

chief crops being wheat, "corn" (maize), sorghum and alfalfa (lucerne), and very little prairie vegetation is seen. As the Great Plains region is entered the cultivation becomes occasional only, and the country is covered with the typical "short-grass" vegetation, having a totally different aspect from typical prairie. This is a grazing country, and "dry farming" unless with a considerable capital is a very precarious means of livelihood. The shortgrass vegetation is broken here and there by sand-hills which bear (strangely as it will seem to a European) a decidedly more luxuriant vegetation, akin to the prairie type, and largely dominated by bunch-grass (*Andropogon scoparius*). The small streams crossed are dry for a considerable part of the year and as one passes westwards into the Great Plains the fringing woodland gradually thins out and disappears, though the larger rivers which never dry up still retain it.

(to be continued)

---

*HORTUS FLUMINENSIS: THE BOTANIC GARDENS OF  
RIO DE JANEIRO.*

BY R. C. McLEAN.

IT was in accordance with an invitation very kindly extended to me by Dr. J. C. Willis, the present Director of the Botanic Gardens of Rio de Janeiro, that I set sail, at the beginning of October, 1912, for a country which I vaguely knew as very rich, and a visionary City Beautiful. In prospect, a voyage of 17 days seems somewhat formidable, but once accomplished it dwindles surprisingly in the imagination, and leaves one wondering why such voyages are not continually being made by European naturalists, when such rewards are bestowed upon all who accomplish a "sail to the southward."

We steamed slowly into Rio Bay in the glow of a red dawn; and, if there be any spectacle upon earth more glorious, it needs must, I fear, transcend the powers of human appreciation. For Rio is the Amazing City, and seems this morning, circled by fantastic mountains and deep forests, and lapped in pearl-pink mists, fit sea-capital for that legendary isle, whose name *Brazil* was given long ago.

The great bay—no river, in spite of the name—green, and island-studded, nearly landlocked too, save for the narrow gate where the towering Sugarloaf guards the way, stretches up some forty miles or so into the country, where, at the head of it, the Organ Mountains stand: but close by here, where lies the city, the quaintly shaped peaks crowd down to the very water edge; and in and out and roundabout among their foothills, twenty sprawling miles of it, lies the city among its palms, on the most extraordinary site for a metropolis that ever man chose.

Rio is a very large and splendid city, where one may obtain everything of the latest—at a price. It models itself pretty successfully upon Paris; and is perforce delightful.

There is unfortunately no University in Brazil as yet, but there is a celebrated School of Medicine in Rio itself, whence emanates most of the botanical interest in the country.

The Gardens lie in the southern outskirts of the city, some seven or eight miles from the landing-place, on a piece of level ground (a somewhat rare commodity hereabouts) between the peak of Corcovado and a wide lagoon; facing, not into Rio Bay, but towards the open Atlantic. As one approaches the Gardens, the first thing that appears is the line of giant West Indian Royal Palms (*Oreodoxa oleracea*) bordering the road. Passing in by the main entrance, one finds oneself facing along the famous central avenue of these Royal Palms, an avenue half-a-mile in length composed of individuals which are upwards of 150 feet in height. The effect of this gargantuan colonnade is unique, and somewhat overwhelming, but I cannot agree with the critics who find it displeasing. Its size is the saving grace of it, the one feature which no picture gives any true rendering of. This avenue traverses the main garden from North to South, and provides a magnificent *mise-en-scène* for glimpses of the mountains which rise all around. There are also two lateral avenues of the same order of size, all three meeting at the principal entrance.

A traveller's first impressions of a tropical garden are apt to be a little mixed, and depend, indeed, a great deal upon the sort of weather prevailing at the moment. If one's arrival at Rio be in the winter-time—any time that is, between April and September—the uppermost idea is likely to be astonishment, for here the newcomer finds a garden multitudinous with palms and epiphytes, yet an atmosphere so cold that he must wear English clothes or an overcoat, and keep all his flimsy tropical gear in the background. During the winter the climate resembles that of late spring in England. It is the dry season, the skies are clear, the sun is comparatively low and most vegetation passive; for Rio is  $22\frac{1}{2}^{\circ}$  S., and is only 50 miles within the Southern tropic. In September the rain begins to increase by periodical downpours, and every time the sun comes out it is a little stronger and a little hotter; while the hottest time of all, the height of summer, comes in January and February.

During the summer which is *par excellence* the rainy season, the sky is very often overcast and the air is extremely moist, yet for some obscure reason, even when the sun stands vertical in a cloudless sky it has nothing of its Eastern power. The sun-helmet is unknown—one can even spend an hour in the sun without any head covering at all, and escape unhurt—a luxury which those who

know the torrid Indian suns appreciate immensely. Neither is the rain always like Eastern rain; quite uncommon are the torrents from the skies which destroy paths and plants together in a few hours: here is gentle English rain, even sunshine showers.

