THE ROYAL BOTANIC GARDENS, KEW, highlighting its interest in tropical West Africa

F. Nigel Hepper
Retired plant taxonomist at Kew Herbarium, with contributions by current members of staff

About a million Londoners and international visitors go to Kew Gardens every year, yet probably few of them realise that it is more than a fascinating garden with lots of beautiful trees, flowers and water birds. This is in spite of the numerous notices explaining the exhibits and how the labelled plants come from all over the world. These notices also provide information on Kew staff's activities at home and abroad – their expeditions to study plants in the wild and how to collaborate with local inhabitants in order to conserve the forests and wild places from destruction. Plant life is vital for the health of the nations, the air we breathe, the food we eat, the medicines we use, and places where wild animals can live. Forests and grasslands are at risk everywhere in the world as human populations expand as never before.

Fig. 1 Sir Joseph Banks who was President of the Royal Society for forty years, as well as the unofficial director of Kew. As the botanist he had been around the world in Captain James Cook's expedition.

How did Kew Gardens begin? We have to go back to the 18th Century when members of the royal family lived there. Princess Augusta was the mother of King George III. It was the botanical garden she created at her home on the banks of the River Thames, which was a favoured location for noble residences, that formed the nucleus of the great garden of some 120 hectares (300 acres) that was to come. Scattered across the estate were various romantic buildings such as the Grotto, the Cathedral, Mosque and Pagoda designed by Sir William Chambers. Most of these fell into disuse and were demolished in the course of time, but the tall, slender Pagoda was incorporated as a feature into the nineteenth century landscaping by W.A.Nesfield.

Kew's development, however, was not straightforward. When on the death of the princess in 1772, George III inherited her estate, he joined it to his own lying alongside and brought Sir Joseph Banks to direct the enlarged garden in the scientific manner of those times. Nearly fifty years of great activity followed, but on the death of both the King and Banks in 1820, the gardens suffered a serious decline. It was not until 1841 with the appointment by the British government of Professor Sir William Hooker as the first official director that the gardens became a national institution. It was known as the Royal Botanic Gardens, rather than Botanical because that was the fashion of those days and the title has persisted. Under the distinguished leadership of Sir William, and at a time when the British Empire was expanding, Kew developed its role as a leading public botanic garden and scientific institution of truly international stature. The impetus of that first directorship has profoundly influenced the subsequent development of Kew to the present day.

The herbarium, library, art & archives

A herbarium is a collection of pressed and dried plant specimens glued to standard sheets of paper and filed in family order. The part of the large building housing Kew's Herbarium is not open to the public, only to researchers. Over the last two centuries the staff botanists (plant taxonomists) who deal with the classification of plants have had a great deal of contact with tropical Africa, and West Africa in particular. Nineteenth century pioneering expeditions to Africa yielded collections of dried plants which were identified at Kew. Nowadays field work is in collaboration with nationals at local universities or research institutes. Sometimes they come to Kew to gain experience of herbarium work. Kew's Herbarium is now a huge collection with some seven million sheets of the world's flowering plants arranged according to their plant family. Monographs of families and genera are researched and published, as well as geographical handbooks of plant species occurring in national boundaries, known as Floras. One of them relevant to this article is the *Flora of West Tropical Africa* in several volumes (revised edition by R.W.J. Keay & F.N.Hepper 1954-72). This includes the plants occurring in the several countries between the coast and the Sahara, and from Senegal to SW Cameroon. A precursor of the first edition of this work by J. Hutchinson & J.M. Dalziel was W. J. Hooker's *Niger Flora* (1849). Kew even embarked on the Flora of Tropical Africa (1862 in several volumes still

incomplete and by now much out of date) Later, the huge undertaking of the *Flora of Tropical East Africa* (edited by W.B.Turrill, E. Milne-Redhead, R.M.Polhill, & H. Beentje,1952-2011) was completed in 62 years.

