not be essential for support of the stem and may be distinguished as "aerial roots," although their anatomy and behavior is identical with that of "prop-roots."

One peculiar feature of many palm roots to which the early attention of plant anatomists and physiologists was drawn is the presence of small appendages called "pneumathodes." Each pneumathode is a lateral root with restricted growth. They are frequently seen on the exposed roots of pot-grown seedlings and most of the early literature on these organs describes them on palms cultivated in glass-houses in Europe. Their frequency and distribution in nature is not well known. Commonly pneumathodes are visible growing erect above the soil surface, but they also occur abundantly underground. In their internal anatomy these short branch roots differ from normal roots largely in having very loose surface tissues. This is apparently designed to facilitate gaseous exchange between the air and the internal atmosphere of the root. It should be noted that many palm roots, particularly those of swampy situations, have a longitudinal system of cortical air-canals with which the pneumathodes are continuous. The function of these pneumathodes as breathing organs is assumed rather than proved, but this interpretation seems likely. For example, in the *Raphia*-swamps of West Africa, the swamp surface is covered by a close carpet of erect-growing roots which are little more than giant pneumathodes. It is reasonable to suppose that these erect roots aerate the underground roots which grow in the oxygen-deficient mud. The situation is analogous to that of *Avicennia* with its breathing roots or pneumatophores, growing in mangrove swamps.

From this brief discussion of roots in palms, with its unhealthy proportion of speculation and supposition, it is evident just how ignorant we are of the structure and behavior of palm roots. Detailed studies on this subject would be of great value and would ultimately throw some light on the physiology and ecology of palms, subjects of great practical importance.

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PALMS AT SUMMIT GARDENS, PANAMA CANAL ZONE

W. R. Lindsay

The present Summit Gardens, or Summit Park as it is now called, was started in 1923 as a plant introduction garden (The Canal Zone Experiment Gardens) for the Panama Canal Zone, Panama. The late David Fairchild of the United States Department of Agriculture and Thomas Barbour of Harvard University were both very active in securing its establishment and made many valuable plant contributions in its early stages. Holger Johansen was the first Agronomist and Director of the Gardens. He was most energetic and did an excellent

job of "putting the infant Gardens on its feet." During his four years at Summit he introduced almost five thousand species of plants.

From 1927 until his death in 1938, J. Edgar Higgins carried on the good work started by Dr. Johansen. I was fortunate in joining the staff in 1930 and have been able to watch the gardens mature. Over fourteen thousand accessions of economic and ornamental plants have been added from all over the tropical world. These include at least two hundred species of palms, of which a hundred and twenty-five species are established. The gardens, embracing some three hundred acres, lie almost directly south of Florida, but are directly in the tropics being only nine degrees north of the equator. The rainfall averages seventy-five to eighty inches a year and practically all of this falls during the period from May through December. The poorly drained, acid, clay soils of this region make it impossible to adopt modern methods of cultivation. This has its drawbacks but also has some advantages. Plants either like it or they do not and respond by making phenomenal growth or dying. This growth is exemplified by the teak tree (*Tectona grandis*), source of the valuable teak wood of commerce, a seedling of which may reach a height of thirty to forty feet by the end of the second year. Seedlings of *Pigafetta filaris (P. elata)* palms have attained a height of over ninety feet in eighteen years.

As it was not always possible to secure cultural requirements for the many plants introduced, an effort was made to plant them out in as many different conditions as possible, such as in the shade or partial shade, in low wet soil or on relatively dry hillsides. Consequently the Gardens were not laid out with definite plots set aside for plant segregation. A small palm planting may be found completely surrounded by fruit trees or even interplanted with them.

A few of the outstanding species of palms include: *Actinorhytis Calapparia*, a single- stemmed palm from the Pacific with beautiful clusters of large orange-pink fruits; *Calamus Muelleri* from Australia, *Cyrtostachys Renda*, a multiple-stemmed palm of Sumatra with bright red leaf sheaths; *Iriartea exorrhiza* and *Socratea durissima* of tropical America with their trunks supported above the ground on a cone of roots, *Normanbya Normanbyi* from a remote part of Australia; *Pigafetta filaris* (P. *elata*), seeds of which were sent to us by David Fairchild in 1941 and which has raised itself to a height of over ninety feet on a bright green cylindrical trunk a foot in diameter, and *Pelagodoxa Henryana*, a beautiful rare shade-loving species from the Marquesas Islands.

A number of other unusual species in our collection are: *Astrocaryum Standleyanum, Bentinckia nicobarica, Calyptronoma dulcis, Deckenia nobilis, Desmoncus oxyacanthos, Euterpe edulis, Manicaria saccifera, Mauritia setigera, Metroxylon amicarum, Phytelephas macrocarpa, Rhyticocos amara.* There are also represented five species of *Caryota*, nine of *Livistona*, seven of *Phoenix*, six of *Sabal* and five of *Thrinax*. Many of the plants produce viable seed which is available in season.

THE EDITOR'S CORNER

It has been suggested that articles on palms which have appeared in other journals, especially those not readily available, be reprinted. A beginning has been made in this issue. Further suggestions will be welcomed.