To find equatorial vegetation and a pure development of rain-forest at so great a distance from the Equator is indeed astonishing. The reason may be found in the local physiography—a low-lying, narrow, littoral belt, backed by high mountains, with a prevailing wind off-sea. The coast is perennially humid: whenever the wind blows off-sea it rains, whatever the season of the year may be, so that the weather is as incalculable as that of an English summer. The Equatorial current keeps the sea warmed for an abnormal distance south, and the effect of this upon the climate may be seen by a glance at any vegetation map of the world showing Drude's phytogeographic areas. Not only does the Tropical American region extend down to the Tropic of Capricorn, but it passes right out of the tropics altogether, and reaches as far as Porto Alegre and the Rio Uruguay, into a region that should be purely temperate.

Indeed, one of the finest and richest pieces of untouched rain-forest yet remaining in Brazil is found at Alto-da-Serra, between Sao Paulo and Santos, in a district actually south of the Tropic.

On the other coast of South America exactly the opposite climatic conditions occur, for the northward-moving Antarctic drift carries the temperate area right up into the Tropics themselves, and even under the Equator, torrid weather is not at all usual.

This piece of forest territory, which is now in the hands of the Government of the State of Sao Paulo, can be recommended in the very highest terms to any who wish to study true rain-forest. It is of wonderful richness, and, I am told, will compare favourably with anything in the Orient. All the well-known characters of jungle are developed abundantly. On the other hand it is very easily accessible, has a healthy, but very moist climate (with a rainfall of  $3\frac{1}{2}$  metres per annum) and there is available a comfortable and splendidly situated bungalow on the area. The ground has been for some years past the property and peculiar care of Herr von Ihring, director of the Sao Paulo Museum, who has cleared paths through the dense jungle, and projected other improvements.

But to return to the Botanic Gardens of Rio. They consist of two portions separated by a road. The one, much smaller portion, comprising about 14 hectares, lies between the road and the marshy edge of the Lagoa Roderigo da Freitas, and remains in a wild condition. The soil is wet and unsuitable for cultivation, but to the botanist the ground is equally interesting in its jungle condition, full of Bamboos and other moisture-loving plants. Big trees will not grow in this part of the garden, and the wood, though dense, does not stand much higher than in England.

The other area, the garden proper, contains about 27 hectares, being practically bisected by the main Palm Avenue. There is not very much open ground, for the marvellous collection of Palms gives rather a woodland aspect to the garden, an appearance which has been intensified by a rather too liberal planting of Mangos. These latter do not fruit in the Gardens, for the water-table is very near the surface, the level of the ground being only some 3-4 feet above the surface of the Lagoa, and the fruit-trees suffer from what

planters call "wet-feet." Nevertheless they form very large and handsome trees. The great size which prevails among the trees, as compared with those of temperate climates, does not appeal to the observer immediately, but becomes impressed upon him gradually. An *Eriodendron*, 40 metres high and large in proportion, looks quite normal among its giant neighbours, and it is only after a little consideration of what a poor figure even a great English Elm would make by the side of it, that the huge stature of the tropical forest tree becomes apparent to the imagination. The last Director but one, Dr. Barbosa Rodrigues, was one of the greatest authorities upon the Palmæ. His library has just been purchased for the Gardens, and will form a valuable asset. The collection of Palms, which he was responsible for introducing into the Gardens, is undoubtedly the finest in the world—comprising nearly 400 species, represented by full-sized specimens in flourishing condition, which lend a charming grace to many of the views in which the Gardens abound. Indeed, from the spectacular point of view, it is scarcely to be believed that anything, in any country, can excel this combination of grand natural surroundings and cultivated beauty.

To realise the grandeur of these hills, the majesty of huge trees and quiet lawns beneath a torrid sun, or the multitudinous abundance of the lesser lives that fill every nook and cling to every crevice, such is the charm that the Gardens of Rio impress upon the minds of those who are happy to linger there.

Swift blaze of dawn, and sea-breeze in the palms, who can forget these things, once known, or the strong vocation that they lay upon him for ever? Or this broad-bladed grass, so painfully pricked-in, root by root, which forms such deep carpets, of purity incomparable, chosen playground of the host of sunny butterflies—all sorts and sizes, from the great *Morpho*, blue and ephemeral as a tropic wave, to the tiny "Figure of Eight" with its quaintly regular markings. Who was it called them "The Dancing Flowers"? Perhaps Lafcadio Hearn—I forget.