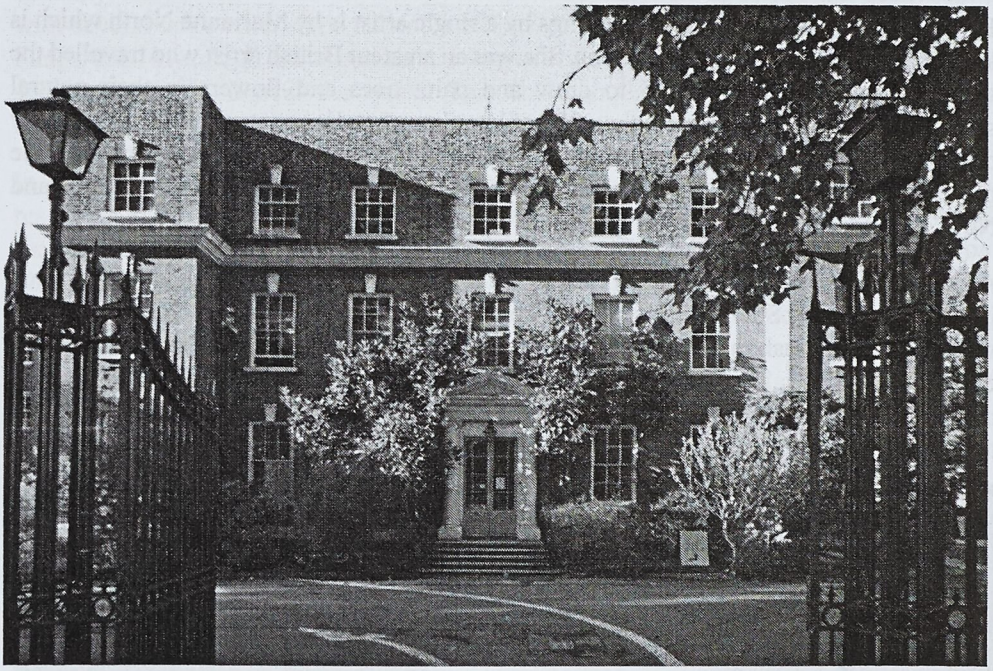

Fig. 2 The Herbarium houses millions of dried plant specimens used for botanical naming and classification.

Currently, fieldwork and study is taking place in SW Cameroon where large National Park/ Nature Reserves have been established in rainforest on Mt Cameroon and in other sites. This is resulting in numerous publications, such as *The Plants of Mount Cameroon: a conservation checklist* by Stuart Cable & Martin Cheek, 1998. Recently, Kew has become involved in the preparation of environmental reports for assessment and conservation of the flora prior to major developments such as opencast iron ore mining in several West African countries. Hundreds of species new to science are being discovered and named in the Herbarium each year. It is vitally important to know what biodiversity exists in order to conserve it, and by naming plants we can open doors to sharing knowledge about them.

Associated with the Herbarium is a large specialist botanical library and archive comprising thousands of floras (regional handbooks of plants) and monographs as well as many series of botanical journals of the world. The importance of Kew's historic archival collections has recently been recognised by the completion of a splendid modern building to house

them. This is open to the public. The Archives include the correspondence and diaries of famous explorers, such as Charles Darwin. There is also a large collection of hand-drawn (line drawings and coloured) illustrations of plants by staff members and many renowned botanical artists.

Perhaps the largest collection of paintings by a single artist is by Marianne North which is kept in a special gallery in the Gardens. She was an amateur British artist who travelled the world between 1872 and 1885 to draw and paint trees and flowers in their natural surroundings. She donated more than 800 of her pictures to Kew, together with a specially designed building to house them for display to the public. Some of these paintings include plants and views of South Africa, with many others from Chile and Brazil to Malaya and New Zealand.

Adjoining this gallery is the Shirley Sherwood Gallery of Botanical Art which was opened in 2008. Dr Shirley Sherwood has a major collection of botanical art by international artists which she generously allows to be shown in the gallery through a series of temporary exhibitions. This gallery principally provides an excellent space to exhibit Kew's own marvellous collections, which are displayed in themed exhibits for visitors to the Gardens to view.

