they were watering every day, sometimes 3 or 4 times a day. But during the winter, a lot more *Atriplex* came up, and by spring it had given about 95% coverage. Today there is just maybe 3 or 4 small areas, a foot here and there that are not completely covered with *Atriplex semibaccata; Mimulus* is coming up there very nicely, too, and it's thick enough to show good color. Watering it once a month would be plenty of water. But it does give a color on that bank all the year round of red and yellow flowers.

MODERATOR HASEK: Thank you very much, Gene, for a most delightful discussion of your interesting work with seeds. Next on the program we will hear from Mr. Otto Martens of Deigaard Nursery, a world authority on palms, speaking on—"Palms—Propagation, Production, and Uses" Otto Martens:

PALMS—PROPAGATION, PRODUCTION AND USES

OTTO MARTENS

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When we think, read or dream of the tropics, nothing comes into mind faster than soft balmy air, blue lagoons with white beaches, palms swaying in the breeze, and glorious sunsets as inviting background for the silhouettes of majestic graceful *Cocos nucifera.*

The International Airport in Los Angeles has taken advantage ot this "tropical" thought association for commercial reasons: The winter traveller from Canada, from the blizzardy plains of the middle-west, or the snowbound eastern states, is made to believe that he landed right in the tropics on stepping out of the plane into all the palms that wise and skillful landscape architects placed in and around the air terminal in groups and in groves.

Limitation of palm habitats and uses makes familiarity with this plant group non-existent to some and restricted to those of you from winter-cold and desert-dry areas. So, to understand our topic easier a few remarks on physiology and ecology may be in order. Palms are the plants most valued and indispensable to millions of people over the world. When Linnaeus, the Swedish botanist who lived during the first half of the 18th century, was asked by his students which plant family he considered the most important, he answered in Latin, the language of the scientists: "Palmae sunt principes"—(palms are the first ones). From his answer was taken the title of the quarterly magazine of the Palm Society: "Principes". The Palm Society has members in 32 countries besides the U. S. (incl. Alaska).

Indeed, when some 25 years ago, Deigaard Nurseries began to think of reintroducing palms into Southern California landscape and

we began to study the history, botany and nursery practice of palms, a whole new world opened up before our eyes, a wonderfully exciting experience, a strange driving enthusiasm took possession of us which to this day still has not left us totally.

Let us share some of the wonders of this plant family, a family of some 2600 species, better than 230 genera, so diversified in every respect, and of such importance as to food and shelter, household goods, utensils, cosmetics, furniture, hats, dresses, buttons and ornamentals, that millions of people not only depend on them, but without them would not be able to survive. Perhaps even the nurserymen of 50 years ago might not have survived. They used raffia for tying and grafting. Raffia comes from the palm, *Raphia ruffia*.

In thought association to most people, palms and tropics are analogous. So it seems to be anomalous that a number of palm species will not tolerate the humid, hot climate of the tropical belt too well. The geographical lines of palm growing are roughly 40 degrees north latitude to 40 degrees south latitude—the northern part of Japan, Spain, Azores, central California in the northern hemisphere, to New Zealand, Cape of Good Hope in Africa, and the center of Argentina in the southern hemisphere. However, the tenderline for the palms (*Cocos nucifera*) is from 20 degrees north to 20 degrees south, much more restricted; the real maximum palm vegetation of the tropics confines itself into a strip of 5 degrees north to 5 degrees south, just narrowly on each side of the equator. For our consideration we omit the latter two belts, because *Cocos nucifera* is beyond the cold and dry heat tolerances, even in the warmest moderate part of California.

