THE CULTURE OF PHALAENOPSIS IN CEYLON

By

B. St. H. QUYN

Royal Botanic Gardens, Peradeniya

INTRODUCTION

THIS genus includes some of the loveliest and the most popular of all orchids. The exotic and graceful beauty of the flowers and their lasting qualities, the profuse blooming habits of the plants and the existence of fine new hybrids raised for exhibition and cut-flower purposes contribute to the increasing popularity of this genus among amateur and commercial growers alike.

DESCRIPTION OF THE GENUS PHALAENOPSIS

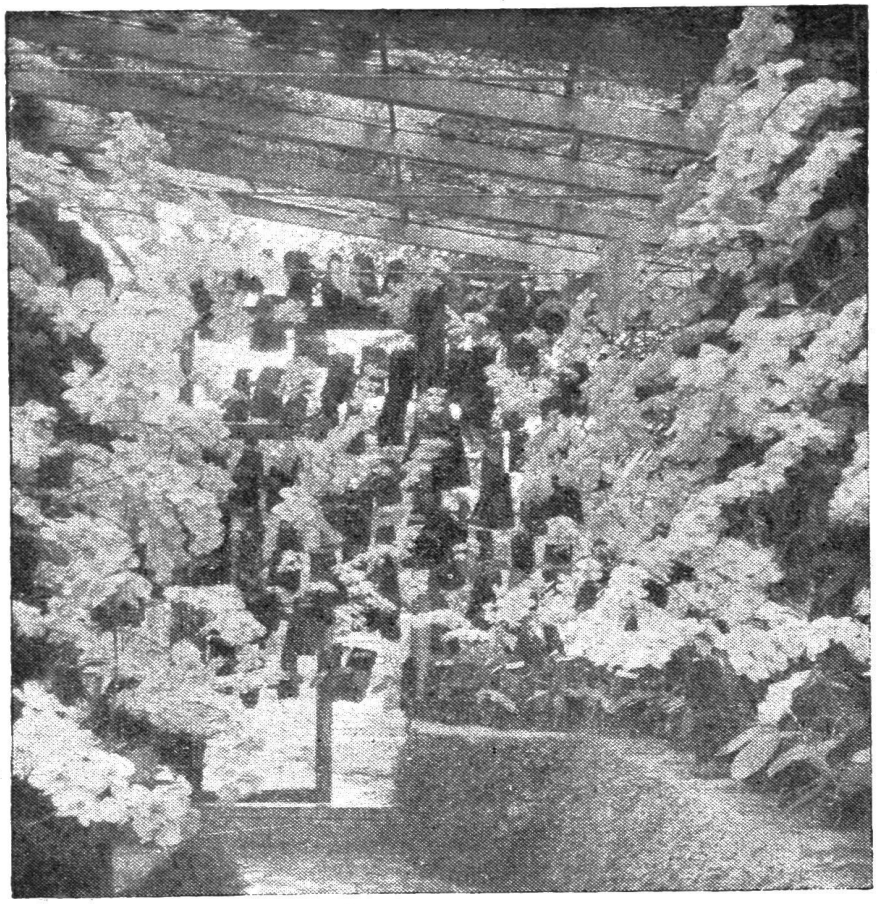
Plants are epiphytic, existing in their natural habitat on stems and branches of trees, generally in shade and in close proximity to water. Few species are also found on rocks. The growth is monopodial. The stems are very short and sheathed by the bases of the leaves which are few and borne close together. Leaves are always few in number, usually persistent, rather fleshy or leathery, glossy green and in a few species mottled grey. They are usually broad, widest in the apical half and narrowed gradually to base, flat and drooping or (in three species viz., *P. Denevei J. J. S.*, *P. Laycockii* Hend and *P. Serpentililingua* J.J.S.) long, terete and curving, more or less in two rows. The inflorescence is of two types. In one a flat rachis bears flowers alternately along its two edges and in the other type a cylindrical rachis bears flowers in a spiral arrangement. Flowers are small to rather large, varied in colour, remarkably showy and long lasting. Sepals and petals similar, spreading, the petals somewhat wider than the sepals. The labellum is immovably fixed to a distinct column foot, three lobed, variable and complex with antenna-like appendages usually carried on the fleshy midlobe. The presence of these forked appendages on the labellum is a distinctive characteristic of the genus. Column is rather long and slender with a well developed foot. The anther is terminal, incumbent and two-celled. Pollinia are two, round or ovoid, cleft, the stipes fairly long, narrow at the base and widening upwards.

GEOGRAPHICAL DISTRIBUTION

The genus is widely distributed, ranging from Assam and the Eastern Himalayas to Burma, the Andaman Islands and through the Indian Archipelago to the Moluccas and Philippine Islands. The greatest number and the more beautiful species are found in the Philippine and adjacent islands. All the species in the section Euphalaenopsis are natives of the Philippines with the exception of the type species *Phalaenopsis amabilis* which occurs in Java, Borneo, Celebes and the Moluccas. In North Borneo, *Phalaenopsis amabilis* Blune is reputed to grow high up in shaded positions on trees receiving heavy showers of rain for more than half the year, and constantly fanned by cool sea breezes.

Among the other popular members of the section Euphalaenopsis, the exquisite *Phalaenopsis schilleriana* Rchb. F. is found in the provinces of Quezon and Batangas in the Philippines. The Batangas variety is said to have lighter flowers and is not so liable to produce adventitions plantlets in place of blooms as the Quezon type. This species needs a somewhat cool temperature in the flowering season. The very beautiful *Phalaenopsis aphrodite* Rchb. F. is found in the province of Laguna through which the Sierra Mountains also run, in the Philippines. Laguna is also the home of the natural hybrids *Phalaenopsis intermedia, Phalaenopis leucorrhoda* and *Phalaenopsis veitchiana. Phalaenopsis stuartiana* Rchb. F. occurs in Suriyago and Agusan in the Philippines. It is reputed to be always found in close proximity to water like all other species of Euphalaenopsis. On the coast of Mindanao it grows on the branches of trees very close to the sea. In southern Mindanao is found the very lovely *Phalaenopsis sanderiana* Rchb. F. thriving on the trunks and branches of trees very close to the sea shore.

