Palm Oasis is being developed as a plush resort area. As for the other groves, they are as difficult to reach as ever. A road (trucks only) leads to the Chino Canyon group which is still safe from subdividers. The *Phoenix dactylifera* groves are becoming more valuable as subdivisions and golf courses and a source from which to obtain ornamental trees than they are as commercial ventures—although date culture is still a major crop in the area and new gardens are planted once in a while.

"My own private collection includes twenty-six different species, of which the *Phoenix* do the best. The sabals do fine if not left entirely exposed to summer sun and *Arecastrum Romanzoffianum* grows at a phenomenal rate. I have three coconuts planted last summer that thrive in 115° and did make it through the winter, which had no freezing nights but had fewer warm days than usual. Most of the difficulties here seem to be low humidity, high temperatures and sunburn, although *Chamaedorea* does fine outside in almost complete shade.

"Your recent article on the palms in Tabasco, etc. was most interesting. I hope to try *Brahea dulcis* here when I can get a plant or two, also the *Acrocomia* from Nayarit. Some very small *Attalea Cohune* from Nayarit [but if native probably *Orbignya Guacayule*—Ed.] survived last winter and are starting to grow now. My next trip will follow your route through the Tabasco country."

ROBERT O. SCHNABEL
1155 Sunny Dunes Rd.,
Palm Springs, Calif.

* * *

Some time ago, a letter from Mr. G. L. Guy, Conservator of Forests in Matabeleland, P. O. Box 467, Bulawayo, Southern Rhodesia, was forwarded to the editor by Dent Smith. Printing has been delayed due to correspondence about one of the species mentioned by Mr. Guy who, in the meantime, has sent some reprints which we hope to utilize later. The original letter is reproduced here.

"Volume 1 no. 3 of PRINCIPES was recently sent to me by Edwin Menninger of Stuart, Florida, and I was particularly interested in the photo of the *Raphia* leaf on the back page.

"About two years ago I had something to do with the preservation of the two groves of *Raphia ruffia* existing naturally in this country, and I can assure you that 27 or 29 feet is a small leaf. Mr. Aylen of the Natural Resources Board and I felled one leaf which measured 53 feet, and it was by no means

(Continued on page 126)

Cold Tolerance of the Cultivated Palms

Based on Observations Made at Daytona Beach, Florida, During the Winter of 1957-1958

DENT SMITH

During the past seven years the writer has maintained at Daytona Beach, Florida, a collection of several hundred planted palms ultimately containing upwards of 135 species belonging to 64 genera. The purpose of this planting has been twofold, (1) to make a more northern palm garden of as many different palms as might be grown, and (2) to determine what species could endure the colder winters of a region nearly two hundred miles north of the Florida latitudes considered warm enough for success in growing any really large number of species.

The second consideration was an ex-

periment full of risks, for the weather records revealed that the Daytona Beach area had been subjected, occasionally, to invasions of deep cold even though the outbreaks usually had occurred many years apart. However improbable, a heavy freeze may descend upon the area in any winter, and several such freezes actually did occur in the winter of 1957-1958 just past, with the inevitable dire results to most tropical plants. The latest outbreak of comparable cold had been eighteen years earlier, in late January, 1940, when a temperature of 18°F. established an absolute minimum in the records of the Weather Bureau station. During the interval of eighteen years between the two outbreaks only a negligible number of the myriad tropical plants had been winter-killed in the warmer parts of the area. Perhaps no planted palms at all had been killed during the period, but only the hardier kinds had ever been generally planted.

The main object of this article is to record as accurately as possible the effect of the past winter's multiple freezes upon each of the planted palm specimens in the writer's collection. In order for such a report to be of much value to subtropical gardeners it becomes necessary to go into some detail about the location, the climate and other factors affecting the palms, so that the gardener may relate the facts (temperatures, *etc.*) to his own situation and perhaps draw practical conclusions.

Daytona Beach is on the east coast of Florida, at latitude 29° 11′ N., about 425 miles north of Havana and about 360 miles north of the Tropic of Cancer. The distance north from Miami is 263 road miles or 242 miles in a straight line. The climate is classified as "humid subtropical" and according to a climatological summary of the U. S. Weather Bureau ". . . is characterized by mostly sunny days, gentle breezes, and pleasant year-round temperatures, suitable for bathing and sunning at the beach every month of the year. . . . Average annual temperature is 71°." But there are, in fact, two separate winter climates in Daytona Beach, that of the mainland and that of the peninsula, a narrow strip of land confined between the salt-water Halifax River and the open Atlantic. The palm collection dealt with here is located on the peninsula, which is more subject to marine influences and hence distinctly warmer in winter.