Amongst the species needing a cool climate for optimum development, therefore for good use in subtropical areas, is the American needle palm, *Rhapidophyllum hystrix,* native from the Carolinas to northern Florida. This dwarf, full and compact, very pretty palmate clump palm can stand 0° F. It is reported to have survived —9° F. Very slow growing, it is, unfortunately, little known and rarely found in cultivation. In landscape it would make an excellent combination with *Chamaerops.*

Better known is the Chilean wine palm, *Jubaea spectabilis.* We have not seen more miserable specimens than those in the hot humid climate of Southern Florida. But they will grow to perfection in the coolness of the Chilean mountain climate, a feather palm tree with the most enormous trunk in thickness of all palms, 4 to 5 feet in diameter. We will see some marvelous groups of this species during the Society's Lotusland* tour. In their native habitats this extraordinary palm is on the nearly-extinct list, because their craving for alcohol makes the natives cut the trees down mercilessly. The massive trunks, after being cut, yield from 75 to 100 gallons of sap; fermented into toddy, this

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* Lotusland, Montecito, California

means a few gay hours for a few people. The one and only palm indigenous to Chile is a sacrifice to human appetite. It is possible that man became infatuated with drink, when in prehistoric times monkeys fought for a place on broken peduncles of palm influorescences, where sap oozed out of the wounds and, in the humid heat of the tropics, quickly fermented. The monkey's tongues lapped it up as fast as they could get to it. Not a joke, but the truth and, in any case, a sinless way of becoming an alcoholic.

Other palms needing a cool climate are:

(1) *Trachycarpus fortunei,* which grows as far north as in the parks of Vancouver, British Columbia, in England as rare specimens, and as tub plants at the Alster Pavillion in Hamburg. Also I had correspondence with a man in Idaho where he grew one outside in open ground, sheltered, for a number of years.

(2) *Chamaerops humilis,* the dwarf palm of the Mediterranean area and much used as accent, where palms will grow in cooler and more arid sections.

(3) *Nannorrhops ritchieana,* very hardy but seldom seen in home plantings, which is found as a small creeping palm on the high plateau of Afghanistan in altitudes up to 9000 feet and often under a cover of snow

(4) *Rhapis excelsa* and *Rhapis humilis,* lady palms from South China are hardy and are jewels used as tub plants in house and patio.

(5) *Rhopalostylis sapida,* the shaving brush palm named so because of its featherduster like crown of leaves, grows to perfection in our Southern California climate so similar to its native country, New Zealand, especially along the cool coast. Again a fine stand of two species may be seen at Lotusland.

(6) The most fascinating of all hardy palms, in fact one of the most fascinating of all palms is a native of Columbia and Equador—not of their steaming jungles in the lowlands, but of their high elevations in snow and frost: *Ceroxylon andicola,* the Andean Waxpalm. At altitudes of 10,000 feet they are found in magnificent stands, glistening white trunks up to the unbelievable height of 200 feet—200 feet of straight white trunk, 1 to 1½ feet in diameter—truly an engineering wonder, with a crown of only 8-10 leaves, but each leaf 20' long, silvery white underneath. Alexander von Humboldt saw them first, but it was the German botanist Engel, enthralled by their beauty as he was camped underneath them, the starry heavens above, who heard in those inspirational moments, the white leaves on the alabaster trunks rustling in the night wind, eternal symphonies of Beethoven in his mind. He called the palms *Beethovenia,* a name which later was preempted because of earlier nomenclature. Once thought to be the tallest trees in the world, they are certainly some of the most inaccessible, and can be reached only by mule trail. Seeds

lose their viability on the long transport back. Although botanists tell us that *Ceroxylon* would grow in the mountain areas of Oregon and Washington, perhaps in the Coast Range of California, no effort has been made so far to do this. The only Andean Waxpalm now in California, to my knowledge, of promising size, is grown by a veterinarian in Vista.