Species of the section *Stauroglottis* are distributed over the whole area of the genus with the exception of the Moluccas. The intriguing *Phalaenopsis violacea* Teijsin and Binn. with its delightful fragrance and *Phalaenopsis sumatrana* Korth and Rchb. F. are found in the hot, damp forests of the Sumatrian province of Palembang growing usually on the trunks of trees overhanging streams and water-courses and in much shaded positions. The small but pretty *Phalaenopsis rosea* Lindl. is found in the mountains of the Laguna province and in northern Mindanao and Leyte in the Philippines. *Phalaenopsis lueddemanniana* Rchb. F. with its numerous varieties is found in the neighbourhood of Manila in the Philippines. *Phalaenopsis tetraspis* Rchb. F. is reputed to thrive suspended from the branches of Mangrove trees a few feet



Block 13—Phalaenopsis in bloom in an aisle of an orchid house at the Royal Botanic Gardens, Peradeniya.

above water along the swampy shores of the Andaman islands, being usually found at the extreme end of the creeks where the water is fresh.

The section *Proboscidioides* which contains only a single species, namely, *Phalaenopsis lowii* Rchb. F. is found in Borneo and Moulmein. The habitat of this species is such that it affords a strong contrast to that of the aforementioned species of this genus. This species is deciduous in its native habitat immediately after flowering. It grows on limestone rocks and on the branches of small bushes that grow in crevices of the rocks.

The section *Esmeralda* which contains *Phalaenopsis pulcherrima* (Lindl.) J. J. S. (*Phalaenopsis esmeralda* Rchb. F.) is distributed in the Siamese peninsula including Burma. This species has been found on isolated rocks on the island of Pluquoc in the Gulf of Siam and in Cambodia. The plants are deciduous in the dry season in their native habitats. Curtis has also found this species on one of the Langkawai islands growing in peat and sand at the foot of trees.

Another species that is deciduous in the dry season in its native habitat is *Phalaenopsis parishii* Rchb. F. of the section Stauroglottis. These dimunitive plants are found in Moulmein generally on the branches of trees covered with moss, subject to great heat and moisture during the growing season and deciduous in the dry season.

Phalaenopsis decumbens (*Kingiella decumbens* Rolfe and *Doritis Wightii* Benth) is found from South India and Ceylon through Burma and Malayasia to the Philippines. It is the most widely distributed species in the whole genus but is rarely cultivated as its flowers are very small. The three known terete-leaved species of Phalaenopsis (*Phalaenopsis denevei* and allies) are found only in a restricted area in Western Borneo growing on trees by rivers.

Another curious species that is deciduous in the dry season in its native habitat when growing in exposed situations but is evergreen when thriving in shade is *Phalaenopsis cornu-cervi* Blume and Rchb. F. (*Polychilus cornu-cervi Breda*) of the section *Stauroglottis*. In regions north of Malaya it is reported to withstand a dry season during which it is deciduous, its roots being kept plump by the night dews. However, it has also been found on the trunks of Mango trees in dense shade in the jungles between Pegu and Shoagun where it is evergreen. In Malaya it is found in Perak and Selangor in more exposed situations.

In general, the genus is distributed in the lower heights of areas in the eastern tropics or north tropical zones where the temperatures are fairly uniform, day temperatures not excessive, the highest day temperature being usually 90° F. with nights that are seldom cool, the temperatures being usually 70° to 75° F. with relatively slight seasonal temperature changes. Rain is the chief seasonal variation in their general climatic conditions. An intense rainy season during which the plants flower is followed by an excessively dry season. This dry season is usually characterised with an atmosphere that is nearly always saturated with moisture and where the cool mornings drench the plants with dew. Strong winds are not uncommon in their native habitats where the plants show a distinct preference for shade.

THE CULTURE OF PHALAENOPSIS

(a) WATERING

Since these plants lack pseudo-bulbs to store water it should be borne in mind to keep the plants moist, but not saturated, at all times and not to let the plants become completely dry at any time. If they dry they are apt to shrivel and often lose their bottom leaves which mar their beauty. When watering, care must be taken to prevent water

remaining in the crown of the plant or the possibility of rot is imminent, especially in dull weather. The technique of correct watering is one of the most important phases in the growing of Phalaenopsis. Keen observation and good judgment on the part of the grower is essential. This is learned only through experience.

A watering schedule will depend on many factors such as type of plant, age and growth stage of plant, humidity, ventilation, temperature, potting media, size of pot, light and sunshine, etc. Watering may be done with a garden hose to which should be attached a sprinkler to break the force of the water, a watering-can or by soaking the plants one by one in a tub of water. The plants are best watered in the morning. During hot bright days watering may be done later in the day but it should be done early enough to allow the plants a few hours of light afterwards. Unless water is really necessary it is best to avoid watering the plants on cool dark or rainy days. They must never be watered overhead during dull weather. One must always remember that orchids in general must be watered only when they need it. Each plant should be considered individually. This fact is of paramount importance in successful orchid culture.

Phalaenopsis violacea and its allies need more moisture than the other species of this genus. The author has had the opportunity to grow *Phalaenopsis amabilis* and some of its allies in their thousands from seed to maturity and, from experience and daily observation over a period of many years it is found that *Phalaenopsis amabilis* and especially some of the white-flowered hybrids of to-day, should never be watered in the afternoon for, when water by chance remains behind on the foliage during the night disastrous results may follow, particularly if the nights are cold. Water should never be allowed to remain on the leaves, crown or lodge among the leaf bases on the stem of these plants during the night, especially so with the white-flowered hybrids many of which though extremely beautiful are unfortunately not very robust being very susceptible to various diseases.

(b) HUMIDITY

The chief function of humidity is to keep the plants from drying out through too rapid transpiration of water from the leaves. High humidity will prevent the potting medium from drying out rapidly, stimulate the production of new roots and help to keep leaf temperature down thus contributing to active plant growth.

For good growing conditions humidity must be maintained for Phalaenopsis at about 70 per cent, higher during bright sunshine and high temperatures, lower at night or during cold, dull weather. Maintenance

of high humidity during hot bright days can be effected by damping down of the floors and stagings where the plants are grown, overhead spraying or syringing and watering. However, care must be taken not to wet the plants if damping down is done in the late afternoon.

Plants in bud or in flower should not be subject to very high humidity, especially at night. Though heavy atmospheric humidity is indicated for proper growth of this genus, it must always be borne in mind that a saturated atmosphere at night combined with low temperatures in cold, cloudy or rainy weather can cause spotting of flowers, bud drop, damping-off, leaf spot and other diseases through condensation of moisture upon the flowers, leaves and other sensitive tissues of the plants.