This usually benign climate was reversed the past winter by three months of record cold weather, suddenly beginning with a light frost on December 2, 1957, followed by hard freezes on December 12 and 13, when minima of 25°F. and 27° were recorded. These two freezes destroyed all the foliage of about half the writer's palms and damaged that of certain others. Although the recorded 25° temperature was the absolute minimum for the three winter months, much worse was yet to come, in January and February, 1958, in the form of continuous cold weather punctuated by eight additional freezes — a total of eleven during the three months. For severe and protracted cold this was by all odds the coldest winter in the history of the local Weather Bureau and in the memory of the oldest lifetime residents. At last here was something an experimenter with palms could sink his teeth into: a trial by cold of historically unheard-of duration, for it eclipsed anything experienced here in over fifty years.

Obviously the result to the palms was calamitous, but by no means was it a total catastrophe. Had it been total, there would be no point in writing this report. Besides the palms already known to be remarkably cold-hardy, a few hitherto believed tender, by surviving unscathed, were proved equally hardy or

nearly so. Many others that were defoliated or otherwise injured are now, nearly eight months after the first freezes, fully recovered, or are definitely recovering, or are attempting to recover with the outcome still in doubt. Much the greater number of the so-called tender palms, however, were killed and conclusively proved not even slightly tolerant of hard freezes.

Without wanting to appear in the least didactic, the writer must make it clear that only a close study of the factors involved—and there were many—could avoid certain misleading conclusions. For example it would be wrong to conclude, from the summary appearing near the end of this article, that the royal palms, just because three specimens here are now unquestionably recovering, can take anything produced by the whims of subtropical weather; on the contrary, only large, older specimens can survive repeated freezes and young ones will surely perish if not protected. The reverse of this is to conclude, and again wrongly, that a planted specimen of *Drymophloeus Beguinii*, say, will succumb to one short freeze of 25° simply because one specimen was finally killed here by the later freezes of the past winter, in February. Actually dozens of palms were not visibly affected by the first few freezes here, but were eventually killed by much later ones. If this report is to be of substantial use or reliability to anyone concerned with periodic invasions of cold air masses, it must be read in conjunction with the Appendices. Reference is made chiefly to Appendix A, which contains the temperature range for each day of the three cold months of December, January and February.

The whole matter of plant injury and survival here is complicated, and not only by the fact that there were eleven freezes during the winter instead of just one. Though the thermometers were housed in the prescribed standard shelter for such instruments, the recorded temperatures do not allow for the differences bound to exist at various locations on the premises. Temperatures may vary by several degrees within only one hundred feet (much more vertically), depending usually on a change in ground level, on proximity to foliage or solid objects, and on air circulation. But there were other factors, of which the principal was insect attack upon freeze-weakened plants. Which one of the eleven freezes finally killed a palm? Which palms finally succumbed to insect attack instead of primarily to cold destruction? These questions are not easily answered, but in the summary towards the end of this report the writer attempts to answer them in every ascertainable case. No attempt, however, is made here to account for numerous other considerations, as, for instance, the moisture content of the plants or the soil, the vigor of the specimens, nor in all cases the size and age of the palms. These are but a few of the factors that directly bear on the subject, and indeed to deal with every one would require more than the available space.

About a quarter of the palms killed owed this outcome directly to bud infestation by insect larvae and only indirectly to cold injury. In many cases an apparently healthy bud appeared only to sicken and die, whereupon it was pulled out and found heavily infested in its soft basal parts with larvae resembling maggots. Unfortunately the insect responsible for these larvae was not discovered, but without presuming to name the culprit, a fly was suspected. The larvae infested the buds of not only the freeze-injured palms but also of thirty or more uninjured palms in perfect vigor. In the latter case the insect showed a preference for the arecastrums,

seven of which were attacked and their buds destroyed by larvae; but all of these palms fully recovered, for they and some of the other cocoids are able to thrust up a new leaf bud when one is destroyed—an ability notably shared with the *Phoenix* and certain other palms not allied with *Arecastrum*.

Presumably the freeze losses could have been reduced by the use of several hundred grove heaters or some other kind of artificial heating. The temperature could have been raised several degrees by such methods, but this would have defeated the purpose of learning the true cold-tolerance of the palms. For this reason no artificial heat was used at any time, and the palms were strictly on their own. On the morning of each of the heaviest freezes it might have been legitimate to sprinkle the frosted palm foliage to prevent the rising sun from thawing it too fast, but this could not be done because the irrigation system was frozen solid.