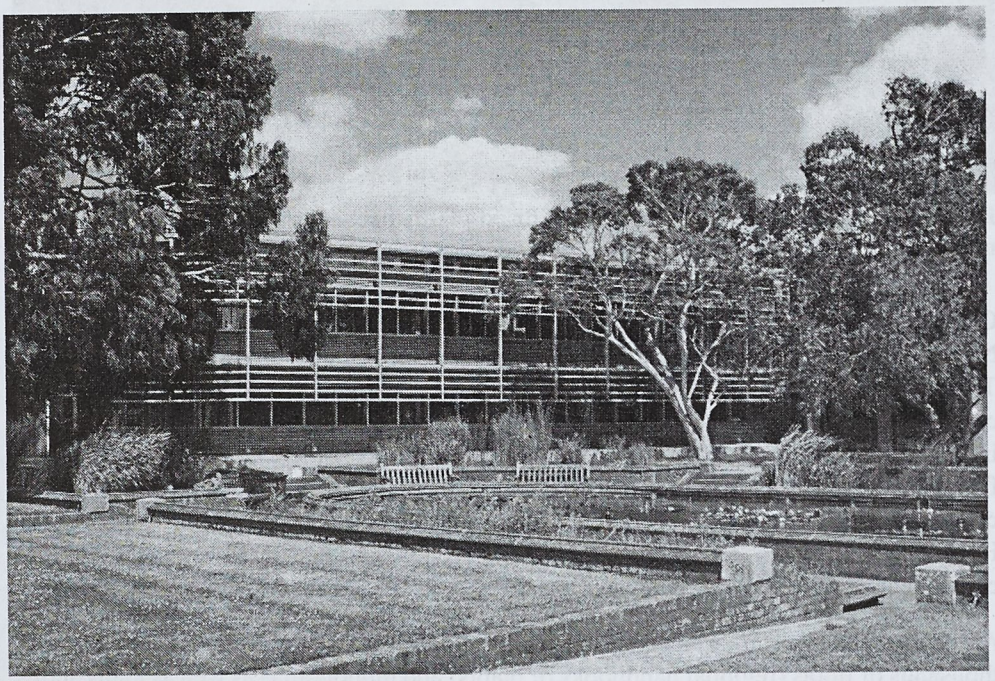

Fig. 3 The recently built extension of the Jodrell Laboratory is the Wolfson Wing which houses the Fungarium. Here it is viewed across the Aquatic Garden planted with moisture-loving species.

Jodrell laboratory

This is Kew's own laboratory which is named after the original benefactor, T.J.Phillips Jodrell who paid for the 1876 building and the scientific equipment for researching plant anatomy, morphology, plant physiology and palaeobotany. Since then, it has been rebuilt, with several large extensions added, too. One of them, the Wolfson Wing, houses the Fungarium (Mycological Herbarium) the largest collection of dried fungi (with 1.2 million specimens) from all over the world. The whole building, although sited in the area frequented by the general public, is not open to visitors.

In more recent years with the continuous expansion of Kew's programme of botanical research other disciplines have been added: cytogenetics, electron microscopy, biochemistry, DNA and other studies. Research scientists, and authorised students, from Africa and other parts of the world join with Kew staff members in researching their specialities. Close liaison is maintained with staff at the Herbarium and in Kew's Living Collections, as well as botanical institutions abroad. Other laboratory facilities are also present in the satellite garden at Wakehurst Place, described below.

The palm house

Contributed by Wesley Shaw who is in charge of the Palm House collections.

The great Palm House is the iconic building that everyone associates with Kew Gardens. Its beautiful curvilinear structure is instantly recognizable as the world's oldest surviving Victorian glasshouse. Built between 1844-1848, it is an example of how Victorian engineers changed from using cast iron to the much stronger wrought iron; inspired by engineering from the shipbuilding industry. This is why the Palm House can be seen from a distance to resemble the upturned hull of a ship.

Originally the coal fired boilers that provided the heat for the house were located in the basement. A 150m long tunnel was constructed so that truck loads of coal could be delivered unseen to the boilers by gardeners that were charged with pushing large containers through the tunnel along a kind of railway track. The fumes from the boilers were then channelled back to a chimney built and disguised to resemble an Italian bell tower. Coal has since changed to much more environmentally gas fired boilers, these are situated in the Shaft Yard and the heated water is pumped through the tunnel to the house.

When the house was first built the glass was tinted green to reduce scorching from the Sun, and all of the plants were grown in large teak containers or terracotta pots, so it would have looked a little different than it does today. Over the years the Palm House has required two complete restorations, the first in the 50s, and the second in the 1980s. During this time pots and containers were replaced with large enclosed beds, which reach a depth of 170cm, enabling a better growing environment for the collections. In the North and South apse ends

