NATIONAL BOTANIC GARDENS*

THE principal objects of national botanic gardens may briefly be summarised under the three headings: educational, research, and economic. Perhaps a fourth function of a botanic garden should be mentioned, namely, that of recreation. Any orderly garden performing the functions of education and research, and carrying out certain useful economic services, must necessarily provide a place for pleasure and recreation, for nothing is more beautiful, or provides a more restful place, than a well-kept garden. A garden may, indeed, be a place of recreation, without performing in any noteworthy way any of the three main functions mentioned above, and such, I am afraid, is the case of many gardens which go under the name of botanic gardens.

As regards the educational objects a botanic garden should provide information for all those who wish to learn about plants, not merely their names, which the enquirer should be able to get by an inspection of the gardens, but also the uses of plants, which the officers of the gardens should be able to supply either of their own knowledge or from specimens, or from publications issued by the gardens.

The method of fulfilling the educational function of a botanic garden is therefore by maintaining a classified and named collection of living plants, and also a museum of plant products. Material should be available for the use of teachers in educational institutions, while the public are more directly reached by lectures, and popular publications.

The research activities of a botanic garden should concern themselves with the exploration of the native vegetation of the country; with investigations into its economic possibilities—for instance, the properties of vegetable oils, tannins, timbers, and drugs; with numerous ecological and evolutionary problems such as the effects of changes of climate on plants; with the production of new forms by hybridization or other means; with breeding and crossing to show the taxonomic status of wild plants; and generally with the behaviour of plants under changes of soil.

Most of such work should be done in the garden's nursery section, though many of the plants on view to the public may also be under observation for some specific purpose. In connection with research work a laboratory, herbarium, and library are required. A large botanic garden should produce sufficient scientific material to justify the issue of a regular publication.

The economic value of botanic gardens will be perhaps of most interest, especially to the community among which the funds out of which the gardens are maintained are raised.

Included among the functions of a botanic garden of economic importance are the acclimatisation of useful plants, the distribution and exchange of seeds, the quarantining of imported plants, and the publication of useful information. The gardens should be used for the vocational training of horticulturists, while surplus plants should be available to public institutions.

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Taking the essential idea of a botanic garden as the growing of different kinds of plants in order to study them from either a scientific or economic view-point, then its development must be traced through the early temple gardens, and gardens where medicinal and other useful plants were grown, including especially the garden of Aristotle who was a student of botany. In the 16th century the herbalists began to grow plants for the purpose of study, and from these gardens sprang directly the modern botanic gardens. The first of these appear to be those founded in Italy about 1540, and the first herbarium that founded by Geraldo Cibo at the same time and now preserved in Rome. The idea of establishing public botanic gardens spread rapidly, and before the end of the 16th century there were several such in Italy, Holland, Germany, and France. One of the most important of the early gardens was that founded at Pisa in 1543. The second director of this garden was the famous botanist Andrea Caesalpini, and its influence accordingly spread far. Other early Italian botanic gardens were those of Padua, Florence, and Bologna. The earliest public botanic gardens in other European countries were Leiden (Holland) 1577, Leipzig (Germany) 1579, Montpellin (France) 1592, Copenhagen (Denmark) 1600, Upsala (Sweden) 1627, Oxford (England) 1632, and Marid (Spain) 1763. The earliest Asiatic botanic garden is said to be that at Tokyo established in 1638. The garden at Sibpur, Calcutta, dates from 1787, Peradeniya (Ceylon) 1813, and Buitenzorg (Java) 1817.

In Australia there are some long established botanic gardens that of Sydney dating from 1816, and that of Melbourne from 1842.

The earliest American garden is the Missouri Botanic Garden founded in 1859. The Arnold Arboretum was established in 1872, and the New York Botanical Garden in 1894.

Perhaps the chief educational function of a national botanic garden is the maintenance of a collection of living plants. In the larger gardens this is carried out to the point of growing as many as 25,000 species, as at Kew, named and, as far as the exigencies of space and landscape effect will allow, classified according to their relationships. The Buitenzorg Gardens contain about 20,000 species, and lesser numbers are reported from the other great gardens of the world.

Complementary to a collection of living plants are the collections of dried plant-products forming botanical museums. These may exhibit not only specimens and pictures designed to illustrate the most striking plants of the world but also commercial products derived from plants, such as timber, fibres, dyes, drugs, tanning material, oils, gums, and rubber. Museums are established in all the larger gardens. At Kew there are four museums, in addition to the North Gallery containing 800 paintings of plants and vegetation by Miss Marianne North. At Buitenzorg both botanical and zoological museums are maintained in the gardens.

The gardens and museums are the chief branches of a botanical institution open to the public, and as an indication as to how they may be appreciated, the tally kept at the Kew Gardens may be quoted. This shows that the average annual attendance is about 3,000,000.

Of equal importance with the educational functions of a botanical garden is its research work. For this a staff of trained botanists and chemists is kept in all the larger institutions. Their work consists not only in investigaions on the flora of the country in which the garden is situated, but in the case of the larger institutions the field is practically world-wide. Thus the officers at Kew carried out the preparation of a number of floras of different parts of the British Empire, and for many years sent collectors out to various parts of the world, while the New York garden has a station for plant study established in the Blue Mountains in Jamaica.