Or else this ceaseless wind among the leaves, irritating, perhaps, in the day time, if one be trying to photograph them on a slow plate, but taking on a deeper significance in the cool dusk, when only the winking fire-flies light the shadowy alleys of the trees, and the elfin piping of the tree-frogs welcomes in the night.

The rhapsodical view is apt to be partial, and while writing the preceding paragraph I forgot the mosquitos, which would never have happened in the Gardens themselves. Rio city itself is now wonderfully healthy, with a death-rate lower than that of many a European capital. Both yellow fever and malaria are ghosts of the past which have been laid, and, thanks to the very efficient sanitary service, the mosquito is almost negligible. But the Gardens do not come within the scope of the municipality's efforts, and, surrounded as they are by jungle, the mosquito remains and flourishes, uninfected fortunately, but capable of much minor mischief on its own account. Certainly anyone intending to penetrate into the forests near Rio, or anyone whose work will lead him to be out-of-doors after nightfall should neglect no safeguard against their incessant attacks.

Immediately behind the Gardens rises a hill some 300 feet in height, of which the slope lying towards the Gardens is included in their area. The remainder of these back-lying hills belongs to the

Horto Florestal, a Government institution designed to encourage the cultivation of certain useful plants. The forest on this slope, although not very rich in comparison with some Brazilian forest, has suffered no interference beyond the felling, in the past, of much of its big timber, a fate attending jungle everywhere within reach of human habitation. Nevertheless the timber is even yet heavier than that of many temperate forests, and the whole remains a perfectly presentable piece of tropical rain-forest. Its unique advantages of proximity to the excellent laboratories in the Gardens, enabled it to be used as the *locale* of experiments on certain ecological questions, the results of which will be published later. Although from the physiological point of view its floral diversity was not a matter of import, yet it is not very striking for a tropical forest, though greater than that of the average temperate woodland. There was little difficulty in collecting 50 species from among the ground herbs alone, and the total number of species present, even on this small slope, whose base might be a mile long, and its height perhaps 200 feet, cannot have been less than 300.

The trees are very diverse, but the area includes a specimen of an almost pure palm association (*Asterocaryum Ayri*) not a common phenomenon in tropical rain-forest, which is well-known to be characterised by the almost perfect commixture of its constituent species. For future students who wish to specialise upon forest however, Alto-da-Serra is certainly the spot to be recommended, after a stay in the Gardens has introduced them to the nature of the Flora. It is safe to say that no man living knows the Brazilian Flora in the way that we understand such knowledge in a temperate country. What such a feat would involve will be easily understood when the dimensions of the Flora are indicated.

Brazil is a country nearly as large as the whole of Europe, occupying almost exactly half of the continent of South America, and exhibiting every variety of climate and habitat, from these rain-forests to almost pure desert. Its vegetation has been as little altered by man as that of any other country of similar latitude in the world, except perhaps portions of Africa, and is of unsurpassable richness.

The Federal Area in which is situated the city of Rio is not large, say about as large as the County of London. A large part of it is covered by buildings, but such is the amazing diversity of form, that the *known* Flora of the remainder of this spot is estimated at not less than 11,000 species, and, considering the almost impenetrable nature of the forest, and the desultory way in which collecting is done, this figure cannot exhaust the possibilities. Indeed, any who are enthusiasts for the capture of undescribed species, may obtain them within a day's walk of the Gardens, in almost any direction.

With the same reservations as before in regard to completeness, the total Flora of Brazil is estimated at 42,000 species—including, not only the huge number in the "Flora Brasiliensis" of Von Martius, which is the basal work of reference, but also the large number variously published by independent collectors.

What riches a systematic exploration of the lesser known portions of Brazil would reveal, it is only permitted to man to dream. Still, it is possible that such an exploration may be

commenced within the next few years, as the Brazilian Government is very creditably munificent in the encouragement of all attempts to open up the resources of their half-continent. The condition of up-country Brazil, even in the settled districts, cannot be called civilized, even by the most partial critic, and any such exploration would involve penetration into areas where the white man has never yet set foot, so that there are certain difficulties in the way of its accomplishment. "God is great," say the Brazilians, "but the forest is greater."

The forests upon the Rio hills are all rain-forests of the most pronounced type, and, where their timber trees have been cut, the lianes and climbing bamboos have multiplied to such an extent that a passage is very nearly impossible. "Matto" is the Brazilian name, and no word could be more excellently descriptive.