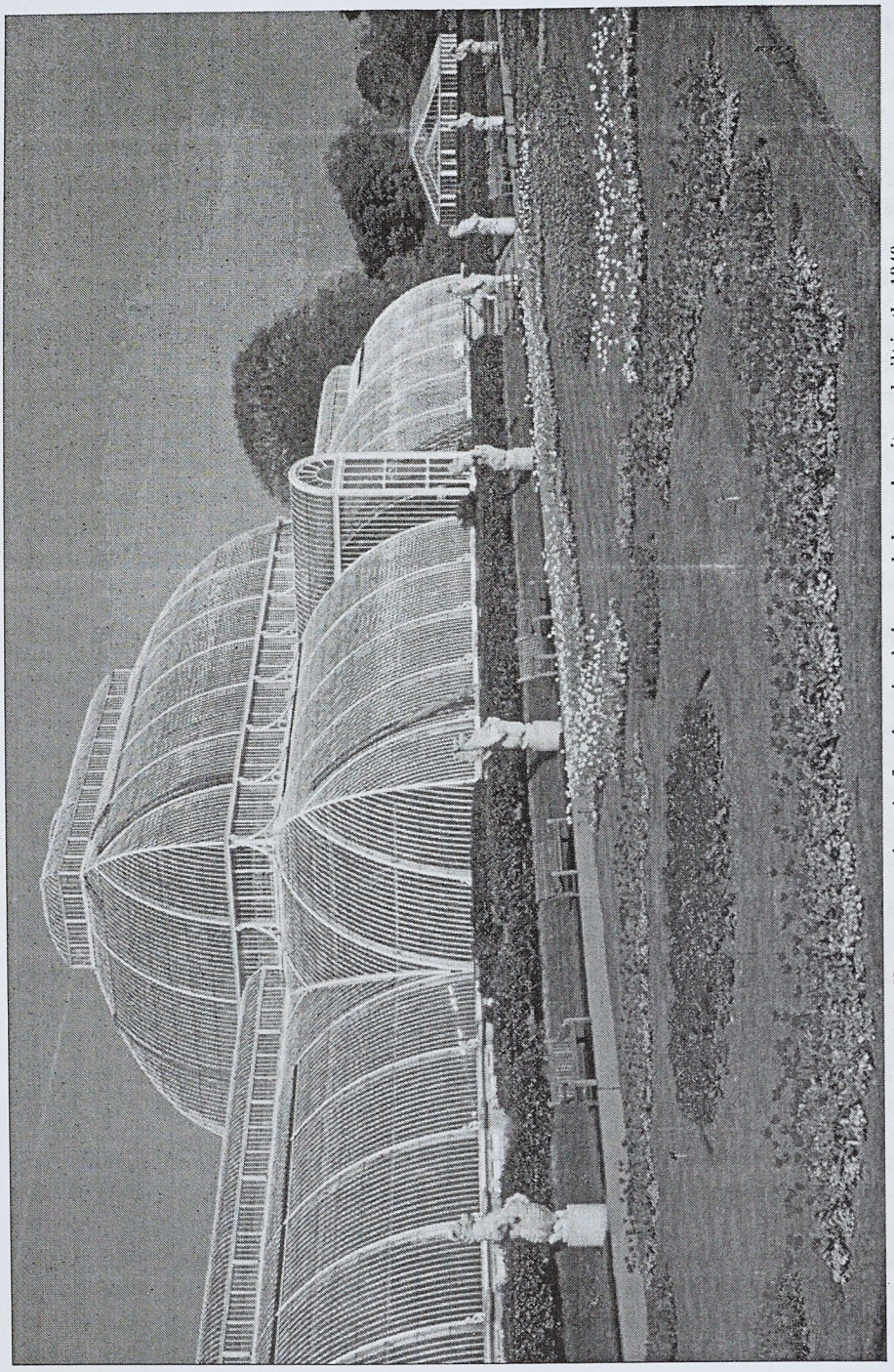

Fig. 4 The Palm House was a triumph of engineering in iron and glass when it was built in the 1840s. Today the exterior ornamental beds are also greatly appreciated by visitors.

plants are still grown in containers as a tribute to how the House used to be presented, teak has since changed to the more sustainable oak.

In one of these oak boxes the old cycad *Encepharlartos altensteinii* can be seen, with a trunk just over 4m long, it is one of the longest surviving plants at Kew, and may possibly hold the title of the world's oldest pot plant. It was collected by Kew's first great plant hunter Francis Masson, who collected the cycad from South Africa in 1775. It has been grown in the Palm House since it was built, being moved only once in the 1980s during the last restoration. In 2009 it underwent a re-potting for the first time in 20 years. It is still thriving today.