Lastly, No. 7 on the cool list is *Howeia*, alias *Kentia*, raised and used for decoration in quantities limited only by the short supply of seeds, with two species: *H. forsteriana* and *H. belmoreana*. They are indigenous to the small Lord Howe Island between New Zealand and Australia, growing right from the waterline in belts halfway up the two mountains which top the island. The upper half is occupied by two species of Arecoid palms, similar to *Howeia*, as well as the aristocrats in the Southern California landscape, *Hedescepe canterburyana* and *Clinostigma mooreanum*. Look for specimens of all four in perfection at the estate of Mme. Ganna Walska (Lotusland). *Howeia* trees in young stages freeze at 28° to 30° F. They are outdoor landscape material only in protected areas; on the other hand, they do not thrive under excessive humid heat; only very few *Howeia* palms were seen on visits to tropical Hawaii and Florida.

Certain species of the following genera are hardy enough to find their place in the California landscape: *Archontophoenix, Arecastrum, Arenga, Butia, Erythea, Livistona, Paurotis* (*Acoelorrhape*), *Phoenix, Sabal, Trithrinax, Washingtonia.*

Palms are divided by their leaf structure into pinnate and palmate palms. They are also distinguished by their differentiation of ultimate size: dwarf, medium, tall, climbing, creeping, branching. In landscaping, the architect more often searches for dwarfness and middle size; tall palms, massive palms, there are many. Unfortunately, often we find *Phoenix canariensis*, enormous of size, bulky in appearance adorning a residence with a 60 foot front yard, entirely out of place; often we find an 80 foot *Washingtonia*, singly or in a group, in front of a window planted on a same size lot. Surely, *Washingtonias* and *Phoenix* trees have their places—on roads, in parks, on freeways.

It is lamentable that the ultimate in dwarfness—*Syagrus liliputiana* and *Iguanura pedunculata*, each 4 inches high only, their maximum rarely surpassing 12 inches, their trunk as thin as a goose quill, may not be used here because their cold tolerance is beyond California's natural environment. This is true for most of the climbers with the exception of one, *Chamaedorea elatior*. It climbs by way of bending its leaves backward in an angle and thus hooking itself to tree limbs

Out of our reach in every respect is the fastest and longest growing of all climbing palms, *Calamus* or Rattan, known for its use in furniture making. A maximum growth of 556 feet in length has been

measured by the Forestry Department of Malaya, amazing and truly phenomenal.

Palms are monocotyledons. Their age, historically, is known to be about 150 million years. Fossils have been found as trunks, roots, leaves, pollen, seeds. I have brought a few to this meeting to look at, 40 million years old; the necktie trinket is supposed to be 150 million years. Note the vascular bundles appearing as dots. The physical structure of the palm trunk shows that it consists of vascular bundles—tubes—no cambium layers for expansion sidewise. The tubes can go only two ways: up or down. Trunk, leaves, roots all grow in one of these directions Therefore, the trunk diameter is determined in the first years of its growth.

The leaf in its top stage actually does not grow, it only unfolds; it already has finished its growth period inside the trunk apex. The astonishing fact is that there are numerically as many leaves inside the apex of the trunk as there are crown leaves on the palm trunk outside. So, if *Cocos nucifera* (we are thinking of well-grown, well-developed, well-watered, well-nourished specimens) has 26 crown leaves, that many leaves are inside in more or less developing stage. For this species it takes 25 days for a new leaf to open and, in a continuous cycle, an old leaf to die, the age of one leaf can be determined as 26 leaves x 25 days = 650 days plus same amount inside apex = 1300 days, or 3.6 years, for a complete leaf cycle. A leaf growth tabulation of 40 species is in preparation at this time. It will be of interest to evaluate rhythm and age, as all species seem to be different.

On two remote little granitic islands of the Seychelles group between Africa and India, north of Madagascar, we get acquainted with a rare and, one of the world's most fantastic palms, *Lodoicea maldivica,* the Coco de Mer, known for its double coconut-like fruit. This tree produces the largest seed in the vegetable kingdom, often weighing 40 to 50 lbs. each. A fully grown plant, 100 feet tall with a straight trunk 1 foot diameter, 100 to 300 years of age, palmate leaves 36 feet long, at its optimum, has 12 open leaves; one new leaf will unfold every 9 months = 108 months. Take the same amount inside the apex = 216 months, or 18 years, is the age of one single leaf. The *Lodoicea* seed matures after 6 years on the tree, drops off to the ground, and rolls down hill (it can't roll uphill), and sprouts after 1 year. But the question remains, "where did the *Lodoicea* palms come from growing on top of the decomposed granite ridges?"—But like so many questions in the world of palms which remain unanswered, so does this one. Speculation is that once in prehistoric ages there was a plateau running from East Africa to India and these ridges, with the palms on them, are remnants and relics.