(c) TEMPERATURE

The recommended temperature range is from 65° F. to 70° F. at night to 80° F. to 85° F. or 90° F. by day. Seedlings may be grown at 70° F. at night and at 85° F. to 90° F. by day.

Efficient operation of the plant processes of making and utilizing sugar is ensured at these temperatures. It will be observed from the geographical distribution of this genus that the plants are tropical by nature and as such they must have heat.

The night temperature must never be below 60° F. The plants will make poor growth unless they have warm nights.

(d) LIGHT

Phalaenopsis do not need much light. However, they want sufficient light for vegetative growth and for flower production. Like all green plants they want light to synthesize sugar from water and the carbon dioxide taken in from the air. Sufficient light is also necessary to harden the flowers for cut flower purposes.

The technique of controlling sunlight is through the use of shade. About 50 per cent. shade will suffice for Phalaenopsis. An essential feature in the shading of Phalaenopsis is that the plants must be shaded in such a way so as to be protected from the sun's rays without being deprived of its warmth as they like plenty of solar heat. It is best to place the plants to face the sunny side as then the flower stems incline very gracefully towards the sun, producing very pleasing sprays of flowers.

A simple method of providing shade for Phalaenopsis in Ceylon is with the aid of coir mesh laid below a glass roof. Opaque, corrugated Acrylic plastic glass is ideal as a roofing material for Phalaenopsis in

Ceylon. It does not break, leak or burn foliage, nor is shading necessary. The light is thoroughly diffused, making it almost impossible to cast a shadow, thus inducing good plant growth. Unfortunately, this excellent roofing material is quite expensive and a luxury that only few can afford.

(e) VENTILATION

Ventilation, the movement of air, is necessary to furnish carbon dioxide to the plants. Good air circulation assists gaseous exchange between the plants and the air, maintains more uniform temperature and humidity, eliminates stagnant air, reduces condensation of moisture on the plants and flowers and dries up excess water. It also helps in reducing bacterial and fungal diseases. Phalaenopsis needs ample air-movement. Good ventilation, without reducing the humidity and in harmony with temperature, is essential.

(f) HOUSING

In Ceylon, protection from our intense monsoonal rains is very essential for successful Phalaenopsis culture. It has been the author's experience that the plants must definitely be protected from intense, continuous rain, especially when such weather prevails on dull, gloomy days, or else various diseases will ruin the plants.

Thus, an orchid house or greenhouse protected by a suitably shaded glass roof is very essential and would afford the plants not only shelter from the rain but also provide shade and heat. A well constructed orchid house which would afford complete protection from the rain and in which it is possible to maintain optimum conditions of humidity, light, ventilation, temperature and shade is a *sine qua non* for the commercial culture of this orchid in Ceylon. Where, however, the culture of this genus is limited to just a few plants for which separate housing accommodation cannot be found, then such plants are best grown indoors in the verandah of one's home in an aspect that provides shade and heat and protection from the rain. It is very essential that the plants must never be exposed to drafts.

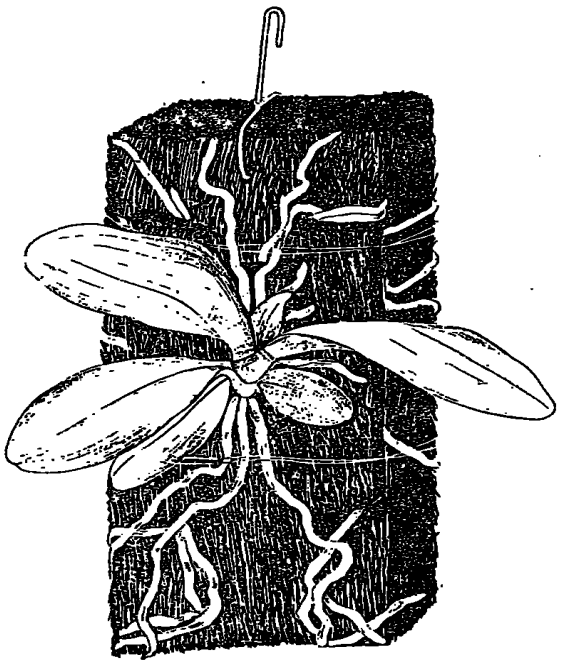
If some of our growers still insist in growing this orchid outdoors in the open in shady spots or under lath, it would be advisable for them to remove the plants into the shelter of their homes when the monsoons set in or else they may lose many of their most valuable plants especially if they are some of the particular delicate white-flowered hybrids.

(g) POTTING

In their natural habitats, Phalaenopsis are usually found growing on the trunks of trees or on rocks with their roots extending for considerable distances, either creeping along the surface or hanging freely in the air and the crown hanging downwards. As such, when grown under cultivation, the roots of Phalaenopsis must not be confined any more than is necessary to mount or pot the plants, but, should as far as possible be allowed to hang free or run exposed along the surface of the mounting or potting medium with the crown hanging or inclined downwards.

In general, orchids should have a supporting medium that supplies adequate water and nutrition. The basic requirement is a medium that will retain moisture and provide good root aeration. The roots of Phalaenopsis in particular require plenty of air as these orchids possess a large number of aerial roots. Thus, in view of the manner in which these orchids grow under natural conditions, they are best grown attached to pieces of wood or tree fern root, in suspended shallow perforated earthenware pots, in slatted wooden baskets or in hydroponic gravel culture.

Out of many years of experience and observation the author has evolved a very simple and practical mothod of growing Phalaenopsis on tree fern root in Ceylon. The method is as described below.



Block 14—A Phalaenopsis plant mounted on a section of tree fern root (*Alsophila glabra Hk.*)

Sections of tree fern root are first prepared out of the compact roots surrounding the trunk, the dimensions of the sections depending on the size of the plants to be mounted upon them. For 3 inch pot size plants, the sections should be about 8 inches high, 4 inches wide and 1½ inches thick, and for flowering size plants the sections may be 10 inches high, 6 inches wide and 1½ inches to 2 inches thick.