In Edinburgh and other gardens are laboratories open to anyone desirous of undertaking botanical research, while all gardens supply on request information on specimens for the use of specialists.

The herbaria established in the world's largest gardens have attained immense proportions, those at Kew and New York, for instance, each containing more than 2,000,000 specimens.

The results of the research carried out by the scientific staff of botanical gardens are published in various monographs and other works and serial publications. Among the larger works may be mentioned the Index Kewensis, which is an alphabetical list of every plant name (other than garden names) published, and is still being carried on by decennial supplements; and the various colonial floras issued by the Kew Gardens. The New York Botanical Garden is issuing an extensive work on the North American flora. The "Revision of the Genus Eucalyptus" published by the Sydney Botanic Gardens may also be mentioned here. The periodicals issued by botanical gardens include such important publications as the following: Kew Bulletin, Curtis' Botanical Magazine, Memoirs of the New York Botanical Garden, Mycologia, Annals of the Royal Botanic Gardens at Peradeniya, and the botanical journals issued by the Buitenzorg Gardens.

The economic work of botanical gardens naturally appeals most to the average person who desires to see some immediately useful return for the money expended in the upkeep of the garden. Such a view is, however, quite a narrow one, as it entirely overlooks the æsthetic, intellectual, and social pleasures derived from the beauty, knowledge, and personal contacts derived from well-kept botanical gardens and from botanical societies. However, as in point of fact the economic interest appeals to a more numerous class than the others, the economic functions of botanical gardens as here defined will be described a little more in detail than the educational and research functions though these are of course, of great economic importance, albeit this may not always be immediately seen. In relation to the economic importance of botanical gardens the following statement made by Mr. Joseph Chamberlain in the House of Commons in 1898 will bear frequent repetition.

> "I do not think it too much to say that at the present time there are several of our important colonies which owe whatever prosperity they possess to the knowledge and experience of, and assistance given by, the authorities at Kew Gardens."

The leading part in the distribution of useful plants to various parts of the British Empire undoubtedly has fallen to Kew Gardens. It was after the appointment of Sir Joseph Hooker, as Director in 1865, that the introduction of new and useful plants to the Dependencies of the Empire and the fostering of new industries in connection therewith was especially made one of the chief duties of the gardens. A great many kinds of useful plants have since been distributed to new centres through the instrumentality of Kew. They include various plants producing fruits—pineapples, bananas, breadfruit; beverages—tea, coffee, cocoa; drugs—quinine, coca; fibres—sisal hemp, New Zealand flax, ramie; besides rubbers, dyes, and timbers.

Both romance and tragedy enter into the story of the first attempt to introduce the breadfruit from the South Sea Islands to the West Indies. In this venture Kew was intimately concerned. A gardener named Nelson was attached to the expedition which set out in the *Bounty* in 1787 under Captain Bligh. One of the objects of this expedition was to obtain breadfruit plants in the Society Islands. After sailing from Tahiti, where the vessel remained for about six months, a mutiny broke out on board

the *Bounty* and Bligh and eighteen others were set adrift in an open boat. After a journey of 3,600 miles the Dutch settlement of Timor was reached, but here Nelson died. The breadfruit was successfully introduced to Jamaica in 1791 with the aid of a Kew gardener, Christopher Smith.

The quinine plant, Cinchona, was introduced from South America through Kew to India in 1860, the seeds being first obtained by Sir Clements Markham. At that time it was costing the Government of Bengal £40,000 a year for quinine. Now a dose of 5 grains can be bought for less than a farthing at any post office, while in England the price is one-sixteenth of what it was then. In Ceylon the Peradeniya Gardens played an important part in the establishment of the Cinchona industry in that country, millions of plants being raised and distributed to growers. It was this industry which helped the planting interests to tide over the period between the collapse of coffee and the establishment of the tea industry.

Rubber is an article of daily use, indispensable in the electrical, motor, and other industries, and up to quite a recent date the world was dependent for the best of all rubbers, the para rubber on natural supplies obtained from the tree *Hevea brasiliensis* in the forests of South America. The seeds are very short-lived, but in 1875 some obtained by Sir Henry Wickham from the forest of the Tapajos Plateau, Amazon Valley, were forwarded to Kew. From these 1,000 plants were raised and sent to Ceylon and the Malay Peninsula, thus establishing the species in those regions.

The above examples briefly summarising the transfer of the breadfruit, cinchona, and para rubber plants from one hemisphere to another should suffice to show the important part that botanical gardens have taken in the establishing of industries in different parts of the world.

It remains now to mention two other functions being carried out by botanical gardens: One is the distribution and exchange of both useful and ornamental plants which is carried out extensively by all national botanical gardens, and the other is the training of horticulturists. Two famous training grounds are Kew, where courses of study are laid out which fit horticulturists, especially for appointments to the botanic gardens of the Empire; and Edinburgh, where the course is free, but anyone not showing satisfactory progress is removed.

Finally, it is worth mentioning that the Botanic Gardens of Adelaide maintains a type-fruit orchard, including apples, pears, plums, and peaches, and from which buds and scions are available to growers.