A similar manner of growth is observed in the root system. Because of their tube system roots do not expand in diameter, but die to make room at the stem base for new and heavier roots, always

developing and growing from the base. This is the reason that nurserymen may dig up palms 80 feet tall with only a small, or hardly any, ball of roots and dirt and transplant them without difficulty. Not the old roots but the newly developing roots will carry on life, while during the transition stage the plant will live on starches stored in the trunk and bole. New roots will form in the warm soil of summer readily whereas in wet, cold, winter weather a transplanted palm may not survive, as no new root growth is stimulated. Therefore summer is the best time for transplanting At the same time, reduction of foliage is compulsory, of course, to diminish water loss from the plant.

Propagation of palms is the easiest of all plant procreation and there is really not very much to tell about Let's write off, one after another, the methods that do not go: cuttings—no, grafting or budding—no, layering—no; meristem culture (we experimented with *Chamaedoreas*), but no results—still there may be a chance; suckering and division—yes, but only on certain stooling species, like *Chamaerops humilis, Rhapis, Areca, Phoenix reclinata,* and *Reinhardtia.* All date palm orchards are started this way but no emphasis has been put on this method for ornamental palms.

The simple, easy method of palm propagation is by seed. One of the principal productions in our nursery is *Howeia forsteriana.* Seeds are gathered commercially on Lord Howe Island (between New Zealand and Australia), packed in slightly moist peatmoss or similar medium and shipped by boat under Australian government rules and prices. At the port of entry the seeds are inspected and fumigated under auspices of the U. S. D A. Division of Entomology and Plant Quarantine. On arrival at the nursery the seeds are immediately planted seed-tight into electric hotbeds with thermostatic soil control at 80° F. At 85° to 95° seedlings start to show burn damage. The propagating medium consists of 50% Canadian peat (fine), 50% perlite (Sponge Rok) No. 2, thoroughly blended with "Water-in".

Previous to planting, beds are sterilized with methyl bromide. The redwood frames are treated with copper naphthanate. The embryo within the endosperm of palm seeds for most species is greatly subject to drying out, therefore seeds on long travel time may be soaked in water for one to two days prior to planting. While seeds of dicotyledonous plants can go dormant for long periods of time, e.g. seeds of native California chaparral plants, monocotyledons — like palms — cannot. They have a limited span of viability, in subtropical zones from 2 to 3 months; in tropical zones with little temperature changes, and little variance between wet and dry seasons, 2 to 3 weeks. Fresh seeds therefore are mandatory for commercial results. *Howeia* seed germination is uneven, from 4 months to 2 years — a good average, 9 to 12 months. Seeds which have not sprouted the first year are put through a water test and replanted. Before roots become large (they do very rapidly), the young seedlings are potted off into 2½"

rose clay pots, plastic pots were discarded because of insufficient root aeration. Height of stem exposure is up to the bole, with seed mostly still attached. The potting medium consists of ¾ sandy loam, ¼ forest humus or mushroom compost, combined with a trace of slow release granulated fertilizer, and sludge. This method of *Howeia* seed propagation is typical of any palm species. However, germination periods vary greatly, some requiring only 3 to 4 weeks, others 1 to 2 years; also species from the tropical belt need higher germination temperatures

A great portion of our palm production is transplanted from liners or 1 gallon cans into nursery rows in the open field to mature into salable landscape specimens. Here regular nursery methods apply· periodic irrigation by an overhead Rainbird system, tractor cultivation (we want green mulch for aeration and soil conditioning), fertilization with Hi-12, commercial nitrogen plus trace elements, and strict pest and obnoxious weed control. Pests are palm scale, mealybugs, mites and rabbits, and occasionally rats. Diseases, mostly encountered under confined and shade conditions are *Penicillium vermoeseni, Rhizoctonia* and watermold. All of this is kept fairly well under control with the help of County Agricultural Inspectors, Farm Advisors and plant pathologists from the University of California.