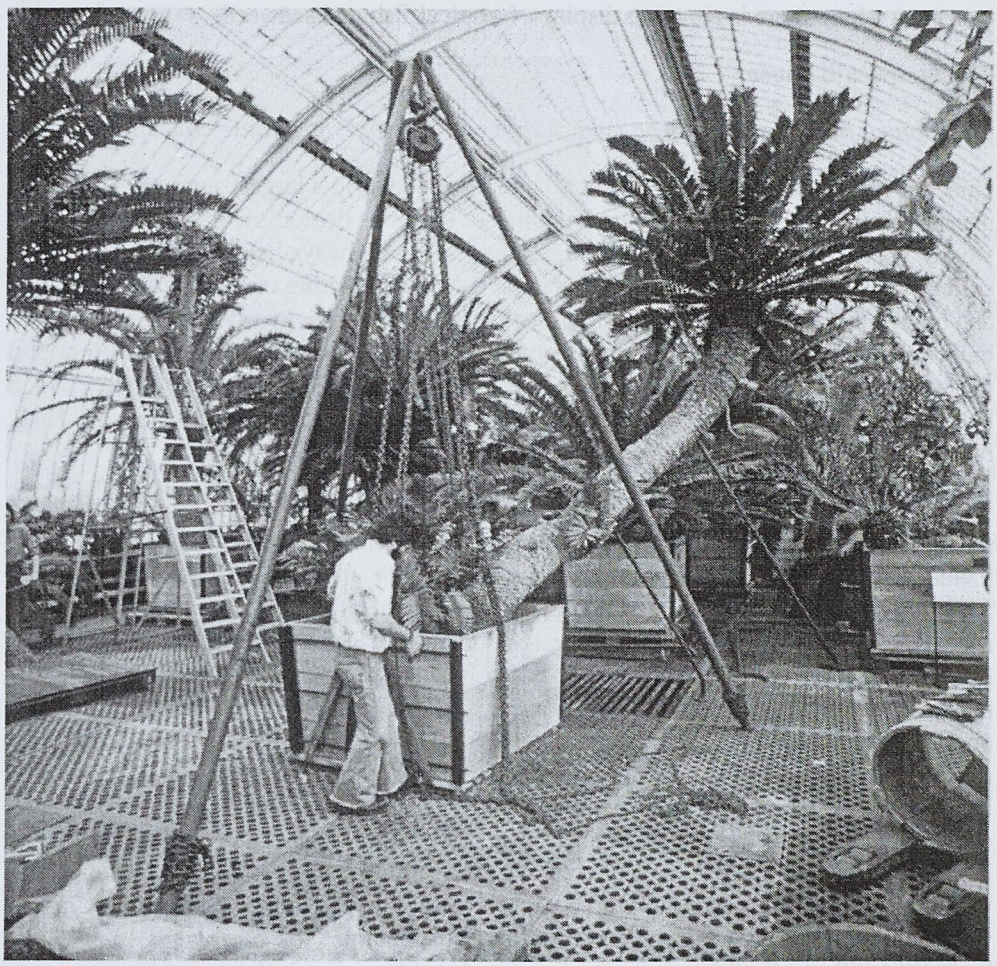

Fig. 5 A large wooden tub inside the Palm House contains the world's oldest greenhouse plant, *Encephalartus altensteinii*, brought from southern Africa in 1775.

The living collection on display are planted to represent the habitat of a tropical rainforest, the plants are used to educate visitors about the importance of rainforest plants for clothing, food and medicine. Therefore much of the collections are dedicated to important economic plants such as bananas, palms, cotton, coffee and other plants of economic importance, well-known in tropical Africa.

The Palm House also incorporates an important palm and cycad collection that is one of the most diverse in Europe, many coming from Africa and Madagascar due to work that Kew's botanists do in the African continent. There are also many rare and endangered species that Kew's gardeners try to conserve. Visitors love to climb the spiral staircase up to the gallery and look down on the palms, bamboos and tropical climbers. They can also descend to the basement where there is a marine display of tropical fish and seaweeds.

The temperate house

Contributed by Dave Cooke who is in charge of the Temperate House collections

Once the largest plant house in the world and now the world's largest surviving Victorian glass structure, the Temperate House is another of Decimus Burton's iconic designs. Tender woody plants from the world's temperate regions have always been a major part of the collection at Kew. In Victorian times, the intensity of collecting meant that the Orangery and many other houses quickly became vastly overcrowded so, in 1859, it was decided to build another major glasshouse to complement the Palm House. The main centre block and the octagons at each end were built between 1859 and 1862 and the end blocks were added between 1860 and 1899. At 4,880 square metres, it is the largest public glasshouse at Kew, twice the size of the Palm House.

Today, the planting is in geographical zones as intended in Burton's original design. The scheme now represents many more regions than there were originally. The plant collection includes many spectacularly beautiful specimens that are deservedly admired, but it represents much more than that. Among the plants on display here are endangered island species being propagated for reintroduction to their native lands, such as *Hibiscus liliiflorus* from Rodrigues Island and *Trochetiopsis erthroxylon* from St. Helena. There are also many plants of significant economic importance such as the date palm, tea (*Camellia sinensis*), quinine (*Cinchona*) and a comprehensive citrus collection. The Temperate House holds an extensive collection of temperate American plants, including fuchsias, salvias and brugmansias. Also in the central section of the Temperate House is the Australian collection, with grass trees; the delightful 'kangaroo's paws' (so called for the shape of its flowers), and a fine array of banksias, named after Joseph Banks, who collected them and who is so intimately connected with Kew.The worlds larges indoor plant is the Chilean wine-palm (*Jubaea chilensis*) in the centre of the Temperate House, which is 16 m (52 ft) high - and still growing! It was grown from seed and there is a replacement nearby, ready for the time when this huge wine palm no longer fits into the roof space. One of the rarest

plants in Kew A cycad, *Encephalartos woodii*, was presented to Kew by the Natal National Park and is not only the rarest plant in the Gardens, but one of the last surviving specimens in the world. The Kew tree is a lone male and it remains an extraordinary challenge to encourage a seed cone from this plant.

Elsewhere in Kew there are other glasshouses, such as the Princess of Wales Conservatory which is a modern complex with an environmentally sophisticated heating system. Parts of it are devoted to cacti and orchids. Even the Alpine plants have their own Davies House with a cooling system for mountain plants. In the Evolution House, visitors are led along a geological time path showing how plants and animals developed through the ages.