Defining a freeze as each time the temperature dropped to 32° or lower, there were during this historic winter of eleven freezes a total of approximately 63 hours of freezing weather. The first one, which was also the shortest, occurred on December 2 and lasted but twenty minutes. The longest one occurred on January 9 and lasted 13 hours. (Actually the latter freeze began at 8:30 p.m. on the 8th and ended at 9:30 a.m. on the 9th, but the weather reports at the writer's station have been made once daily covering the 24 hours from 5 p.m. of the previous day to 5 p.m. of the day newly reported, for the reason that the thermometers are read but once each 24 hours.) December had three freezes with 20 hours of freezing weather, January had one with 13 hours, and in February there were four freezes on consecutive days with 30 hours. No temperatures below freezing were recorded during daylight after 10 a.m. The most damaging weather occurred in mid-February, when the minimum temperatures were in either the 20's or 30's on nine consecutive mornings. A good many of the tropical palms that had survived all seven preceding freezes—some of them virtually unaffected—at last were killed by the sustained cold of February, which was the winter's parting shot. No frost recurred after February 20th.

Including the palms in containers there were represented in this collection, before the freezes, over 250 species in more than 100 genera. About half of the potted palms were casualties, but this account is concerned only with planted specimens, of which there were 445. More than half of these were still very small juveniles, and hence less resistant to cold.

In the alphabetical summary below, an attempt is made to account for each individual palm up to August 1, 1958, the date of this report. Brevity occasionally has been sacrificed in favor of detail that may be essential. Because the size of a palm has a great deal to do with its cold resistance, the overall height of each specimen is shown in either feet (′) or inches (″). Figures in parentheses signify the total number of individuals of each species. The word "now" always means at August 1st.

Acanthophoenix rubra (1), 20″, killed Dec.

Acrocomia aculeata (2), 11′ and 17′, both severe foliage damage Dec., total loss remaining foliage Feb., both now healthy with new foliage. *A. fusiformis* (1), 20″, unaffected. *A. Totai*, (1), 10′ unaffected at any time. *A. mexicana* (1), 2′, slight damage Dec., seemingly dead Feb., began recovery late Mar., now fully recovered. *A.* sp. (1), 3′, quickly recovered from very slight damage.

Aiphanes acanthophylla (2), 5′ and

8′, both killed outright Dec. *A. caryotaefolia* (1), 11′, killed Dec. *A. erosa* (1), 3′, killed Dec. *A. Lindeniana* (3), all 2′, two killed Jan., the third apparently dead also but began recovery July 3, recovery now certain.

Archontophoenix Alexandrae (4), one of 9′, two of 15′, one of 25′. The three smaller specimens slowly died from effects Dec. and Jan. freezes. Woody stems as well as foliage destroyed. Only the foliage of the tallest injured; not yet dead, but recovery not likely.

A. Cunninghamiana (2), 11′ and 16′, foliage of both gradually made unsightly but none of it destroyed, buds of both killed by larvae early June despite drenchings of malathion solution, smaller died early July, larger slowly recovering after July 15th.

Areca Cathecu (1), 4′, killed Dec. *Areca triandra* (2), 4′ and 8′, slight damage to the smaller Jan., severe Feb., died May from insect attack. Minor damage to foliage of the larger Dec., more in Jan. and Feb., 3 stems killed by insects Mar., 1 stem alive and rapidly growing. *A. sp.* (2), 3′ and 5′, killed Jan.

Arecastrum Romanzoffianum (8), 8′ to 24′, unaffected.

Arenga Engleri (3), 4′ to 9′, unaffected. *A. pinnata* (1), 7′, foliage destroyed Dec., pruned back to bare 2′ stub, so remaining till late June, when a stunted leaf appeared. Recovery now likely but not certain.

Arikuryroba schizophylla (1), 8′, only minor damage early freezes, severe in Feb., lingered till mid-Mar. and died.

Bismarckia nobilis (1), 1′, unaffected.

Butia capitata (4) 1′, 5′, 7′ and 13′ all unaffected. *B. eriospatha* (1), 6′, unaffected.

Caryota mitis (6), 6′, 8′, 9′, 12′, 20′, most or all foliage destroyed Dec. except of shaded suckers. The three smaller specimens killed Dec., the three larger now alive only through the three to six suckers in each clump. *C. urens,* (3), two of 8′ and one of 16′, the two smaller killed Dec. but the largest, also apparently dead, began recovery late Apr., now definitely safe. *C.* sp., rec'd as *C. Cumingii,* (1), 2′, killed Dec. *C.* sp., rec'd as "*C. plumosa,*" (1), killed Feb.