Howeia palm and shade-loving palm production is different. From liner pots *Howeias* are shifted into 6'' clay pots as triplets, established above ground, then plunged, pots and all, into sterilized open ground in the shade house until salable—after 4 to 5 years. A part of this 6 inch stock (triplets) is shifted into 2 gal. green metal containers which are readily accepted by the trade. A third part is knocked out of their pots and transplanted back into open ground to be advanced into larger specimens for later digging and establishing in wooden tubs. This procedure requires considerably more time, but since there is a ready market, even by air freight to the east coast, the investment is warranted.

Those varieties of palms, other than *Howeias,* used for indoor decoration or requiring a shady location are brought from liners to salable container size by similar growing procedures. As the plants are brought up into larger containers periodic fertilizing begins. We use a U C. soil mix together with dried blood or hoof and horn, potassium nitrate, oyster shell, dolomite lime, gypsum, single superphosphate, and potassium sulfate in regulated proportions.

Earlier we listed those hardy species of palms which have proven best for California landscaping. Species which are dwarf, or semi-dwarf, and commonly used as house or conservatory plants are: *Chamaedorea, Howeia, Phoenix roebelenii, Phoenix rupicola, Rhapis, Microcoelum weddellianum, Trachycarpus takil, Livistona, Arenga,* and *Linospadix monostachya.* Species for hedge, fence, or

windbreak are: *Chamaerops humilis, Phoenix reclinata, Acoelorrhaphe wrightii, Sabal,* and *Arenga.*

Palms are playing an ever-increasing role in the landscape picture. They again have come into their own. It is false, however, to assume that palms are "low maintenance" or "no maintenance" plants. They are to a degree—they will exist under adverse conditions, even under plain neglect, when other trees would have, long ago, given up the ghost, but then, of course, they are far from looking their finest. But give them water, some fertilizer, even once in a great while, and they will respond. They will give back to you their appreciation with great beauty.

REFERENCES

Bomhard, M.L., Palm Trees in the U.S., *U.S. Forest Service Agr. Inf. Bull.* No 22

Braun, August, Cultivated Palms of Venezuela, *Principes,* Vol. 12, No. 4.

Cook, O.F., Kentia Palms in California, *Journ. of Herdity,* Bol 18, No. 9.

Corner, E. J. H., The Natural History of Palms.

DeLeon, Nat J., Viability of Palm Seeds, *Amer. Hort. Soc. Mag.,* Vol. 40, No. 1.

Hertrich, William, Palms and Cycads.

McCurrach, James C., Palms of the World.

Moore, Jr., Harold E., Annotated Checklist of Cultivated Palms, *Principes,* Vol. 7, No. 4.

Moore, Jr., Harold E., Botany and Classification of Palms, *Amer. Hort. Soc. Mag.,* Vol. 40, No. 1.

Moore, Jr., Harold E., Palm Hunting around the World, *Principes,* Vol. 10, No. 1.

Mowry, Harold, Native and Exotic Palms of Florida, *Fla. Agr. Ext. Serv. Bull.* 152.

Tomlinson, Parthasarathy and Vargo, Collecting—Palm Style, *Principes,* Vol. 10, No 1.

MODERATOR HASEK: I would like to thank you very much, Otto, for such an excellent talk. We certainly appreciate your being here to give this fine presentation.

We will now go on to our next speaker, Mr. Ralph Shugert from Spring Hill Nursery in Tipp City, Ohio, and President of the IPPS. Ralph: