophulariaceae	Orobanchaceae

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THE ANGIOSPERM PHYLOGENY GROUP

People involved in the APG author group represent six institutions, namely:
Royal Swedish Academy of Sciences;
Uppsala University, Sweden;
Royal Botanic Gardens, Kew, UK;
University of Maryland, College Park, USA;
University of Florida, Gainesville, USA;
Missouri Botanical Garden, USA.
In addition there were contributors from many other institutions.

APG II was compiled by:
Birgitta Bremer
Kåre Bremer
Mark W. Chase
James L. Reveal
Douglas E. Soltis
Pamela S. Soltis
Peter F. Stevens

Contributors to APG II:
Arne A. Anderberg
Michael F. Fay
Peter Goldblatt
Walter S. Judd
Mari Källersjö
Jesper Kårehed
Kathleen A. Kron
Johannes Lundberg
Daniel L. Nickrent
Richard G. Olmstead
Bengt Oxelman
J. Chris Pires
James E. Rodman
Paula J. Rudall
Vincent Savolainen
Kenneth J. Sytsma
Michelle van der Bank
Kenneth Wurdack
Jenny Q.-Y. Xiang
Sue Zmarzty

Ref: Wikipedia, http://en/wikipedia.org

BG-BASE

BG-BASE™ is a database application designed to manage information on biological (primarily botanical) collections. It is used in a wide variety of botanic gardens, arboreta, herbaria, zoos, universities, and similar institutions needing to document their collections as well as to maintain other biological information.
See http://rbg-web2.rbge.org.uk/bg-base/

ENGRAVER

The plastic engraved plant labels used at RBGE are currently provided by IP Engraving, a company based in Cumbria. Orders are sent electronically on an Excel spreadsheet, and then the data is moved into the engraving software by the operator at IP Engraving. Although there is a template detailing the RBGE label layout, there is often some input to adjust font sizes, etc. if a plant has an unusually long name, or the label looks overcrowded. Completed labels are returned by mail.
See www.ipengraving.co.uk

LABEL STANDS

RBGE are experimenting with different types of label stands in the four gardens.

Fig. 6 Traditional aluminium stands have been used which are attached to the labels using rivets. Photo: J. Latta.

Fig. 7 There are a small number of metal stands that are black in colour which hold the label by sliding it between two in-turned lips. Photo: J. Latta.

Fig. 8 At one of the gardens, wooden posts are being tested and these fit comfortably into the landscape. Labels are attached to these using small brass screws. Photo: J. Latta.

Fig. 9 Labelling an *Acer* sp. at Dawyck Botanic Garden. Photo: N. Frachon.

Fig. 10 Labels ready to go to the Rock Garden at RBGE. Photo: J. Latta.

Fig. 11 David Gray at Benmore Botanic Garden, labelling plants around the pond. Photo: J. Latta.

Fig. 12 Benmore Botanic Garden labelling team. Photo: N. Frachon.

Fig. 13 Labelling *Cordyline* in the walled garden at Logan Botanic Garden. Photo: N. Frachon.