The arboretum

Fig. 6 A snowy view down one of W.A. Nesfield's vistas through the Arboretum to the ornamental Pagoda which was designed by Sir William Chambers and built in 1761-62.

This is a living collection of trees that covers much of the Gardens, named from the Latin *arbor*, a tree. The trees are from non-tropical climates as they are planted in the open air. They are mainly arranged in collections according to their families or genera, such a the Pine Collection (or Pinetum) and Magnolia Collection, with spectacular displays of spring bulbs growing in the grassy lawns between the trees. Some are quite ancient British species such as the large oak trees. There is also cedars with widely extended branches, and a cluster of coniferous redwoods from USA where they grow into gigantic trees.

In 2008 the Xstrata Tree-top Walkway was opened in the woodland in the southern part of Kew, not far from the Temperate House. So it is now possible for visitors to climb up the stairs at all times of year and to walk 200m around the platform which is 18m high and level with the upper

flowering and fruiting branches of the forest trees growing there.

The woodland conservation area around the 18th century thatched Queen Charlotte's Cottage has a spectacular natural display of bluebells *Hyacinthoides nonscripta* in springtime.

Rock garden & herbaceous garden

Visitors love to see the colour of flowers throughout the year at Kew, with massed bulbs planted in lawns and grassy places throughout the Arboretum and beside paths. Because this is a botanical garden most of the ordinary, pretty plants of public parks' flower beds give way to unusual, interesting species form anywhere in the world. The formal beds on the east side of the Palm House are always spectacular, as well as the permanent display of roses on the other side

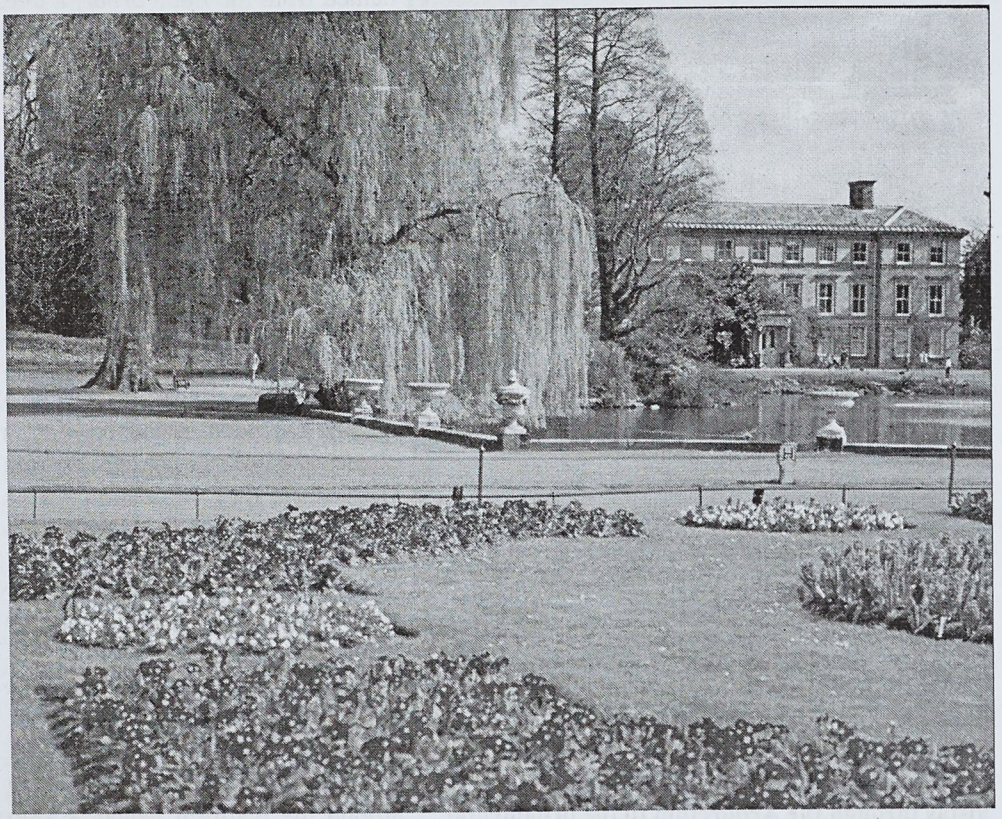

Fig. 7 Museum No 1 of Economic Botany seen across the Palm House Pond.

The Rock Garden has detailed landscaping with large rocks, waterfalls and streams to simulate mountainsides. In crevices between the rocks there are numerous species that one would expect to find in the mountains. Notices explain where they grow and often what Kew is doing to protect them as part of the nature conservation programme. Near by there is a fascinating collection in the Herbaceous Garden grouped according to plant families. There is also an enclosure where the Diploma Students cultivate vegetables as part of their course.