About 1½ inches below the top of each section a small hole is bored through and a thin strip of galvanized wire (16 s.w.g.) about 11 inches long passed through and twisted above with the aid of a pair of pliers to form a hook which serves to hang up the plant. A thin rectangular block of fern root about 1¼ inches wide, 2 inches long and ¾ inch thick is laid in the centre of the prepared section. The plant to be mounted is cleaned up of all dead roots, etc., and placed on the centre of this small rectangular block with its roots spreading out and its crown facing downwards. Next, two thin flat shavings of fern root about ¼ inch thick, 7 inches long and 1½ inches wide are gently placed over part of the roots, one on either side of the plant and lying along side the central rectangular block. These shavings function as a root dressing and are firmly tied on to the section about 2 inches above and below the plant with two thin strips of fine copper wire (26 s.w.g.) thus completing the operation of mounting which in practice is really very simple by this method. Another suitable root dressing is Osmunda fibre. This method ensures perfect aeration at the base of the plant which is the most important factor in the technique of mounting Phalaenopsis.

The author has also tried out another method for the growing of Phalaenopsis in Ceylon and has found it very suitable when only limited quantities of tree fern root are obtainable. In this method the hard wood of the Kithul tree, *Caryota urens* Linn. is employed as the basic supporting medium and a root dressing of tree fern root or osmunda fibre utilised to retain moisture and supply nutrition.

In this method, too, the technique is quite simple. Hard well seasoned Kithul wood is prepared into reepers 3½ inches wide and 1 inch thick. These reepers are sawn into sections 10 inches long for 3 inches pot size plants and 12 inches long for adult flowering size plants. Provision to hang up the mounted plant is very necessary and this is first done with the aid of a galvanised wire (16 s.w.g.) about 7½ inches long at the top of each section as in the previous method. A shaving of fern root in the form of a small thin rectangular block about 1¼ inches wide, 2 inches long and ½ inch thick is laid in the centre of a section. The plant to be mounted is cleaned of all dead roots, &c., and gently placed on the centre of this block with its roots spreading out and crown facing downwards. A root dressing of very

Block 15—A Phalaenopsis plant mounted on the wood of Kithul (*Caryota urens* Linn) with shavings of tree fern root as a root dressing.

thin flat shavings of fern root are gently placed over part of the roots above, below and alongside this central block so as to form more or less a complete root dressing of fern root. Finally strips of fine copper wire (26 s.w.g.) are tied over the root dressing around the section above and below the plant, thus serving to keep the root dressing firm and to attach the plant to the section. One disadvantage in this method is that the Kithul wood being hard and non-porous tends to dry very fast thus necessitating a very regular watering schedule. However, the advantages of a very durable supporting medium that is not easily affected by constant moisture and regular fertilization far outweigh the disadvantage of a necessity to water regularly. Further, the author has observed that the roots of Phalaenopsis have a great affinity to the wood of Kithul.

Hanging earthenware pots have a charm of their own, and bearing this in mind the author has also tried out with success a method for growing Phalaenopsis in perforated earthenware pots in Ceylon. Further, this method too is very suitable when only limited quantities of fern root are available.

In this method, perforated earthenware pots are used, 5 inch pots being utilized for 3 inch pot size plants and 6 inch pots for adult flowering size plants. A length of galvanised wire (16 s.w.g.) about

Block 16—A Phalaenopsis plant potted in perforated earthenware pot.

one yard long is first twisted with the aid of a pair of pliers around the two sides of a pot and shaped into a loop above which serves to hang up the pot. The pot is then very loosely filled to one third of its depth with 1 inch size pieces of granite. The plant to be potted is cleaned of all dead roots, &c., and held within the pot in such a manner that some of its roots are within and some outside the pot with the crown of the plant about 1 inch to 1½ inches above the surface of the pot and slightly tilted so that it faces downwards. More pieces of granite of the same dimensions are loosely packed into the pot to cover up part of some of the roots within and until the pot is loosely filled to a little more than half of its depth with granite. Finally fairly large pieces of fern root are very loosely packed in as a top dressing to fill the pot. It is very important that this top dressing of fern root be packed in very loosely so as to provide very good aeration within the pot. An essential feature to be borne in mind is that after potting the plant should stand out well above the surface of the fern root with its crown slightly inclined downwards.

Mounting the plants on sections of tree fern root is the most simple, practical and safest method of growing Phalaenopsis in Ceylon. This at least has been the author's experience so far.

REPOTTING

A Phalaenopsis plant should be repotted or remounted only when it needs it. The best time to repot or remount is when the plants are making new roots. Repotting Phalaenopsis requires patience, skill

and practice. The roots will be found clinging on to the pots and around the fern section on all sides making their removal very difficult. The roots are brittle, tender and fleshy, so that great care has to be exercised in their removal.

COMPOSTS

In Ceylon, tree fern root has been so far the ideal growing medium for Phalaenopsis. The tree fern *Alsophila crinita* Hook,. which thrives in Ceylon at elevations of between 4,000-7,000 feet, produces at its base an intricate, interwoven mass of fibrous roots in the form of a compact black fibre. It is this hard compact fibre that is referred to as fern root and widely utilized for mounting most epiphytic orchids. The base of the tree fern consists of about two feet or more of the tree trunk itself which is composed of black fibre and a rounder, lower section of root fibre which is below the ground. It is the basal underground portion which consists of hard compact roots that is most suited for mounting Phalaenopsis.

Tree fern root as a mounting medium for Phalaenopsis is very long lasting. It deteriorates only very slowly and has been used with success over a period of many years.

FEEDING

The feeding of orchids is a very important and controversial issue in orchid culture. Many expert growers hold different views on this subject.

In the feeding of orchids certain basic principles must guide any fertilization schedule. Orchids in general are slow growing plants and consequently their nutrient requirements are very low and, as such, must be fertilized with only very dilute fertilizers. Fertilizer must be given only under conditions of good light and when the plants are in active growth. Plants can only make use of their food elements and transform them into plant tissues by a process of photosynthesis through the aid of light. In the feeding of orchids, better growth is possible only when an adequate high relative humidity is maintained along with good light intensities. Plants must never be fertilized during cool, gloomy weather when there is little day light and during prolonged rainy spells. Feeding must be done only during the growing period of the plants when new roots are showing in order that the plant may utilize the feed when it needs it most. Weak, sickly plants and dormant plants must never be fertilized. Whenever fertilizer is given to a plant in the form of dilute solutions,

the solution should be allowed to saturate the growing medium thoroughly and run through the pot in potted plants. In between fertilizations water must be generously flushed through the growing medium at the proper watering times.