Chamaedorea brachypoda (1), eleven stems to 2′, six stems killed Jan., five uninjured. *C. cataractarum* (1), 2′, unaffected. *C. costaricana,* (1), 2′, one stem killed Dec. and one Feb., two stems now alive, flourishing. *C. elegans* (3), 1′ to 4′, all unaffected. *C. erumpens* (12), two weak plants killed Feb., ten alive suffered very slight to moderate injury.. *C. fragrans,* (1), 3′, killed to ground Jan., new stem of this single-stem plant rose from roots late June. *C. geonomiformis* (1), 1′, foliage shabby from repeated freezes, larvae destroyed bud, recovery doubtful. *C. Klotzschiana* (1), 5′, unaffected. *C. oblongata* (1), 3′ severe injury Jan., killed Feb. *C. radicalis* (2), 10″ and 16″, smaller killed Feb., larger unaffected. *C. Seifrizii* (1), 3′, unaffected. *C. Tepejilote* (2), each 18″, both killed Dec. *C. Wendlandiana* (3), 2′ to 3′, all injured Dec., killed Feb. *C.* spp. (11), 1′ to 3′, four of these several undet. species killed Dec., remaining seven uninjured.

Chamaerops humilis (2), 1′ and 6′, both unaffected.

Chrysalidocarpus lutescens (5), 7′, 9′, two of 10′, 12′, severe injury to foliage and stems Dec. except shaded suckers, one killed outright Feb., remainder alive only through new suckers and shorter stems. *C.* sp. "Soledad" (2), 2′ and 3′, minor injury to both Dec., larger killed Feb., smaller no further injury till May when killed by insect larvae.

Coccothrinax argentata (1), 2′, injured Jan., killed Feb. *C. crinita* (2), 1′ and 2′, very minor damage to foliage of smaller, larger totally uninjured, ob-

viously suitable for the climate. *C. Dussiana* ? (1), 3′, unaffected. *C.* sp. (1), 2′, killed Dec.

Cocos nucifera (9), 3′ to 13′, five killed Dec. incl. one dwarf Malay, two killed Jan., two killed Feb., all severely injured unless killed by the first hard freeze.

Corypha umbraculifera (1), 10″, damage quite minor, killed by insect larvae late Mar.

Cryosophila Warscewiczii (1), 2′, seemingly killed Dec. when stem pruned back to 3″ stub, first new leaf mid-June, now definitely recovering. *C.* sp. (1), 3′, killed Dec.—or, one might well ask, would it not have recovered as the other plant did if it had not been grubbed out and discarded?

Dictyosperma album (4), 2′ to 9′, all except smallest severely injured Dec., no recovery, but smallest persisted with only minor damage till May when killed by insect larvae. *D. album* var. *rubrum* (1), 8′, killed Dec.

Drymophloeus Beguinii (1), 4′, unaffected by first seven freezes, killed Feb.

Elaeis guineensis (3), 2′, 8′, 11′, total destruction foliage of all Dec. and all presumed dead till late June when the bare stub of the former 8′ palm erected a first leaf and is now rapidly recovering, but no recovery of the others as yet.

Euterpe edulis (1), 4′, killed Dec.

Gaussia attenuata (4) 2′ to 3′, all killed Dec.

Geonoma sp. (1), 3′, stem killed Dec., suckers killed Jan.

Guilielma Gasipaes (1), 6′, killed Dec., new suckers have since risen from roots.

Hedyscepe Canterburyana (1), 10″, killed Dec.

Heterospathe elata (1), 4′, severe injury Dec., killed Jan.

Howeia Belmoreana (1), 3′, killed Dec. *H. Forsteriana* (5), 2′ to 7′, all but one of only 2′ killed Dec., but inexplicably the two-footer was uninjured at any time.

Latania borbonica (5), 1′ to 5′, all minor to moderate leaf damage Dec., more extensive Jan., all killed Feb. except for one small specimen that lingered on till killed by larvae late July.

Licuala grandis (2), 10″ and 16″, only minor damage to foliage of either through first seven freezes, smaller killed Feb., larger never did lose quite all its foliage and is now definitely recovering. *L. peltata* (1), 14″, unaffected Dec. and Jan., killed Feb. *L. spinosa* (1), 1′, weak plant, killed Feb.

Livistona australis (1), 3′, unaffected. *L. chinensis* (5), 3′ to 5′, none affected. *L. cochinchinensis* (6), 2′ to 4′, none affected. *L. rotundifolia* (2), 1′ and 3′, the smaller killed Jan., the larger lost half the foliage but is now fully recovered.