Economic botany collections

Near the Palm House Pond is Museum No 1, a splendid building dating from 1856, housing the fascinating *People + Plants* exhibition. It shows how plants are vital for food, medicine and many other uses and is arranged for family viewing. Many of the exhibits are historic in their own right and are a small representation of the main reference collection of some 85,000 objects, some of them from tropical Africa, kept in the Sir Joseph Banks Building which is not open to the public.

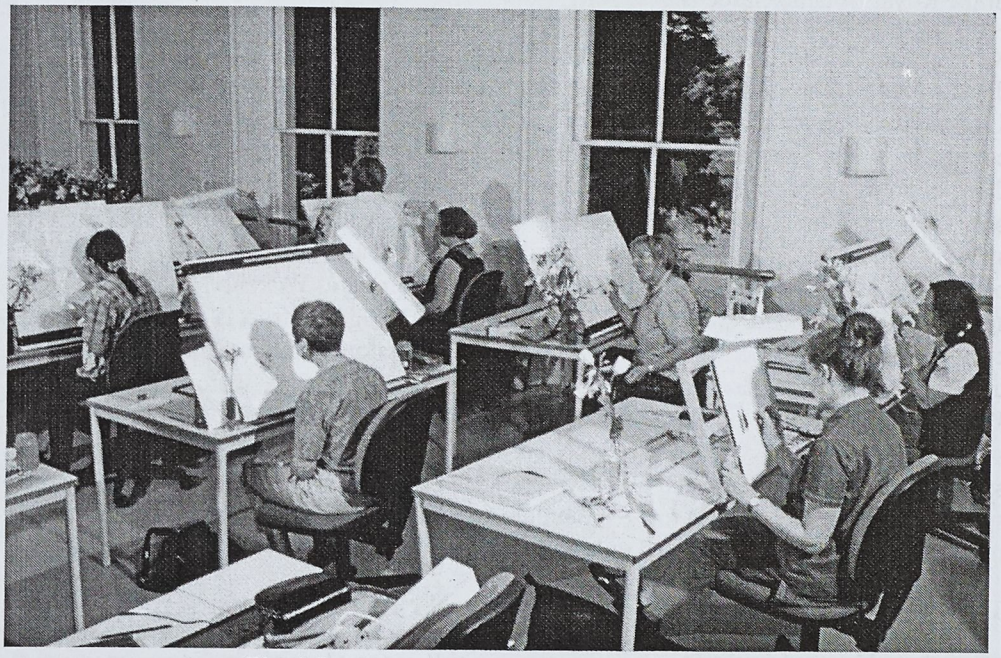

Fig. 8 Students in the School of Horticulture.

Childrens' activities

In recent years young people have been encouraged to visit Kew with school groups – every

year Kew welcomes more than 100,000 children. Others come with families or individually. Play areas furnished with plant motifs and museum displays dealing with useful plants and things made from them are fun and attract attention. In the Arboretum there are ecological displays and recreation places where children can play or study wildlife. As mentioned above, the Museum by the Palm House pond has a fascinating, informative exhibition for people of all ages to show how plants are used for food, medicine, timber and numerous other purposes.

School of horticulture

The Kew Diploma is a qualification admired and highly regarded in horticultural circles. Every year some 14 students from all over the world, often including Africa, embark on the three-year course which is approximately one third lectures and two-thirds practical. Other courses and lectures are also held for international groups.

Wakehurst place

Fig. 9 A view to the 16th century mansion of Wakehurst Place in Sussex, which is also part of the Royal Botanic Gardens.

Kew in the London area as a site for a national botanic garden, was not without its disadvantages. The limitations imposed on its poor soil in the Thames valley led in the 1960s to a search for a satellite garden. The choice of the estate of Wakehurst Place in the county of Sussex was made largely because of its many features that are complementary to those of Kew, and it is more than twice the area. For example, although the two estates are only some 50 kilometres (31 miles) apart, their climates are surprisingly different. The dry summer atmosphere coupled with sandy soil at Kew, contrasts with the cooler, moister air of the high Sussex Weald, where the delayed start of spring at Wakehurst enables tender species to survive better since they begin to grow after danger of frost is largely past. The cleaner country air is better than that of the built-up London area, too. The collections of trees and shrubs are also complementary – Kew having mature, historic trees, while Wakehurst has newer plantings, including rhododendrons and other plants from the southern hemisphere. There was also sufficient space for the construction of the subterranean Millennium Seed Bank where seeds of many of the world's endangered species are preserved alive at low temperatures. In the associated laboratories research on the physiology of seeds is carried out.

The Millennium Seed Bank

Contributed by Dr Moctar Sacande, International Projects Co-ordinator for Africa

By 2010 Kew's Millennium Seed Bank (MSB) partnership is a depository of over 10% of the world's flowering plants (over 25000 species) - and for the next decade, it intends to

Fig. 9 A view to the 16th century mansion of Wakehurst Place in Sussex, which is also part of the Royal Botanic Gardens.

conserve one out of four plant species. The scientific knowledge generated on these seeds is being used for solving technical impediments in wild plant propagation, enabling local communities and end users to benefit from native useful species.

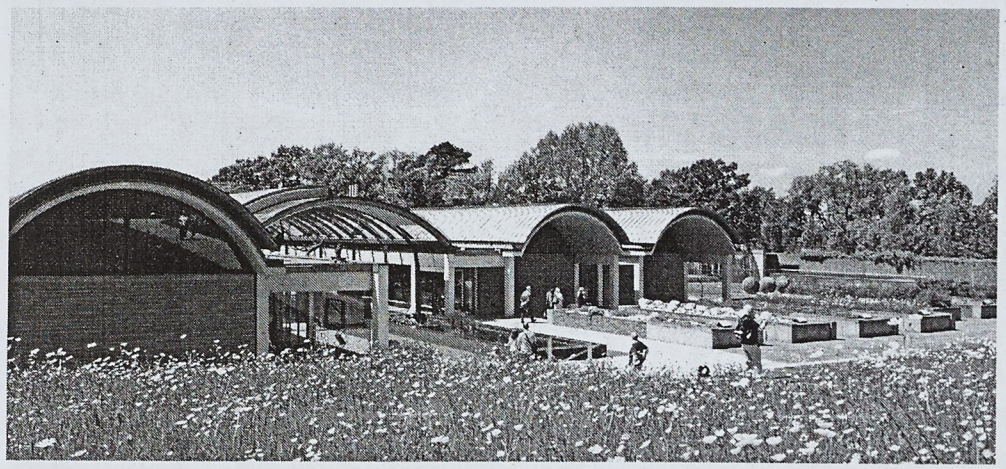

Fig. 10 The exterior of the Millennium Seed Bank at Wakehurst Place.

Domestication of wild species is becoming an imperative and greatly important for species conservation. In 2010, UN International Year of Biodiversity, over 200 selected priority tree species have been produced in over 50,000 seedlings that have been planted by the Kew's MSB partners in Africa. These include medicinal, pesticide or food species such as, for example, *Securidaca longepedunculata, Erythrina senegalensis, Garcinia kola, Tetrapleura tetraptera, Terminalia spp., Spondias mombin, Diospyros mespiliformis, Parkia biglobosa and Vitellaria paradoxa.* The seedlings were planted by various users, including many communities in Mali to mark and celebrate the country 50th anniversary of independence from France; in Ghana in cocoa farms; or elsewhere in village woodlands, sacred forests, school and home gardens. This is being a successful operation as the MSB is assisting in seed handling and germination that is needed in order to grow these wild species. Importantly, this initiative will continue to be scaled up and consolidated so that the MSB partners play a significant technical assistance in af/reforestation, re-introduction, preservation of biodiversity and sustainable use of wild plant species.

In West Africa, the MSB programme in Burkina Faso and Mali, has already collected between 40-50% of their flora, which is banked in country and duplicated at Kew. In both countries, the herbaria are now in an international recognised standard and are being used by conservationists and educationists for native species identification.

Other MSB collaborations in the region are extended to agriculture and forestry institutions

in Benin, Cameroon, Ivory Coast, Ghana, Guinea, Niger, Nigeria and Togo. In these countries Kew delivers training and capacity building in seed banking and conservation techniques, and supports partners on technical issues regarding seed germination and wild plant propagation and domestication.

Because African communities are highly and directly dependent on a diverse range of useful forest products and services, which are being excessively exploited for food, health and in a variety of livelihood activities, domestication and cultivation of these forest species are necessary to address people's needs -- and at the same time to reduce the pressure on natural populations. However, this is a complex process, requiring biological and ecological research on candidate species, which has been for very long a limiting factor to the planting programmes of many forestry and horticulture departments in developing countries. By now Kew's MSB partnership has gathered a great deal of scientific and technical information on most of such important species and, in collaboration with our partners, is helping to cultivate them, some for the very first time.

Fig. 11 The seeds are stored in jars which are kept at low temperatures to maintain their viability.

Conclusion

It will be seen from the foregoing descriptions - brief and selective as they inevitably must be – that Kew's Royal Botanic Gardens, including Wakehurst Place, are diverse and vitally important for the study and conservation of plant life around the world. At a time when the problems of the burgeoning human population are being better appreciated, literally life and death are at risk. We need sufficient plants to support our atmosphere, as well as our population with food and plant products. And the wild flora of forest and grassland from which they are derived must be conserved at our peril.

I wish to acknowledge the help of several current members of staff in the preparation of this account.

Further reading

Desmond, Ray, The History of The Royal Botanic Gardens, Kew. Second Edition, Kew, 2007.

Paterson, Allen, The Gardens at Kew. Kew, 2008.