In the fertilization of Phalaenopsis two very important factors must be borne in mind, namely, the growing media and the light intensities. In Ceylon tree fern root is widely used and is more or less the standard potting or mounting medium for Phalaenopsis. This is an organic media and as such heavy feeding of Phalaenopsis when grown on it is not very essential. Besides, the light intensities under which Phalaenopsis is grown does not permit generous use of fertilizer. Low light intensities and an organic growing media certainly do not favour a heavy feeding schedule which will only set the stage for disease. Provided the plants are in active growth and in conditions of bright weather the author would suggest feeding of Phalaenopsis on fern root only once a month with a solution of a standard balanced inorganic fertilizer such as Hyponex, Gaviota orchid fertilizer, &c. Seedlings, however, are always in active growth and respond to regular feeding. They may be fertilized once a week in bright weather with a water soluble balanced inorganic fertilizer when potted in a mixture of granite chips and tree fern and twice a month when growing purely in organic media such as fern root.

Inorganic fertilizers such as Hyponex, Gaviota orchid fertilizer, &c., in solution may be applied to seedlings in community pots as a fine spray and to seedlings in 2 inch and 3 inch pots with the aid of a fine-rosed watering can. Adult plants on fern root sections or in pots may be immersed one by one in an enamel pail containing the prepared solution until it thoroughly saturates the growing medium.

PROPAGATION

(a) VEGETATIVE PROPAGATION

Phalaenopsis does not easily lend itself to vegetative propagation. Occasionally, off sets are produced from the sides of the main plant. These, when they have sufficient roots, may be separated and a mounted or potted up. More frequent, however, is the production of adventitious buds which develop into plantlets on proliferous roots and peduncles of certain species.

The very interesting morphological phenomenon of root proliferation is commonly expressed on *Phalaenopsis Stuartiana, Phalaenopsis Schilleriana* and *Phalaenopsis deliciosa* Rchb.f., the peculiarity being most prolific in *Phalaenospis Stuartiana*. These proliferous roots

produce adventitious buds that give rise to little plantlets which may be detached and treated independently when they have sufficient roots and leaves to ensure such an existence. Proliferation of the peduncle is fortunately much more common and is exhibited by the flower nodes on the flower scape which give rise to vegetative buds that develop into plantlets. Proliferation of the peduncle is very common in *Phalaenopsis Lueddemanniana, Phalaenopsis Schilleriana* and *Phalaenopsis Stuartiana.* It is also seen in *Phalaenopsis intermedia, Phalaenopsis rosea,* and *Phalaenopsis aphrodite. Phaloenopsis Lueddemanniana* is particularly generous in this respect.

Proliferation of the peduncle of *Phalaenopsis Schilleriana* is very common at the low, warm elevations in Ceylon where for instance at the Henaratgoda Botanic Gardens, Gampaha, the author has found it very convenient to propagate this lovely species from the plantlets that arise from the flower scape. It has never flowered at these Gardens, the night temperature at Gampaha being far too high to induce flowering in this particular species.

Sometimes, it is possible in older Phalaenopsis plants to propagate them vegetatively by means of top rooted stem cuttings provided however the plants are fairly large and long with a few roots arising from along the stem. In this method an adult plant which has a fairly long stem with at least two or three roots running along the upper half of the stem is selected. The top section of the stem is cut off leaving part of the stem with about two pairs of leaves on the base of the plant behind. The apical stem cutting which is detached should have at least three leaves and one or two roots on it.

The cutting is now potted up in a very shallow 10 inch earthenware seed pan or pot in very fine granite ($\frac{1}{4}$ in. size approx.) so that the leaves lie on the edge of the pot, thus supporting the plant and keeping it firm. The potted stem cutting is now treated with the same after-care that is bestowed upon a newly potted plant in respect of its general cultural requirements. Root action is noticeable in about three weeks time when the plant may be fertilized with a solution of an inorganic fertilizer such as Hyponex of half the recommended strength. Fertilization may be done once in ten days during bright weather. In a few months' time good root action will be observed when the plant is ready to be transplanted into a pot in the usual compost employed for Phalaenopsis or mounted on a section of fern root. In the meantime the original plant from which the cutting was severed would have produced a vegetative shoot at its base which develops into a plant. Sulphur or some other suitable fungicide must always be applied on the cut surfaces when the apical portion of the stem is severed.

Phalaenopsis pulcherrima usually produces secondary growths which when well rooted may be separated and potted up. Here, at the Royal Botanic Gardens, Peradeniya, as many as five secondary growths have been produced on a single plant. Further, this charming species roots very freely along its stem, thus lending itself to vegetative propagation.

Rooted vegetative shoots or offsets and little plantlets when separated from their parents and mounted on sections of fern root have usually to be root-dressed with soft osmunda fibre and treated with special attention until they are strong enough to receive adult treatment.

(b) SEED PROPAGATION

Propagation by seed involves considerable difficulties and is too vast a subject to be described in this paper. However, a brief summary on some of the author's experiences in this field may be of interest to the amateur and even perhaps to some professional orchid breeders.

The author has raised and flowered *Phalaenopsis amabilis* at the Royal Botanic Gardens, Peradeniya, in 2½ years from seed. It is possible to reduce this transition period from seed to flower to two years provided however that optimum conditions are maintained and that individual attention is conferred upon the plants which is not always possible in commercial orchid culture when many thousands of plants have to be cared for.

Certain authorities on orchid seed germination have reported that death of Phalaenopsis seeds results when sown in asymbiotic cultures with a pH value of 4.8. Some workers who have done extensive work on asymbiotic cultures have observed that Phalaenopsis embryos are rendered sterile on a medium which has a pH value of less than 5.2. These reports and observations are contrary to the author's investigations and experiences. The author has successfully germinated seed of six Phalaenopsis hybrids and of one species in asymbiotic culture media with pH values ranging from 4.8 to 5.0 after sterilization of the media. The culture media used, however, could have been responsible for such germination. The mediums were Knudson's C sol. modified with an addition of 250 c.c. of fresh young coconut water per litre and Knudson's C sol. modified with an addition of 10 gms. of yeast per litre. The author's observations indicate that either of these two mediums, modified as specified above, induces optimum germination of Phalaenopsis seed at a pH value of 5.2 and satisfactory germination at pH values ranging from 4.8 to 5.0. These pH values are values indicated after sterilization of the media. Perhaps, some growth stimulating substances in the young coconut water and

in the yeast may have been the cause for satisfactory germination at pH values of 4.8 and 5.0. The author has also obtained successful germination of Arachnopsis (Arachnis × Phalaenopsis) and Vandaenopsis (Vanda × Phalaenopsis) hybrids on the above mentioned culture media with pH values of 4.9 and 5.0 after sterilisation of the media. The author has used fresh young coconut water very extensively in asymbiotic culture media and has found that it promotes excellent germination and growth of orchid seedlings especially when it is used with Knudson's C sol., and has further observed that it serves as an unique buffer in culture media which, when supplemented with young coconut water can be maintained in a stable condition for even three years without any adverse effects on the seedlings.