Mascarena Verschaffeltii (7), 2′ to 8′, foliage of all seven destroyed Dec., no recovery of six, seventh recovered partially June only to lose bud to larvae.

Mauritia setigera (1), 2′, killed Dec.

Metroxylon amicarum (1), 3′, killed Dec.

Nephrosperma Vanhoutteanum (1), 1′, killed Dec.

Opsiandra Maya (11), 2′ to 6′, all but one killed Dec., and that one appeared dead till early July, full recovery still uncertain.

Orbignya Cohune (1), 2′, unaffected. *O. speciosa* (4), 1′ to 2′, injury none to inconsequential, apparently hardy here.

Parajubaea cocoides (1), 20″, unaffected.

Paurotis Wrightii (2), 3′ and 7′, unaffected.

Phoenix. Plants of the following species were in no way affected: *P. abyssinica* (1), 6′; *P. canariensis* (4), 2′ to 12′; *P. dactylifera* (3), 2′ to 7′; *P. humilis* (1), 5′; *P. Roebelenii* (5), 3′

to 5′; *P. reclinata* (20), 4′ to 11′; *P. rupicola* (1), 5′; *P. sylvestris* (2), 6′ and 9′. A few of each of the following hybrids, of which only the female parent is known, lost their buds but not any of the opened leaves and subsequently grew new buds: *P. pusilla* × ? (6), 2′ to 5′; *P. rupicola* × ? (5), 2′ to 3′; *P. zeylanica* × ? (6), 1′ to 2′.

Phytelephas macrocarpa (1), 2′, killed Dec.

Pinanga Kuhlii (1), 3′, minor damage Dec., extended Jan., killed Feb.

Pritchardia Beccariana (1), 2′, minor injury Dec. and Jan., seemingly killed Feb., revived Apr., killed by larvae May. *P. pacifica* (2), 2′, killed Dec. *P. Thurstonii* (8), all 2′, all killed Dec. save one specimen which retained one green leaf and is now gradually recovering.

Pseudophoenix vinifera (1), 5′, killed Dec. *P. Sargentii* (1), 2′, inexplicably not injured. *P. saonae* (2), 18″, killed Dec.

Ptychosperma elegans (9), 5′ to 12′, foliage and also woody trunks destroyed Dec., trunks exuding a pinkish paste where cells were ruptured, fatal damage obvious to every specimen from the first hard freeze (these palms had survived, without the slightest injury, five light freezes in past years). *P. Macarthuri* (2), 3′ and 4′, killed Dec. *P.* sp. "Ragey" (2), 5′ and 7′, killed Dec. Also killed Dec., five specimens of two undetermined species.

Raphia Ruffia (1), 2′, foliage destroyed Dec. and plant seemingly dead, recovery started early June and now rapidly progressing.

Rhapis excelsa (2), 3′ and 6′, unaffected.

Rhapidophyllum hystrix (1), 3′, unaffected.

Reinhardtia gracilis var. *gracilior* (1),, 1′, three fruiting stems killed, two suckers remained alive, plant dug up and placed indoors on eve of Jan. freeze, not yet replanted.

Rhopalostylis Baueri (1), 1′, apparently killed Dec., revived late Mar., killed by larvae Apr.

Rhyticocos amara (1), 4′, half foliage destroyed by successive freezes, recovery now seems certain.

Roystonea elata (8), all 4′ and two years old, planted Nov. '57, all killed the following month. *R. oleracea* (2), 3′ and 5′, both killed Dec. *R. regia* (17), 5′ to 24′, nine of which were 2½ years old averaging 5′ in overall height, all killed Dec.; five six-year olds averaging 12′ killed Dec. except for one survivor growing under oak foliage, this survivor now healthy again; one 14′ specimen eight years old killed Jan; one 16′ specimen ten years old lost all foliage Dec., grew two new leaves late in the month, new foliage destroyed Jan., began recovery late Mar., now rapidly recovering; one 24′ specimen about twenty years old lost all foliage Dec., made no recovery till Apr. but full recovery now certain.