In such forest, an homogeneous formation, yet a pure mixture of the representatives of every order extant, where one can penetrate for a kilometre and hardly see the same species twice—the problems of transpiration and light supply are obviously dominant questions. The carefully-filtered light which eventually reaches the few Hymenophyllaceæ and Orchids on the ground, and the steamy air that rises through the tree tops, are the warrants for it; and some attempt was made to attack one or two aspects of these great problems during an all-too-short stay in Rio.

Not that forest is everything, even in the Rio Gardens. There are open spaces where European and Tropical flowers flourish bedded side by side as in an English Park; many also are the strange fruits which a visitor may enjoy if he be there in summer-time; but in these he will probably find disappointment, for tropical fruits do not seem to bear out their common reputation. Those of the sub-tropics are in general, more agreeable to an untrained palate.

The Gardens comprise, as above described, a considerable extent of uncultivated ground, of more interest to the botanist than to the general, but that is only a minor part of the total area, and the features of horticultural interest are many and striking.

Foremost in public estimation are the great Palm Avenues, but there are also plantations of Bamboos which reach a height of about 10 metres and form a water-side arcade, always in deep shadow; a group of *Dendrocalamus giganteus*, rivalling in size that at Peradeniya; an avenue of *Fourcroya*, striking too in its rigidity; avenues of Mangos; fine groups of the hugh musaceous *Ravenala madagascariensis*; a very good collection of Cycads—some 22 species—only just installed; sections devoted to distinctive families such as Aroidæ or Marantaceæ; a great abundance and variety of epiphytes on almost everything, even the telegraph wires being decorated, while some of the larger trees are hardly visible under their load of *Tillandsia*, *Rhipsalis*, Orchids, etc.; extensive nurseries; a collection of Conifers, including fine specimens of *Araucaria*; a pond full of Pontederiaceæ in variety, and many other aquatics; and, lastly, one must recall the great collection of Palms and the native trees, planted everywhere in great profusion.

The pond and its surroundings are remarkably picturesque, and, even on the hottest day the bamboo shade is cool. The water comes from a small river, running down the valley behind, and crossing the Gardens on its way to the Lagoa. From this river,

higher up, water is led off into a canal, which passes along the hillside, and pours the water down into the Gardens in two cascades, from which it runs everywhere in little shallow waterways along the paths and among the grass.

There are three glass-houses in the Gardens, in cool spots, for the care of smaller and more delicate plants, and in one of these is housed a fine collection of Orchids, made by one of the naturalists attached to the Gardens, Dr. Armando Frazao, to whom I am very much indebted for his great kindness during my stay in Rio.

The Gardens contain some statuary, and also some fine old masonry, including a Colonial gateway, now almost unique. There is a bust of the Founder, Dom Joao VI, placed beside his great Palm brought from the West Indies, the mother-palm of all the *Oreodoxas* in Brazil; and there is also a rocky mound beside the pond which bears a monument to Fra Leandro, a churchly Director of a former day.

It is impossible to deny that the Gardens have suffered from past neglect, and there is a certain disorder that is indicative of the insouciant outlook of the Brazilian upon matters which do not concern politics; but even in the short time that Dr. Willis has been in office he has effected great improvements, and his energetic measures will within another year place the cultivation of the Gardens upon a very different footing.

Among other improvements at present in progress, may be mentioned the great expansion of the present small library, and the erection of a fine building for the accommodation of the herbarium, at present confined to a single room. The new library will then occupy the whole ground floor of the present single building which houses the executive offices, library and herbarium. These offices, the Director's present house, the Director's old house—a building dating from the XVIIth century, and now inhabited by work-people—and the laboratories, are all grouped at the western extremity of the Gardens, and are approached by a special gate from the Rua Jardim Botânico, which is rapidly being transformed from a country road into a broad Avenida.

The neighbourhood of the Gardens is interesting in itself. The brackish Lagoa Roderigo da Freitas between the Jardim and the sea, is but one of the many features of interest. Without doubt its plankton would repay investigation, so little being known about that subject in tropical countries. Upon the shore is an extensive stretch of Restinga forest, a type peculiar to Brazil, and ecologically uninvestigated. The valley behind the Gardens; the famous mountains themselves, all swathed in forest, and many another thing besides, the student can find to attract his attention. It is indeed to be hoped that many students will visit a tropical station of such merit. The general cost of living in Rio is undoubtedly high; but even a short visit repays one so amply, that this need not be an insuperable barrier; and accommodation at a moderate price can always be obtained without great difficulty. The journey can be performed without risk at any season of the year, but for a student the Long Vacation would be most convenient, and, by going out in May or even June, and returning in October, no outfit beyond ordinary English summer things would be needful, and tropical vegetation might be studied with the maximum of comfort.

This document is a scanned copy of a printed document. No warranty is given about the accuracy of the copy. Users should refer to the original published version of the material.