PESTS AND DISEASES

The prevention and control of pests and diseases is of fundamental importance in successful Phalaenopsis culture. Pests on Phalaenopsis are not a problem and are easily controlled but diseases, both bacterial and fungal, can very rapidly devastate a whole collection of Phalaenopsis unless checked and treated in time. This lovely orchid is unfortunately very susceptible to fungal and bacterial diseases especially so when their culture is not well understood and thus grown in an unfavourable environment. The most important factor in the control of pests and diseases on Phalaenopsis is the maintenance of the plants under conditions that favour optimum growth. These conditions of temperature, humidity, light, housing, &c., have been stressed in detail in this paper because a harmonious combination of these factors tend to create a favourable environment that reduces the incidence of pests and diseases, particularly the incidence of disease.

The author would further suggest that all Phalaenopsis plants be sprayed with 76% Ferric dimethyl dithiocarbamate about once in two months as a routine preventive measure against fungal diseases such as Anthracnose, a leaf spotting disease to which Phalaenopsis is very susceptible. This is a mild organic fungicide and is safe to use. It has a pH of approx. 7 and is therefore a neutral product. It has no detrimental action on the roots of Phalaenopsis or on the growing media. The dilution is $\frac{1}{4}$ oz. of 76% Ferric dimethyl dithiocarbamate in 2 gallons of water.

As a preventive against insect pests Diazinon 60% may be used as a routine spray on the plants also once in about two or three months. The dilution is $\frac{1}{8}$ oz. of Diazinon 60% in $11\frac{1}{4}$ bottles of water

(approx. 2 gallons of water). Diazinon 60% kills aphids, thrips, caterpillars, mealy bugs, scale insects, leaf miners, &c. It is an emulsifiable concentrate reputed to have the same range of action against insects as Parathion, but without the great dangers that are associated with Parathion. It has no detrimental action on the plants and is safe to use.

The following pests and diseases occur on Phalaenopsis :—

FALSE SPIDER MITES

False spider mites are common pests on Phalaenopsis seedlings, but, are sometimes found on adult plants too. They are very small pests, extremely difficult to see with the naked eye and range in colour from whitish to yellowish or reddish. They are, however, very readily seen with the aid of a microscope. Their damage is characteristic and easily recognised with the trained eye. The beginner, however, who is not familiar with this minute pest may be unaware of the presence of these mites until the infestation is rather severe and the damage very obvious. Their presence is revealed by a silvering or pitting of both surfaces of the leaves, although the ventral surface is preferred. They cause damage by sucking the cell sap, leaving silvery white areas. The injured areas which are silvery at first become rusty brown and in severe infestations the leaves tend to become yellow and eventually drop from the plant. Unlike the true spider mites, these mites do not spin webs.

Complete control of these pests is possible with any Sulphur wettable powder which has both fungicidal and acaricidal properties.

The dilution is 1 oz. of a 70% Sulphur wettable powder in 1 gallon of water.

The author's experience with these pests has been to find them at least once a year attacking Phalaenopsis seedlings in community pots. Their presence is always verified with the aid of a microscope and the following method of control adopted by the author as it has been found to completely eradicate them.

The seedlings are gently teased out of the community pots and immersed for a minute in a solution of a 70% Sulphur wettable powder prepared in the dilution given above. They are then dried on a clean sheet of blotting paper in the shade under cover. They remain in this position for two days, being watered with a fine spray as necessary. Two days after the first immersion, a second immersion is done which destroys all stages of this pest. On the day following the second immersion, the seedlings are replanted in another community pot in fresh compost. If the plants are now examined with

4——J. N. R 9270 (4/60)

the aid of a microscope no living stages of this pest are ever visible. This method of treatment may seem to be a little drastic but the author has found it to be quite safe and very effective in the control of these very troublesome pests.

Larger seedlings or adult plants in individual pots or on fern root sections when attacked may be treated by applying the solution prepared as given above with a soft camel hair brush or by a thorough spraying which should wet the plant completely, especially the ventral surface of the leaves which in Phalaenopsis are extremely difficult to wet with a sprayer owing to their mode of growth.

Many other insecticides and acaricides are also reputed to be very effective in the control of these pests.

SCALE INSECTS

Scale insects are small, sap-sucking insects. They vary in colour from white to dark brown depending on the species. There are two types of scales, the soft scales and the armoured scales. The soft scales have poorly developed legs and move about very sluggishly. They do not possess a separate shell. They also secrete honey dew on which sooty mould grows. The armoured scales develop hardened protective shields or scales of wax. Plant injury is caused by the females as the males have no mouthparts. They do not secrete honey dew.

The author has observed a yellowish white species of scale, referred to as fluted scale, on the roots of *Phalaenopsis sanderiana,* which was effectively controlled by immersing the roots for a minute in a combined preparation of 50 per cent wettable D.D.T. powder and Diazinon 60 per cent prepared by combining 1/2 oz. of 50 per cent wettable D.D.T. powder and 1/8 oz. of Diazinon 60 per cent in 2 gallons of water.

The author has never seen scale on the stem or leaves of Phalaenopsis. However, if they do occur they can be very effectively controlled with Diazinon 60 per cent prepared in a dilution of 1/8 oz. of Diazinon 60 per cent in 11 1/4 bottles of water (approx. 2 gallons of water). Two sprayings may be given at 1 week's interval.

Other insecticides such as Malathion can also be used for the effective control of scale insects.

MEALY BUGS

Mealy bugs are white or yellow soft bodied insects and are covered with a floury substance. They are closely related to the scale insects and damage plants by sucking the sap. Several species of mealy bugs

attack orchids. A ' honey dew ' is secreted by them which attracts ants and sooty mould fungi. The author has had occasion only once to find these pests on the roots of Phalaenopsis seedlings in 2 in. and 3 in. pots. In this instance, to all outward appearances the seedlings seemed to be free of any pests but as they were degenerating they were removed from their composts and it was not surprising to find the roots heavily infested with mealy bugs.