Sabal causiarum (1), 3′, unaffected. *S. Etonia* (14), 3′ to 5′, native, unaffected. *S. glaucescens* (1), 3′, unsightly damage to foliage, no deep injury. *S. mauritiaeformis* (1), 20″, ugly but inconsequential damage to foliage. *S. mayarum* (1), 5′, unaffected. *S. nematoclada* (1), 3′, foliage mostly burned, otherwise uninjured. *S. Palmetto* (42), 8′ to 26′, native, unaffected. *S. parviflora* (1), 2′, totally uninjured though its "saucer" was covered with a thick cake of ice for seven hours. *S. texana* (1), 3′, unaffected. *S. umbraculifera* (2), 1′ and 3′, unaffected. *S. Yapa* (1), 2′, unaffected. Note degree of variance in cold-tolerance of the strictly tropical species: *S. causiarum* (Puerto Rico), *S. mayarum* (British Honduras), *S. parviflora* (Cuba), *S. umbraculifera* (His-

paniola), *S. Yapa*, are all hardy here, whereas *S. glaucescens* (Trinidad), *S. mauritiaeformis* (Colombia), and *S. nematoclada* (British Honduras) are only half hardy.

Salacca edulis (1), 3′, killed Dec.

Scheelea sp. (1), 8′, third of foliage lost Dec., more in Jan., severe injury Feb., appeared moribund Mar., recovery now almost complete.

Serenoa repens (3), 1′ to 6′, native, unaffected.

Syagrus coronata (4), all 2′, all seemingly killed by cumulative effect of freezes, three dug up and discarded, mere stub of the fourth invisible after being mashed by wheel of tree-crane truck, began revival early May, now fully recovered, wherefore it may be suspected that the three other plants might have survived if not discarded. *S. quinquefaria* (1), 3′, seemingly dead from December 12 till late May, this palm has fully recovered. *S. Sancona* (1), severe damage Dec., seemingly dead early Jan. till early July, now recovering beyond any doubt. *S. Weddelliana* (2), each 2′, minor damage to one which was later killed, Mar., by larvae in bud, the other one unaffected.

Synechanthus sp. (1), 3′, its only stem killed Dec., suckers killed Feb.

Thrinax parviflora (8), 1′ to 4′, three killed Dec., three others killed Jan., two largest both survived the winter but were killed May by larvae in lower buds. (This palm much more cold-resistant when adult).

Trachycarpus Fortunei (3), 18″ to 3′, unaffected. *T. Martiana* (1), 18″, unaffected.

Trithrinax brasiliensis (1), 2′, unaffected.

Veitchia Merrillii (19), 3′ to 9′, all killed Dec. (*Adonidia Merrillii* now synonymous for this palm). *V. sp.* (probably *V. Montgomeryana*) (2), 5′ and 6′, both killed Dec.

Washingtonia robusta (3), 6′ to 14′, unaffected.

Zombia antillarum (1), 1′ foliage off-color from cumulative effect of freezes, three buds killed by larvae Mar., foliage now restored to good green color (all of it last year's) but no buds have as yet risen, survival possible but not certain.

APPENDIX A

Daily Range of Temperature for the Three Cold Months

The maximum and minimum temperatures below were recorded at 2514-2518 S. Peninsula Drive, Daytona Beach, Florida, in degrees Fahrenheit. Each recording was made at 5 p.m. for the 24-hour period then ending. Temperatures of 32° or less are shown in bold-face type.

Day	Dec. '57	Jan. '58	Feb. '58
1	64-35	70-56	65-41
2	62-**32**	56-45	59-35
3	69-40	58-54	49-**32**
4	66-40	52-50	56-**30**
5	62-39	61-50	63-35
6	69-44	65-54	76-44
7	76-57	53-47	75-57
8	80-59	42-35	57-39
9	66-50	43-**27**	57-36
10	55-38	52-33	53-57
11	65-43	61-35	55-45
12	44-**25**	63-38	54-45
13	55-**27**	65-58	47-35
14	63-35	68-53	55-**31**
15	62-42	63-44	68-36
16	63-50	53-45	61-35
17	70-45	59-39	49-**29**
18	69-55	55-39	48-**26**
19	67-55	55-45	54-**26**
20	78-58	68-46	53-**29**
21	64-52	66-47	58-35
22	72-61	57-48	63-42
23	76-64	59-45	65-47
24	77-63	71-57	67-47
25	76-62	62-41	66-59
26	70-63	68-44	67-40
27	71-58	61-45	83-60
28	73-61	61-40	75-55
29	67-58	57-44	
30	69-56	59-39	
31	68-54	69-56	

APPENDIX B

Under the heading "Severe Weather," the following summary of the winter weather in Florida as a whole is taken from the February, 1958, "Climatological Data" for Florida, a Weather Bureau publication of the U. S. Department of Commerce.

The persistent pattern of abnormal cold that was established in early January of this year continued unabated the first three weeks of February. Monthly average temperatures were 8° to 11° below the long-term February mean in all areas. February temperatures averaged lower than those recorded in January 1958, and at almost all central and southern peninsula points temperatures this February averaged lower than any other month since records have been kept. In the northern and western county area February 1895 averaged slightly colder, making this February the second coldest in those areas. When Old Man Winter finally released his grip the last week of the month, Florida had been subjected to eight consecutive weeks of abnormal cold.

February 5th brought a most destructive freeze to all of Florida [the peninsula at Daytona Beach escaped this freeze] and particularly to the extreme southern portion where farming areas of Dade, Broward and Palm Beach Counties were subjected to early morning temperatures in the middle twenties. Except for a brief period of moderating temperatures following this freeze, the general temperature trend was downward during the first three weeks of the month. Periodic cold surges from a vast cold air reservoir, which covered most of the continent east of the Rocky Mountains, prevented any appreciable temperature moderation. Relatively strong winds accompanied each cold air surge and added to the general discomfort. The week of the 15th to 21st, on the basis of average temperatures, was the coldest period. Temperatures were generally 15 to 20 degrees below seasonal averages and many northern and western county points experienced freezing on seven consecutive days. Frost or freezing temperatures were noted in the central peninsula areas and at numerous Everglades points on 5 days the same week.

Precipitation-wise, February was not nearly as extreme. The general snowfall in the northern and western counties on the night of the 12th-13th was the outstanding precipitation feature. Total snowfall in the area west of the Suwannee River and the northern-most counties east of that river ranged from one to three inches. At several places this snow was the heaviest since February 13, 1899. At Jacksonville, the 1.5 inches measured there occurred on the 59th anniversary of the only other measurable amount: 1.9 inches on February 13, 1899. At Tallahassee, the 2.8 inches measured was the greatest amount ever observed since records began in 1886. Snowfall was observed as far south as Gainesville but at that point it melted as it fell. The relatively light rainfall in the southern area was about the only weather feature this month that can be considered other than adverse. Drainage of lands in that area, left inundated or waterlogged by the record January rains, was aided by the light rainfall.

The persistent and prolonged cold was especially damaging to agriculture. A large portion of the crops that survived the earlier freezes was either destroyed or seriously damaged by the freeze of the 5th. Subsequent continued cold and freezing retarded the germination of seeds planted soon after this freeze. Cattle continued to suffer from the cold and wind as pastures already devastated by the earlier freezes and flooding could

not provide the much needed forage. The unrelenting cold continued to discourage tourists and adversely affected the vacation trade.

A survey of historical weather records reveals the past three months [December, January, February], judged on the basis of average temperature, is the coldest three-month period ever recorded at nearly all places. Significantly, these record low average temperatures were the result of persistently cold weather over a lengthy period of time and the all-time low temperature for Florida (2° below zero at Tallahassee on February 13, 1899) was never seriously threatened.

KEITH BUTSON, *State Climatologist*
Weather Bureau Office
Gainesville, Florida

APPENDIX C

I. Check list of the hardier cultivated palms

II. Check list of half-hardy cultivated palms.

NOTE: Because the term "hardy" cannot be universally applied with accuracy to suit all subtropical climates, the adjective "hardier" has been availed of to avoid any possible misinterpretation. Obviously the climates of the cooler palm-growing regions are not identical, and on the contrary are sometimes drastically different even within the borders of each state or country where palms are cultivated. It follows, then, that the word "hardy" referring to cold tolerance is only relative and cannot always be used interchangeably for the cultivated palms of northern Florida, southern California, southern Texas, southern Japan, *etc.* In the check list below, however, the names of those palms actually proved cold-hardy for the peninsula at Daytona Beach, Florida, are preceded by an asterisk (see Appendix A for range of temperatures).

I. The Hardier Cultivated Palms

ACROCOMIA
*fusiformis
*Totai
ARCHONTOPHOENIX
*Cunninghamiana
ARECASTRUM
*Romanzoffianum
ARENGA
*Engleri
BISMARCKIA
*nobilis
BORASSUS
flabellifer
BRAHEA
dulcis
BUTIA
*capitata
*eriospatha
all other spp.
CEROXYLON
spp.
CHAMAEDOREA
*cataractarum
*elegans
*erumpens
*Klotzschiana
*radicalis
*Seifrizii
CHAMAEROPS
*humilis
COCCOTHRINAX
*crinita
COPERNICIA
australis
cerifera
DIPLOTHEMIUM
campestre
ERYTHEA
armata
Brandegeei
edulis
JUBAEA
chilensis
JUBAEOPSIS
caffra
LIVISTONA
*australis
*chinensis
*cochinchinensis
decipiens
Mariae
NANNORHOPS
Ritchieana
ORBIGNYA
*Cohune
*speciosa
PARAJUBAEA
*cocoides
PAUROTIS
*Wrightii
PHOENIX
*"abyssinica"
*canariensis
*dactylifera
*humilis
paludosa
*reclinata
*Roebelenii
*rupicola
*sylvestris
zeylanica
RHAPIS
*excelsa
humilis
RHAPIDOPHYLLUM
*hystrix
SABAL
*causiarum
*Etonia
*mayarum
mexicana
minor
*Palmetto
*parviflora
*texana
*umbraculifera
*Yapa
SERENOA
*repens
TRACHYCARPUS
*Fortunei
*Martiana
Takil
TRITHRINAX
acanthocoma
*brasiliensis
WASHINGTONIA
filifera
*robusta

The check list above is not represented to be complete, for no records exist for all the palms cultivated at one time or another in all the subtropical climates throughout the world. Moreover the list might be extended by the inclusion of borderline cases. Longer experience with more palm species and larger speci-

mens should lead to an expansion of a check list. There is more than just a suspicion that many palms having tough or waxy foliage may possess cold-resistant properties, as untried species of *Copernicia, Coccothrinax, Corypha,* several other genera; and there is little question that several dozen species of *Chamaedorea* not yet tested for cold endurance would prove markedly hardy in cultivation.

II. Half-hardy Cultivated Palms

NOTE: The term "half-hardy" as used here is restricted to the palms which suffered relatively minor damage during the coldest winter of record on the peninsula at Daytona Beach, or else, though severely damaged, have shown a consistent ability fully to recover; plus certain other palms for which good grounds exist to consider them equally cold-resistant. The names of those palms proved half-hardy on the peninsula are preceded by an asterisk.

ACROCOMIA
*aculeata
armentalis
*hospes
*mexicana
sclerocarpa
AIPHANES
*Lindeniana
ARCHONTOPHOENIX
*Cunninghamiana
CARYOTA
*mitis (suckers, shorter stems only)
*urens (older specimens only)
ochlandra
CHAMAEDOREA
*brachypoda
*costaricana
*Ernesti-Augustii
graminifolia
*several undet. spp.
CORYPHA
*umbraculifera
CRYOSOPHILA
*Warscewiczii
DIPLOTHEMIUM
maritimum
LICUALA
*grandis
LIVISTONA
*rotundifolia
PSEUDOPHOENIX
*Sargentii
RHOPALOSTYLIS
Baueri (older specimens only)
sapida (older specimens only)
RHYTICOCOS
*amara
ROYSTONEA
*elata (older specimens only)
*regia (older specimens only)
SABAL
Allenii
*glaucescens
*mauritiaeformis
Morrisiana
*nematoclada
yucatanica
SCHEELEA
*sp.
(prob. other spp.)
SYAGRUS
*coronata
insignis
*quinquefaria
*Sancona
*Weddelliana
ZOMBIA
*antillarum

The above list might be extended almost indefinitely, depending on the degree of conservatism brought to bear. None of the palms surviving in the compiler's collection solely by some odd streak of luck have been included in it, though of these there are a surprisingly fair number. Something less than half-hardy, as defined above, but well able to tolerate a few light freezes not followed by continuous cold weather are some of the palm species of the following genera: *Areca (A. triandra), Arenga (A. pinnata, A. Ambong), Arikuryroba, Chrysalidocarpus, Drymophloeus, Hedyscepe, Howeia, Latania, Licuala, Mascarena, Pinanga, Pritchardia (P. Beccariana* and certain other Hawaiian spp.), *Pseudophoenix, Raphia, Thrinax* and still other genera not much represented in cultivation as yet if at all.

EDITOR'S CORNER

(Continued from page 116)

the longest but it was the only easily accessible one . . .

"We are poorly off for indigenous palms in this country having only *Phoenix reclinata, Hyphaene crinita, H. ventricosa, Raphia ruffia* and *Borassus aethiopum.* The last is very rare; I know of only three specimens which are probably on the old slave routes.

"*Hyphaene ventricosa* is common in some localities, but since the native learnt to tap it, and distill a virulent bootleg liquor, a lot of trees are being destroyed annually.

"Seeds of *Phoenix* and *Hyphaene* are easy to come by if any of your members want any, and I could arrange to have *Raphia* seed collected and sent at cost, but *Borassus* would be best obtained from Tanganyika. But from the list of palms at your address [Dent Smith] you need only genera from undiscovered lands!"