Effective control was possible with a systemic and also contact insecticide containing thiometon which unfortunately possesses quite an obnoxious odour. The method of treatment used was as follows :—

The seedlings were removed from their pots and immersed for a minute in a solution of the insecticide prepared by the dilution of 1/2 oz. of a thiometon 20 per cent emulsifible concentrate in 3 gallons and 3/4 bottle of water. On drying, the seedlings were re-potted in fresh compost. Ten days later they were sprayed with a fresh solution of this same insecticide prepared at the dilution rate given above. This method controlled these pests completely and had no injurious effects on the seedlings.

Other insecticides such as Diazinon and Malathion can also be used for the effective control of mealy bugs.

SLUGS AND SNAILS

Slugs and snails do enormous damage and could be a serious problem. They eat up root tips, young leaves, tiny seedlings and flowers. They are especially partial to Phalaenopsis seedlings in community pots, one slug being sufficient to destroy a whole pot of seedlings. They generally attack at night but are sometimes seen by day usually attacking root tips. Leaves ravaged by them have a characteristic appearance of being eaten unevenly. Their presence is also detected by their excrements which are elongate and coiled and by the trials of slime which they leave behind.

Cleanliness in the house is very essential for their control. They must always be searched for and destroyed. Hand-picking at night with a flashlight is a very useful means of control.

Any liquid preparation of metaldehyde can be used effectively in the control of slugs and snails. It can be applied as a spray or watered throughout the orchid house, on the stagings or benches and even into the pots. The dilution is 1 fluid ounce or two tablespoonfuls of a metaldehyde emulsion to 2 gallons of water, which will suffice for treating an area of about 10 square yards.

Metaldehyde baits in the form of balls or tablets are also very valuable commercial preparations for the control of these very troublesome and destructive pests.

COCKROACHES

Another common pest on Phalaenopsis is the cockroaches. They eat flowers and root tips. They prefer warm dry places and come out of their hiding places at night.

Cleanliness is a very effective preventive measure. They may be searched for at night and destroyed. Most contact insecticides control this pest. Aldrin, Dieldrin and Chlordane preparations are of special value for their control. The dilution rate is 1 oz. of a 20 per cent emulsifiable concentration of these products in 5 gallons of water. The prepared solution may be watered into the pots and on the stagings, benches, floors, warm dry corners, &c., one treatment being effective for many months.

WASPS

The author has observed that Megachilid wasps can be quite a nuisance as they cut the flowers of Phalaenopsis, particularly the white flowered varieties. The damage is done usually at dusk and is very characteristic. The sepals and petals of the flowers are cut in a crescent like shape, giving the flowers quite a new look which may appear to be the normal shape of the flower to the casual observer who is not familiar with the shape of a Phalaenopsis flower. The cut portions of these flowers are carried away by the wasp which utilises them for building its nest. This nest is hidden away in some recess in the orchid house and is not easy to find unless the insect itself is traced to it. The nest consists of rolled up portions of the sepals and petals of the flowers along with parts of small leaves such as those of the common Ivy (*Ficus repens* Rottl.), &c., which are usually found growing on the walls of green houses.

The wasp must be searched for, trailed to its nest and destroyed. Likely hiding places must be looked for and examined for nests.

DISEASES

BLACK LEAF SPOT

This is a very common disease on Phalaenopsis, especially in wet weather. It is said to be caused by a parasitic fungus having common characteristics with those of Colletotrichum and is known as Glomeralla. The author's experience has been that the white-flowered

Phalaenopsis seem to be very susceptible to this disease. The disease breaks out in the form of a few black dots which occur quite suddenly on the leaves. These black spots increase in number very rapidly especially if the plants are exposed to the rain. Quite rapidly too, the spots enlarge in size and become surrounded by yellowish rings which radiate outwards. The lesion increases in dimension and upon maturation of the spot the central portion becomes softened and disintegrated. It becomes somewhat transparent and gets surrounded by a black area where the stromata are borne. Eventually a brownish black zone is formed around the blackened area and causes the leaves to become putrid.

Warm, moist weather without sufficient light and ventilation, continual dripping of condensed moisture from a roof and continuous exposure to rain are some of the chief reasons for the breaking out of this disease. The spores of the fungus causing it germinate fast especially when warm, moist weather conditions prevail and are readily dispersed by water or rain.

Control

1. If the spots are many and the infection heavy, cut away and destroy the spotted or diseased leaves. When the spots are very few, cut off completely the infected areas with a sharp scalpel. No portion of infection should be left behind on the plant. The plant is then thoroughly sprayed with a solution of 76 per cent Ferric dimethyl dithiocarbamate prepared in the dilution of 1/4 oz. of this fungicide in 2 gallons of water. It must now remain under shelter and receive water when necessary only at its roots. Water must never be applied to the stem and leaves of such a plant. If a few spots still break out owing to the parasitic nature of the fungus causing it, these too should be promptly cut away removing with them all infected tissue. A little of this fungicide may be applied to the cut surfaces and it is best that these affected plants be isolated. Three weeks later the plants may be sprayed again with the same fungicide prepared in the original dilution. After a few months if the disease does not break out any further, the plants may be treated normally.

2. All plants irrespective of whether they are diseased or not must be sprayed thoroughly with a protective fungicide such as 76 per cent Ferric dimethyl dithiocarbamate.

3. Prompt adjustment in the environmental factors must be carried out. Good ventilation and shelter from the rain must be provided. Until the disease is eradicated it is best to avoid wetting the foliage of the plants, water being given only at the roots. Insects also carry

5——J. N. R 9270 (4/60)

the living spores from diseased plants to healthy plants and should therefore be controlled.

4. Since prevention is better than cure it is wise to spray all plants with a protective fungicide such as 76 per cent Ferric dimethyl dithiocarbamate at least once in six weeks or two months.

Bordeaux Mixture has been recommended in the Philippines as a protective fungicide against this disease but the author's experience has been that it is inconvenient to prepare and that it scorches the roots of Phalaenopsis.

DAMPING-OFF

This is a fungal disease generally affecting seedlings in community pots. It is caused by several species of Phythium. Its growth is encouraged under warm, moist conditions with lack of ventilation. It is easily spread.

Symptoms of the disease are the appearance of watersoaked plants which topple over and die. Initially only the basal part of the leaves and the collar of the plant are affected but very soon the whole plant appears water-soaked, topples over and dies. These symptoms are very characteristic and serve to easily identify this dreadful disease in seedlings.

Control

All diseased seedlings must be removed and destroyed. Seedlings yet unaffected must be pricked out of the pot and immersed for a minute or two in a solution of 8 hydroxy quinoline benzoate 2.50 per cent prepared in the dilution of one tablespoonful of 8 hydroxy quinoline benzoate 2.50 per cent in 2 bottles of water. They are then dried on a clean blotting paper and re-planted a few hours later in another pot in fresh compost which has been previously saturated with a solution of this same fungicide prepared in the same dilution. When re-planting special attention must be paid not to overcrowd the seedlings. Ample ventilation must be provided.

Several applications of this fungicide may be given at weekly intervals until the disease is eradicated.

This is a specific fungicide for damping-off. It is also a good general fungicide.

2. Preventive measures must be adopted. The seedlings must not be overwatered or overcrowded. They should receive ample ventilation. 50 per cent copper oxide is also reputed to effectively control this disease.

CROWN ROT

This is a fungal disease to which Phalaenopsis is susceptible. It is reputed to be caused by *Phytophthora omnivora.* This disease is a serious rot that starts in the very heart of the plant at the base of the leaves which become discoloured and fall off. The disease spreads upwards, dropping the leaves and destroying the growing point. It spreads rapidly, the fungus causing it thriving in warm, moist conditions.

The control of this disease can be effected as follows :—

1. Remove the discoloured leaves by cutting them away from their point of attachment to the stem, taking away all apparent traces of the infection. This is very carefully done with the aid of a scalpel.

2. The plant in its growing media must be immersed for about five minutes in solution of 8 hydroxy quinoline benzoate 2.50 per cent prepared in the dilution of 3 tablespoonfuls of this fungicide in 1 gallon of water.

3. The plant is then dried off and watered only at its roots until the disease is eradicted. If necessary a second treatment with this fungicide is repeated about a week later.

The above is the method of control that the author has carried out and found to be quite effective.

50 per cent copper oxide and similar fungicides are reputed to control this disease.

BACTERIAL BROWN LEAF SPOT

This is a bacterial disease caused by the pathogen *Phytomonas cattleyae.* It attacks Phalaenopsis plants usually near the base of the leaf and moves upwards to kill the growing point. It first starts as water-soaked spots frequently near the base of the leaf and then become soft and brown, changing from light to darker brown with age. The spots quickly increase in size and may coalesce to form larger areas. The tissue of the leaves become soft and breaks and the disease spreads rapidly, resulting in death of the plant.

The diseased plant is isolated and the identical control measures adopted as suggested for crown rot, which have been found to be quite effective with this disease too.

8—quinolinol benzoate is also reputed to control this disease.

ANTHRACNOSE

This is a fungal leaf-spotting disease caused by many kinds of fungi. Phalaenopsis is susceptible to the anthracnose of Gloeosporium and Colletotrichum. The disease is usually mild, but occasionally can become serious enough to kill a leaf or plant. The disease thrives under high humidity, high temperature and low light intensity. The leaves develop sunken spots reddish-brown at first which later turn dark brown or grey. The spots enlarge and frequently coalesce. When the spots increase in number they may kill the leaf.

Control

1. The diseased portions must be cut off and all spots cut away along with some of the healthy green tissue surrounding them.

2. Drench or submerge the plant for about two or three minutes in a solution of 8 hydroxy quinoline benzoate 2.50 per cent prepared in the dilution of three tablespoonfuls of the fungicide in one gallon of water. The leaves of the plant must be thoroughly sponged with the fungicidal solution. The plant is then dried off and watered only at its roots until the disease is eradicated.

Removal of the diseased portions and sponging of the plant with 1 per cent solution of bichloride of mercury is also reputed to be very effective.

ACKNOWLEDGMENTS

The author is very thankful to Dr. M. F. Chandraratna, Director of Agriculture, for his very valuable suggestions on this paper. He also wishes to express his most sincere thanks and gratitude to Mr. D. M. A. Jayaweera, Superintendent, Royal Botanic Gardens, Peradeniya, for having at all times afforded to him the necessary facilities such as housing accommodation for the many thousands of plants, labour, laboratory equipment, provision of funds for stud plants, &c., without which this work would not have been possible. He is also very thankful to him for the encouragement given in the course of this work.

The author further thanks Dr. H. E. Fernando, Entomologist, and Dr. J. W. L. Peiris, Plant Pathologist, for their helpful criticism on some of the portions pertaining to the pests and diseases described in this paper, and Mr. H. A. Fonseka and Mr. A. I. Weerasinghe of the Publicity Division for the drawings and photographs respectively.

REFERENCES

1. Breddy, Norman C.—Observations on the raising of orchids by asymbiotic cultures. *American Orchid Soc. Bull. Vol. 22, pp. 12-17.*
2. Curtis, Charles H.—Orchids, their description and cultivation. *pp. 157–159.*
3. Hawkes, Alex D.—A brief history of the Genus Phalaenopsis. *The Orchid Journal, Vol. 1, pp. 386–387.*
4. Holttum, R. E.—A revised flora of Malaya. Vol. 1, Orchids of Malaya, *pp. 661–673.*
5. Kirch, Wm.—Culture of Phalaenopsis. *Australian Orchid Review, pp. 26–27.*
6. Kirsch, O. M.—A new way of potting Phalaenopsis. *Pacific Orchid Society of Hawaii, Vol. 13, pp. 95–99.*
7. Knudson Lewis.—Nutrient solutions for orchid seed germination. *American Orchid Society Bull, Vol. 21, pp. 94–96.*
8. Logan, Hary B. and Cosper, Lloyd C.—Orchids are easy to grow. *pp. 233–239.*
9. Miyo Shi, R.—Phalaenopsis. *Na Pua Okika Hawaii Nei Vol. 11. pp. 123–128.*
10. Reyes, Gaudencio M.—Black leaf spot of Phalaenopsis. *Philippine Orchid Review Vol. IV. pp. 13–16.*
11. Sander, David and Cooper, Edward.—Orchids and their cultivation.
12. Sanders, C. F. and F. K. and L. L.—Orchid Guide. *Revised (1927) Edition pp. 371–378.*
13. Veitch James & Sons.—A manual of Orchidaceaus plants. *Vol. 11 pp. 13–52.*
14. Williams, Benjamin Samuel and Henry.—The Orchid Grower's Manual. *pp. 657–675.*
15. ——. Phalaenopsis, the Moth Orchid. *American Orchid Society Bull. Vol. 25. pp. 756–758.*
16. ——. A summary of the programme at the Second World Orchid Conference in Hawaii. *American Orchid Society Bull. Vol. 26. pp. 833–834.*